Clinical Practice Guidelines

DRAFT

for Surveillance Colonoscopy – in adenoma follow-up; following curative resection of colorectal cancer; and for cancer surveillance in inflammatory bowel disease

May 2011
Submitted by the Colonoscopy Surveillance Working Party

This document is a draft and is not yet published.

It is not to be duplicated, referenced, implemented or linked on the internet unless permission is granted in writing from the Cancer Council Australia.

These Guidelines are proposed for submission to the NHMRC for approval.
These Guidelines are proposed for submission to the NHMRC for approval.

© Cancer Council Australia 2011

ISBN: 978-0-9807421-4-5

This work is copyright. Apart from any use as permitted under the Copyright Act 1968, no part may be reproduced by any process without prior written permission from the Cancer Council Australia. Requests and enquiries concerning reproduction and rights should be addressed to the Copyright Officer, Cancer Council Australia, GPO Box 4708, Sydney NSW 2001, Australia. Website: www.cancer.org.au Email: info@cancer.org.au

Approvals

It is planned by Cancer Council Australia to review the guidelines after a period not exceeding five years. Readers should check with Cancer Council Australia for any reviews or updates of these guidelines.

Disclaimer

This document is a general guide to appropriate practice, to be followed subject to the clinician’s judgment and the patient’s preference in each individual case.

The guidelines are designed to provide information to assist in decision-making. They are based on the best evidence available at time of compilation. The guidelines are not meant to be prescriptive.

Conflict of interest

The development of these clinical practice guidelines has been undertaken by a non-remunerated Working Party of the Cancer Council Australia (see Appendix 3 for details).

Periodic updates

New information arising in areas considered to be of importance will be posted periodically on the Cancer Council Australia website (www.cancer.org.au/clinicalguidelines). This information will be included as appropriate in future editions of the document.

These guidelines can be downloaded from the Cancer Council Australia website at www.cancer.org.au/guidelines.

Copies of this Guideline document can be ordered through the Clinical Guidelines Network, Cancer Council Australia on 02 8063 4141 or email: info@cancer.org.au

Suggested citation:

CONTENTS

Summary of clinical practice recommendations ........................................................................................... v
Summary of recommendations ...................................................................................................................... vii

1 Advances in colonoscopy, ct colonography and other methods of investigation .......................... 1
  1.1 Accuracy of colonoscopy .................................................................................................................. 1
  1.2 Technological developments ........................................................................................................... 1
  1.3 Quality of colonoscopy .................................................................................................................... 3

2 Barium enema .................................................................................................................................. 12

3 CT Colonography .............................................................................................................................. 12

4 Emerging technologies ......................................................................................................................... 13
  4.1 Magnetic resonance colonography ............................................................................................... 13
  4.2 Video-capsule colonoscopy ............................................................................................................ 13

2 Management of epithelial polyps: colonoscopic surveillance after polypectomy ...................... 20
  2.1 Adenomas and risk of developing colorectal cancer ........................................................................ 20
  2.2 Polypectomy ................................................................................................................................... 22
  2.3 Malignant polyps ............................................................................................................................. 23
  2.4 Follow-up surveillance for adenomas ............................................................................................. 24
  2.5 Hyperplastic polyposis ..................................................................................................................... 30
  2.6 Issues requiring more clinical research study .................................................................................. 31

3 Follow-up after curative resection for colorectal cancer ............................................................... 38
  3.1 Role of pre- or peri-operative colonoscopy in CRC patients ....................................................... 38
  3.2 Which patients should be followed up with surveillance colonoscopy? ....................................... 39
  3.3 Effectiveness of surveillance colonoscopy following resection for colorectal cancer ..................... 40
  3.4 Intervals for surveillance colonoscopy following resection for colorectal cancer ......................... 41
  3.5 Issues requiring more clinical research study .................................................................................. 44

4 Colonoscopic surveillance and management of dysplasia in inflammatory bowel disease (IBD) ....................................................................................................................................................................... 48
  4.1 Introduction .................................................................................................................................... 48
  4.2 Efficacy of colonoscopic surveillance in IBD .................................................................................. 48
  4.3 Clinical and endoscopic predictors of CRC in IBD ........................................................................ 49
  4.4 How is surveillance practised and can it be improved? ................................................................... 50
  4.5 Optimal surveillance intervals ......................................................................................................... 52
  4.6 Optimal colonoscopic protocol ....................................................................................................... 53
4.7 Surveillance protocol practiced in Crohn's disease, indeterminate colitis and patients with ileo-anal pouches .............................................................. 55
4.8 Management of dysplasia ........................................................................................... 56
4.9 Issues requiring more clinical research study ............................................................. 58

5 Psychosocial aspects of surveillance after colorectal cancer, polyps and inflammatory bowel disease ................................................................................. 63
5.1 Introduction ................................................................................................................. 63
5.2 Community attitude towards colonoscopy ............................................................... 63
5.3 Colonoscopy and anxiety ............................................................................................ 64
5.4 Anxiety level before and during colonoscopy ............................................................ 64
5.5 Compliance with surveillance colonoscopy ............................................................... 65
5.6 Amelioration of anxiety in relation to colonoscopy ................................................... 65
5.7 Music as an aide to improving comfort of colonoscopy ............................................. 67
5.8 Patient comfort and colonoscopy ............................................................................. 68
5.9 Elements of clinical care available for patients undergoing colonoscopy ............... 68

6 Socio-economic factors ................................................................................................. 72
6.1 Introduction ................................................................................................................. 72
6.2 Socioeconomic factors and surveillance after i, ii and iii impact on these guidelines ...................................................................................................................... 72
6.3 What impact is made by socioeconomic factors in the three treatment groups undergoing surveillance colonoscopy? .............................................................................. 72

7 Economic considerations ............................................................................................... 77
7.1 Economic burden of colorectal cancer in Australia ................................................... 77
7.2 Economic evaluation .................................................................................................. 77
7.3 Cost and cost-effectiveness of colonoscopy follow-up strategies after curative resection for colorectal cancer ................................................................................. 78
7.4 Cost and cost-effectiveness of colonoscopy follow-up strategies after removal of adenomas ................................................................. 86
7.5 Costs and cost-effectiveness of colonoscopy follow-up strategies in ulcerative colitis .................................................................................................................. 89
7.6 Cost-effectiveness analysis of proposed Surveillance Guidelines ................................ 93

Appendix 1 Guideline development process ................................................................ 101
Appendix 2 Working party members and contributors .................................................... 113
Appendix 3 Conflict of interest summary for working party members ............................. 116
Appendix 4 Economic evaluation of surveillance colonoscopies .................................... 118
Appendix 5 Abbreviations ............................................................................................... 155
SUMMARY OF CLINICAL PRACTICE RECOMMENDATIONS

These guidelines are intended for use by all practitioners and health workers who require information about surveillance colonoscopy - in adenoma follow-up, following curative resection of colorectal cancer, and for cancer surveillance in inflammatory bowel disease. They are specifically revising the colonoscopic surveillance sections of the *Clinical Practice Guidelines for the prevention, early detection and management of colorectal cancer* 2005 chapters 8, 9, 17, and introduce a new chapter on cancer surveillance in inflammatory bowel disease. They also cover psychosocial care (chapter 18 in the 2005 Guidelines), socio economic factors and cost effectiveness (chapters 23 and 22 in the 2005 Guidelines).

The guidelines have been produced by a process of systematic literature review; critical appraisal and consultation encompassing all interested parties in Australia (see Appendix 1).

The following table provides a list of the evidence-based recommendations detailed in the text of each chapter. The table below provides details on the highest level of evidence identified to support each recommendation (I-IV). The Summary of Recommendations table includes the grade for each recommendation (A-D). The key references that underpin the recommendation are provided in the last column. Individual levels of evidence can be found in the Evidence Summaries for each recommendation in each chapter.

Each recommendation was assigned a grade by the expert working group taking into account the volume, consistency, generalisability, applicability and clinical impact of the body of evidence supporting each recommendation.

When no Level I or II evidence was available but there was consensus among the working party members, recommended best practice points have been provided, and can be identified throughout the guideline with the following: Good practice point (GPP).

<table>
<thead>
<tr>
<th>Grade of recommendation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Body of evidence can be trusted to guide practice</td>
</tr>
<tr>
<td>B</td>
<td>Body of evidence can be trusted to guide practice in most situations</td>
</tr>
<tr>
<td>C</td>
<td>Body of evidence provides some support for recommendation(s) but care should be taken in its application</td>
</tr>
<tr>
<td>D</td>
<td>Body of evidence is weak and recommendation must be applied with caution</td>
</tr>
</tbody>
</table>
### LEVELS OF EVIDENCE

Table 1. Designations of levels of evidence for intervention research questions (NHMRC, 2009)

<table>
<thead>
<tr>
<th>Level</th>
<th>Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>A systematic review of level II studies</td>
</tr>
<tr>
<td>II</td>
<td>A randomised controlled trial</td>
</tr>
<tr>
<td>III-1</td>
<td>A pseudo-randomised controlled trial (i.e. alternate allocation or some other method)</td>
</tr>
<tr>
<td>III-2</td>
<td>A comparative study with concurrent controls:</td>
</tr>
<tr>
<td></td>
<td>- Non-randomised, experimental trial</td>
</tr>
<tr>
<td></td>
<td>- Cohort study</td>
</tr>
<tr>
<td></td>
<td>- Case-control study</td>
</tr>
<tr>
<td></td>
<td>- Interrupted time series with a control group</td>
</tr>
<tr>
<td>III-3</td>
<td>A comparative study without concurrent controls:</td>
</tr>
<tr>
<td></td>
<td>- Historical control study</td>
</tr>
<tr>
<td></td>
<td>- Two or more single arm study</td>
</tr>
<tr>
<td></td>
<td>- Interrupted time series without a parallel control group</td>
</tr>
<tr>
<td>IV</td>
<td>Case series with either post-test or pre-test/post-test outcomes</td>
</tr>
</tbody>
</table>

### Reference

1. NHMRC Levels of evidence and grades for recommendations for developers of guidelines (2009).
### SUMMARY OF RECOMMENDATIONS

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Recommendations</th>
<th>Grade</th>
<th>Refs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. ADVANCES IN COLONOSCOPY, CTCOLONOGRAPHY AND OTHER METHODS OF INVESTIGATION</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2. MANAGEMENT OF EPITHELIAL POLYPS: COLONOSCOPIC SURVEILLANCE AFTER POLYPECTOMY</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1 Adenomas and risk of developing colorectal cancer</td>
<td>Determination of risks for patients with adenomas must clearly distinguish between 1. variables that relate to the likelihood of any particular adenoma having a malignant focus and 2. variables that relate to patient, pathological and epidemiological characteristics which predict a risk of future (metachronous) adenomas and cancers.</td>
<td>GPP</td>
<td></td>
</tr>
<tr>
<td>2.1.1.6 Location of adenomas and cancer: protection against right sided cancer in adenoma follow up</td>
<td>Proximal location of adenomas may be a risk factor for metachronous neoplasia. The extent to which this is driven by the difficulty of detecting proximal polyps, because of their flat and unobtrusive nature (ie. sessile serrated polyps), poor bowel preparation and anatomical blind spots in the right colon, is unclear. For these reasons the right colon deserves particularly careful scrutiny at colonoscopy.</td>
<td>GPP</td>
<td></td>
</tr>
<tr>
<td>2.1.1.7 Models for risk index</td>
<td>Multivariate analyses offer little advantage over more pragmatic guideline driven approaches.</td>
<td>GPP</td>
<td></td>
</tr>
<tr>
<td>2.2 General considerations relating to polypectomy</td>
<td>All polyps should be considered for removal. Diminutive polyps may be too numerous to be cleared completely. In subjects with multiple small polyps, a sample of at least three should be taken for histological study. However, if a syndromic diagnosis is under consideration, then sampling of many more polyps is important, to guide decisions on which gene should be subjected to mutational analysis.</td>
<td>GPP</td>
<td></td>
</tr>
<tr>
<td>2.2.3 Tattooing polypectomy sites</td>
<td>Tattooing any polyp site where there is a possibility that surgical resection will be needed is important at the primary colonoscopy if at all possible, or very soon after with a second procedure. This is necessary even for conventional surgery, as the site of polypectomy may well be inpalpable, but particularly important where follow-up treatment may be laparoscopic, as the surgeon has no capacity to palpate the area.</td>
<td>GPP</td>
<td></td>
</tr>
<tr>
<td>Chapter</td>
<td>Recommendations</td>
<td>Grade</td>
<td>Refs</td>
</tr>
<tr>
<td>---------</td>
<td>----------------</td>
<td>-------</td>
<td>------</td>
</tr>
<tr>
<td>2.3 Malignant polyps</td>
<td>In general, malignant polyps which have 1. a clear margin of excision, 2. are well or moderately differentiated, 3. lack lymphatic or venous invasion and 4. are endoscopically assessed as totally removed can be managed without subsequent surgical resection. However, the decision needs to be individualized with respect to the particular histological and endoscopic features and the patient’s age and co-morbidities.</td>
<td>GPP</td>
<td></td>
</tr>
<tr>
<td>2.4.2 Quality of colonoscopy</td>
<td>High quality colonoscopy is critically important for good practice and patient safety. Adenoma detection rates (ADRs) should be monitored, though they will be influenced by patient mix (e.g. age profile, indications). ADRs within the National Bowel Cancer Screening Program provide a sound basis for benchmarking.</td>
<td>GPP</td>
<td></td>
</tr>
<tr>
<td>2.4.3 Approach to adenoma follow up in surveillance</td>
<td>Colonoscopy surveillance intervals should be planned when the colonoscopist is satisfied that the colon has been completely cleared of polyps and the polyp histology is known.</td>
<td>GPP</td>
<td></td>
</tr>
<tr>
<td>2.4.4 Follow up for patients with low risk adenomas</td>
<td>Low risk adenomas are those which lack advanced features, namely three or more adenomas at one colonoscopy, adenomas 10 mm or more in size, tubulovillous or villous histology or high grade dysplasia/cancer.</td>
<td>GPP</td>
<td></td>
</tr>
<tr>
<td>In follow-up of patients with one or two small (&lt;10 mm) tubular adenomas, surveillance colonoscopy should be performed between five and ten years.</td>
<td>B</td>
<td>33, 64-67</td>
<td></td>
</tr>
<tr>
<td>2.4.5 Follow up for patients with high risk adenomas</td>
<td>Surveillance colonoscopy should take place at a three yearly intervals for patients with advanced neoplasia (three or more adenomas, ≥10mm, or with tubulovillous, or villous histology, or high grade dysplasia).</td>
<td>A</td>
<td>7, 13-15, 33, 64, 66, 68, 69</td>
</tr>
<tr>
<td>2.4.6 Follow up of patients with sessile adenomas and laterally spreading adenomas</td>
<td>If sessile adenomas are removed piecemeal, follow-up colonoscopy should be at three to six months and again at twelve months to ensure complete removal. If removal is complete, subsequent surveillance should then be based on histological findings, size and number of other adenomas (as set out in 2.4.4 and 2.4.5).</td>
<td>B</td>
<td>21, 70, 71</td>
</tr>
</tbody>
</table>
### 2.4.7 Follow up following resection of serrated adenomas (SA) and sessile serrated adenomas (SSA)

At present there is not enough evidence to differentiate follow up protocols for sessile serrated adenomas from standard adenoma follow up guidelines. Follow up should be determined by the other more conventional parameters outlined elsewhere in this chapter.

**Grade**: GPP

### 2.4.8 Follow up for patients with multiple numbers of adenomas

As multiplicity of adenomas is a strong determinant of risk of metachronous advanced and non advanced neoplasia, follow up should be at twelve months for those with five or more adenomas and, because the likelihood of missed synchronous polyps being present, sooner in those with ten or more adenomas.

If a polyposis syndrome accounts for the findings, follow-up colonoscopy should be within one year for patients with five or more adenomas at one examination.

FAP or MYH associated polyposis should be considered with as few as ten adenomas; referral to a familial cancer clinic is advisable. Practically dictates that these counts apply to the most recent colonoscopy, though logic may suggest it should be cumulative. Data is scarce on this point.

**Grade**: B

**Refs**: 13, 38, 69, 74

### 2.4.9 Interaction of Age and Family History of Colorectal Neoplasia

Family history should be considered separately when planning colonoscopy surveillance. Intervals should be predominantly determined by the adenoma characteristics, unless a syndromic risk mandates more frequent surveillance.

**Grade**: C

**Refs**: 13, 76

### 2.4.10 Follow up based on two or more examinations

Maintaining a three yearly schedule is prudent if advanced adenomas or multiple adenomas are found during surveillance, but the frequency may be reduced if no, or only a few small tubular adenomas are found.

**Grade**: C

**Refs**: 33, 67

### 2.5 Hyperplastic polyposis

Risk of cancer in hyperplastic polyposis is still being defined; however, there is sufficient evidence to identify these patients as being at high risk. Colonoscopy, with the aim of complete polyp removal, including the right sided sessile serrated polyps, should be the aim. Risks of polypectomy, notable because of the number and sessile nature of these polyps, should be explained.

Surgery is an acceptable alternative in patients with well defined hyperplastic polyposis.

**Grade**: GPP
### Chapter 3. The Role of Surveillance Colonoscopy After Curative Resection for Colorectal Cancer

#### 3.1 Role of Pre- or Peri-operative Colonoscopy in CRC Patients

A perioperative colonoscopy should be attempted in all patients with a newly diagnosed colorectal cancer (CRC).

<table>
<thead>
<tr>
<th>Grade</th>
<th>Refs</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>7-10</td>
</tr>
</tbody>
</table>

Colonoscopy should be performed three to six months after resection for patients with obstructive CRC in whom a complete perioperative colonoscopy was not performed and in whom there is residual colon proximal to the obstructing cancer.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Refs</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>7-10</td>
</tr>
</tbody>
</table>

#### 3.2.2.1 Risk Factors for Metachronous Neoplasia Following Resection for Colorectal Cancer

Patients with proved Lynch syndrome (HNPCC or hereditary non-polyposis colorectal cancer), should continue to have annual surveillance colonoscopy performed post-operatively because of the apparent rapid progression of neoplasia from adenoma to carcinoma.

Patients including those (i) whose initial diagnosis was made younger than 40 years of age, (ii) with probable or possible HNPCC (i.e. patients whose tumours are MSI-high and less than 50 years old at time of initial cancer diagnosis but not proved by genetic testing to have HNPCC), (iii) with hyperplastic polyposis and BRAF mutation and (iv) with multiple synchronous cancers or advanced adenomas at initial diagnosis should be considered following surgery to continuing with more frequent surveillance than would otherwise be recommended (e.g. initial post-operative colonoscopy at one year and then annually, second-yearly or third-yearly.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Refs</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPP</td>
<td></td>
</tr>
</tbody>
</table>

#### 3.4 Intervals for Surveillance Colonoscopy Following Resection for Colorectal Cancer

Colonoscopy should be performed one year after the resection (or one year following the clearing colonoscopy if performed at a later time). This includes all risk categories.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Refs</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>8-10, 15, 21, 29, 31, 36-39, 44, 49, 51, 52</td>
</tr>
</tbody>
</table>

If the examination performed at one year reveals advanced adenoma or a metachronous cancer, then repeat the procedure in twelve months.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Refs</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>8-10, 15, 21, 29, 31, 36-39, 44, 49, 51, 52</td>
</tr>
</tbody>
</table>

If the examination performed at one year is normal or identifies only one or two non-advanced adenomas, then the interval before the next subsequent examination should be five years.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Refs</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>26</td>
</tr>
</tbody>
</table>
Patients undergoing either local excision (including transanal endoscopic microsurgery) of rectal cancer or advanced adenomas or ultra-low anterior resection for rectal cancer should be considered for periodic examination of the rectum at six monthly intervals for two or three years using either digital rectal examination, rigid proctoscopy, flexible proctoscopy, and/or rectal endoscopic ultrasound. These examinations are considered to be independent of the colonoscopic examination schedule described above.

### 4. COLONOSCOPIC SURVEILLANCE AND MANAGEMENT OF DYSPLASIA IN INFLAMMATORY BOWEL DISEASE

#### 4.2 Efficacy of colonoscopic surveillance in IBD

Colonoscopic surveillance is recommended in high risk patients with ulcerative colitis (UC) to reduce cancer-related mortality.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Refs</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>1, 6, 8-10</td>
</tr>
</tbody>
</table>

Although evidence for colonoscopic surveillance in Crohn’s disease is limited, experts recommend it be considered in at risk patients.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Refs</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPP</td>
<td></td>
</tr>
</tbody>
</table>

#### 4.4.1 Starting time for surveillance

Patients with ulcerative colitis extending beyond the sigmoid colon and individuals with Crohn’s colitis that involves more than one-third of colon should commence surveillance no later than eight years after onset of symptoms.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Refs</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>14, 22, 24, 32, 34</td>
</tr>
</tbody>
</table>

If Primary Sclerosing Cholangitis (PSC) is detected before this time, surveillance should commence at the time of its diagnosis.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Refs</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>14, 22, 24, 32, 34</td>
</tr>
</tbody>
</table>

Patients with a strong personal family history of colorectal cancer (CRC) should start surveillance earlier.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Refs</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>14, 22, 24, 32, 34</td>
</tr>
<tr>
<td>Chapter</td>
<td>Recommendations</td>
</tr>
<tr>
<td>---------</td>
<td>----------------</td>
</tr>
<tr>
<td>4.5</td>
<td><strong>Optimal surveillance intervals</strong></td>
</tr>
<tr>
<td></td>
<td>A. Annual colonoscopic surveillance is recommended for patients with ulcerative colitis extending proximal to the sigmoid colon or patients with Crohn’s colitis affecting more than one third of the colon and with one or more of the following risk factors:</td>
</tr>
<tr>
<td></td>
<td>• active disease</td>
</tr>
<tr>
<td></td>
<td>• Primary sclerosing cholangitis</td>
</tr>
<tr>
<td></td>
<td>• Family history of colorectal cancer in first degree relative &lt; 50 years old</td>
</tr>
<tr>
<td></td>
<td>• colonic stricture, patients with multiple inflammatory polyps or shortened colon</td>
</tr>
<tr>
<td></td>
<td>• previous dysplasia</td>
</tr>
<tr>
<td></td>
<td>B. Three yearly colonoscopy is recommended for patients with:</td>
</tr>
<tr>
<td></td>
<td>• inactive ulcerative colitis extending proximal to the sigmoid colon without any of the above risk factors</td>
</tr>
<tr>
<td></td>
<td>• patients with Crohn’s colitis affecting more than one third of the colon without any of the above risk factors</td>
</tr>
<tr>
<td></td>
<td>• IBD patients with a family history of colorectal cancer in a first degree relative &gt; 50 years old</td>
</tr>
<tr>
<td></td>
<td>C. Five yearly colonoscopy recommended for patients in whom two previous colonoscopies that were macroscopically and histologically normal.</td>
</tr>
<tr>
<td>4.6</td>
<td><strong>Optimal colonoscopic protocol</strong></td>
</tr>
<tr>
<td></td>
<td>If available, the use of chromoendoscopy/dye spraying where targeted biopsies are obtained from visibly abnormal lesions or strictures is the preferred means to conduct colonoscopic surveillance in IBD. This is especially true for patients at high risk of colorectal cancer.</td>
</tr>
<tr>
<td></td>
<td>If chromoendoscopy is unavailable, or if an endoscopist lacks sufficient expertise with this technique, or if the presence of inflammation interferes with the interpretation of chromoendoscopy, an acceptable alternative practice is using standard white light endoscopy with random non-targeted biopsies from each colonic segment and from raised lesions.</td>
</tr>
<tr>
<td></td>
<td>When chromoendoscopy is used, random biopsies are required from each colonic segment to establish histological extent and severity of disease. More intensive mucosal sampling from each colonic segment is indicated in patients with a suspicious visible lesion or in situations where chromoendoscopic interpretation is compromised by factors such as active inflammation, inflammatory polyps or poor bowel preparation.</td>
</tr>
</tbody>
</table>
## 4.7 Surveillance protocol practised in Crohn’s disease, indeterminate colitis and patients with ileo-anal pouches

Based on cancer risk, experts recommend that similar colonoscopic surveillance be undertaken for Crohn’s colitis as in ulcerative colitis of equivalent extent, even though supporting evidence is sparse.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Refs</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>31,46</td>
</tr>
</tbody>
</table>

Specific areas where surveillance is required in Crohn’s disease are patients with colonic strictures or complicated anorectal disease.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Refs</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>31,46</td>
</tr>
</tbody>
</table>

### 4.8.1 Elevated dysplastic lesions

Raised lesions containing dysplasia may be treated endoscopically provided the entire lesion is removed and there is no dysplasia in flat mucosa elsewhere in the colon.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Refs</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>49, 52</td>
</tr>
</tbody>
</table>

If a raised dysplastic lesion cannot be completely removed, or if there is dysplasia elsewhere in the colon, surgical intervention is strongly recommended.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Refs</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>49, 52</td>
</tr>
</tbody>
</table>

### 4.8.2 High grade dysplasia in flat mucosa

High grade dysplasia in flat mucosa is a strong risk factor for established or imminent carcinoma, and colectomy is usually recommended.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Refs</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>35, 53</td>
</tr>
</tbody>
</table>

### 4.8.3 Low grade dysplasia in flat mucosa

Multifocal low grade dysplasia is associated with a sufficiently high risk of future cancer that colectomy is usually recommended. Patients who elect to avoid surgery require follow up surveillance at three months, preferably with chromoendoscopy, and if this examination is normal, annually.

Unifocal low grade dysplasia may be followed by ongoing surveillance at six months, and if this examination is normal, annually.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Refs</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>35, 54-58</td>
</tr>
<tr>
<td>C</td>
<td>35, 54-58</td>
</tr>
</tbody>
</table>

### 4.8.4 Indefinite dysplasia in flat mucosa

Indefinite dysplasia in flat mucosa does not require surgery, but follow-up colonoscopic surveillance is justified, preferably with chromoendoscopy, at more frequent intervals.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Refs</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>35, 59</td>
</tr>
</tbody>
</table>

## 5. PSYCHOSOCIAL ASPECTS OF SURVEILLANCE COLONOSCOPY AFTER: COLORECTAL CANCER, POLYPS AND INFLAMMATORY BOWEL DISEASE

### 5.6 Amelioration of anxiety in relation to colonoscopy

Pre-colonoscopic advice to patients by means of educational material, video and clinical explanation can assist in improving patient experience with the procedure and in reducing anxiety.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Refs</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>7, 12, 15, 16, 18, 19, 20, 21</td>
</tr>
<tr>
<td>Chapter</td>
<td>Recommendations</td>
</tr>
<tr>
<td>---------</td>
<td>----------------</td>
</tr>
<tr>
<td>5.7</td>
<td><strong>Music as an aid to improving comfort of colonoscopy</strong>&lt;br&gt;Music provided to patients during colonoscopy may reduce their discomfort.</td>
</tr>
<tr>
<td>5.9</td>
<td><strong>Elements of clinical care available for patients undergoing colonoscopy</strong>&lt;br&gt;An RCT to study variations in the use of available sedative drugs and patient monitoring when sedated during colonoscopy, may allow development of an Australian Standard Practice profile.</td>
</tr>
<tr>
<td>6.</td>
<td><strong>SOCIO-ECONOMIC ASPECTS THAT MAY IMPACT ON SURVEILLANCE COLONOSCOPY</strong>&lt;br&gt;Clinicians may assist in improving survival outcomes in curative resection for colorectal cancer by expediting access to optimal clinical care.</td>
</tr>
<tr>
<td>7.</td>
<td><strong>COST EFFECTIVENESS</strong></td>
</tr>
</tbody>
</table>

*Note: The table includes recommendations with their respective grades and references for further reading.*
1 ADVANCES IN COLONOSCOPY, CT COLONOGRAPHY AND OTHER METHODS OF INVESTIGATION

1 COLONOSCOPY

As described in Chapter 8 of the Second Edition of the Clinical Practice Guidelines for the Prevention, Early Detection and Management of Colorectal Cancer (2005)¹, colonoscopy is the first-line investigation for assessing the colon and rectum, having a sensitivity of 95% for detection of colorectal (bowel) cancer². Colonoscopy allows biopsy and histologic confirmation of the diagnosis of cancer as well as identification and immediate removal of synchronous polyps.

1.1 Accuracy of colonoscopy

Like most other diagnostic tests, colonoscopy has a false negative rate for detection of colorectal cancer and adenomas. This needs to be taken into consideration when decisions are made about the choice and timing of surveillance procedures. While the overall sensitivity for colorectal cancer is 95%², the available literature suggests that cancer miss rates are higher in the proximal colon than elsewhere in the large bowel ³. In a systematic review of polyp miss rates as determined by tandem colonoscopy, Van Rijn et al (2006)⁴ identified studies in which patients had undergone two same-day colonoscopies with polypectomy. The research yielded six studies, involving a total of 465 patients. The pooled miss rate for polyps of any size was 22%. Adenoma miss rate by size was 2.1% for adenomas ≥10 mm, 13% for adenomas 5–10 mm, and 26% for adenomas 1–5 mm, respectively. Analysis of the data suggests that, in expert hands, colonoscopy rarely misses polyps ≥10 mm, but the miss rate increases significantly with smaller sized polyps.

In a more recent study, Heresbach et al 2008⁵ examined adenoma miss rate by performing a large multicentre study, with same-day back-to-back video colonoscopy performed by two different colonoscopists in randomised order and blinded to results of the other examination. The miss rates for all polyps, all adenomas, polyps ≥5 mm, adenomas ≥5 mm, and advanced adenomas were, respectively, 28 %, 20 %, 12 %, 9 % and 11 %. Greater diameter (1-mm increments) and number of polyps (≥3) were independently associated with a lower polyp miss rate, whereas sessile or flat shape was significantly associated with a higher miss rate⁵.

1.2 Technological developments

In recent years there has been rapid progress in instrument design to enhance colonoscopic identification of lesions, reduce miss rates and reduce complications⁶-⁸. The new features include high definition colonoscopy, wide angle colonoscopy, narrow band imaging (NBI), hood-assisted colonoscopy and chromoendoscopy. High definition, wide angle and narrow band imaging technologies have been incorporated into most of the latest generation of colonoscopes. However, more studies are needed to assess the place of these various modifications, especially chromoendoscopy, in colonoscopic surveillance.

1.2.1 High definition colonoscopy

As the name suggests, high definition (HD) colonoscopy system uses a high-definition 1080-line television and a high resolution charge-coupled device (CCD) with up to 1 million pixels, which provides images double the quality of normal television⁹,10. While Pellise et al⁹ did not find any improvement over standard colonoscopy, Buchner et al indicated that adenoma detection rates are improved through use of...
high-definition colonoscopy, which can detect subtle mucosal changes\textsuperscript{10}. In their retrospective study, the adenoma detection rate was higher among patients who underwent high definition white light compared with standard definition white light colonoscopy (28.8\% vs 24.3\%; $P = .012$). These findings remained after adjusting for potentially confounding variables\textsuperscript{10}.

1.2.2 Wide angle colonoscopy

With this method, the instrument has a field of vision of 170\textdegree, which is 30\% more than the conventional model. The aim is to improve the detection of lesions hidden behind colonic folds. With one exception\textsuperscript{11}, all studies reported in the available literature from 2003 to 2010 suggest that prototype wide angle colonoscopes do not eliminate polyp miss rates, but have the potential to reduce examination time and improve visualisation in the periphery of the endoscopic field of view\textsuperscript{9,12-14}.

1.2.3 Narrow Band Imaging (NBI)

The NBI technology uses a band-restricted light source centred at 415 nm (blue) and 540 nm (green). The narrowed light penetrates the mucosa and submucosa and is absorbed primarily by haemoglobin. Thus, surface micro-vessels are visible as dark structures. Because the density and shape of micro-vessels change in neoplasia, NBI and equivalent technologies have the potential to aid in the diagnosis of neoplastic lesions. In addition, NBI helps distinguish between different histologic groups and assess depth of invasion\textsuperscript{15,16}.

In a randomised controlled trial, 401 patients were assigned to undergo wide angle colonoscopy using either conventional high-resolution imaging or NBI during instrument withdrawal. When the two techniques were compared in consecutive subgroups of 100 patients, adenoma detection rates in the NBI group remained stable (approximately 25\%) whereas these rates steadily increased in the control group (8\%, 15\%, 17\%, and 26.5\%, respectively). Significant differences in the first 100 cases (26.5\% versus 8\%; $p=0.02$) could not be maintained in the last 100 cases (25.5\% versus 26.5\%, $p=0.91$). The increased adenoma detection rates with NBI colonoscopy were statistically not significant\textsuperscript{17,18}. Similar results were reported by Rex and Helbig\textsuperscript{19} and Kaltenbach et al\textsuperscript{20}.

Significant differences were, however, identified when NBI was used to detect additional polyps in members of Lynch syndrome (HNPCC) families\textsuperscript{21}.

1.2.4 Chromoendoscopy

Chromoendoscopy (or dye spray) has been introduced to enhance the detection of polyps particularly diminutive flat lesions that may be otherwise difficult to detect\textsuperscript{22}.

When combined with high magnification, chromoendoscopy was found to be highly efficient for separating adenomatous from non-adenomatous polyps\textsuperscript{23} and for detecting changes in patients with inflammatory bowel disease\textsuperscript{24}. As discussed in Chapter 4, chromoendoscopy is becoming the standard method for detection of dysplasia in inflammatory bowel disease\textsuperscript{25}.

However, based on results from their studies, Lapalus et al\textsuperscript{25} and Le Rhun\textsuperscript{26} could not recommend the systematic use of chromoendoscopy and structure enhancement, although the detection of small adenomas in the proximal colon was improved. In the randomised prospective study by Lapalus et al\textsuperscript{25}, a combination of chromoendoscopy and structure enhancement was used to increase the adenoma detection rate in high-risk patients with a personal history of colorectal adenomas and/or a family history of colorectal cancer\textsuperscript{14}.
Separate randomised controlled trials published within the same year also suggest that chromoendoscopy detects more polyps missed by standard colonoscopy than intensive inspection28,29, particularly in patients with Lynch syndrome30,31. Although very promising, the main drawback of this technique is that chromoendoscopy is labour intensive, more expensive and time-consuming and its use has not become widespread.

More recently, Sanduleanu et al32 combined chromoendoscopy (C) with confocal laser endomicroscopy (CLE) that allows real-time in vivo microscopy of the mucosa and provides accurate histopathology. The study concluded that C-CLE accurately discriminates adenomatous from nonadenomatous colorectal polyps and enables evaluation of the degree of dysplasia during ongoing endoscopy.

1.2.5 Hood-assisted colonoscopy

Hood assisted colonoscopy is colonoscopy with a transparent retractable extension. A transparent “hood” (or “cap”) is a simple device that can be attached to the tip of a colonoscope before performing the examination. Although adding to the cost of colonoscopy, it has been proposed as a method for shortening withdrawal time in addition to improving adenoma detection rates33.

Some consider that use of the hood mainly helps less experienced colonoscopists. With more experienced colonoscopists, the hood does not improve either the caecal intubation rate or the adenoma detection rate, but does shorten the caecal intubation time. It therefore should be reserved for selected cases, especially when initial caecal intubation fails34.

1.3 Quality of colonoscopy

Many factors affect the quality of colonoscopy, including the provision and proper maintenance of appropriate equipment, adherence to up-to-date protocols for all phases of the procedure, and having processes in place for regular auditing of outcomes and on-going quality improvement.

Above all, the colonoscopist must have the necessary technical skills and understanding to perform colonoscopy effectively and with safety. Colonoscopy is highly operator-dependent35. The colonoscopist therefore should have undergone supervised training that meets the requirements of appropriate professional bodies as well as meeting agreed standards for ongoing competence. Basic skills include torque steering, loop recognition and reduction, recognition of landmarks to confirm complete examination, and the ability to carefully withdraw the colonoscope to maximize lesion detection and to perform polypectomy.

Higher lesion detection rates are associated with adequate distension, suction and cleaning, position change, and slow and meticulous examination of the colonic mucosa, including areas behind folds36. Measurement and recording of colonoscope withdrawal time (the time taken between caecal intubation and colonoscope withdrawal from the anus, excluding the time taken for biopsy and polypectomy) is a key indicator of adequacy of the examination36.

Advances continue to be made in colonoscopic techniques (e.g. the use of carbon dioxide rather than air for insufflation, availability of foot pedal-operated water jets to clear faecal matter and through-channel narrow endoscopes for retroflexion in the caecum and rectum) that may allow easier examination and greater patient comfort and safety.

Colonoscopy is considered to be a relatively safe procedure for the diagnosis of colorectal disease. However, as with any invasive procedure, there is a risk of adverse events occurring either directly or indirectly as a result of the procedure37.
The National Bowel Cancer Screening Program (NBCSP) Quality Working Group report recommends standards, objectives and performance indicators for use in Australia, as set out below. They are grouped together for three phases – before, during and after the procedure – as high quality colonoscopy depends on decisions and actions taken during each phase.

1.3.1 Indicators of quality for the pre-procedure phase

Indications for colonoscopy should comply with national guidelines and risk factors should be assessed, with recording of actions taken to address specific risks (Table 1.1).

<table>
<thead>
<tr>
<th>What will your patients expect?</th>
</tr>
</thead>
<tbody>
<tr>
<td>• That there is a valid indication for the procedure</td>
</tr>
<tr>
<td>• That risk factors (e.g. anticoagulant therapy, presence of severe co-morbidities) will be identified well before colonoscopy and action taken to minimise risk</td>
</tr>
</tbody>
</table>

Table 1.1: Clinical standards, objectives and indicators for the pre-procedure phase - indications and assessment of risk

<table>
<thead>
<tr>
<th>Standard</th>
<th>Objective</th>
<th>Performance indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard 1: Patient indications and risks</td>
<td>Objective 1.1: Assessment of patient indications</td>
<td>A 100 per cent documentation and reporting of the following indications for colonoscopy for:</td>
</tr>
<tr>
<td>A comprehensive assessment of indications for the procedure and risks and co-morbidities is undertaken for each patient prior to the performance of the procedure.</td>
<td>The colonoscopist ensures that there is full documentation and reporting of the indications for colonoscopy as listed for each patient category</td>
<td>○ Asymptomatic patients:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>– family history (as per CRC Guidelines 2005)(^1);</td>
</tr>
<tr>
<td></td>
<td></td>
<td>– previous colorectal cancer or adenomatous polyps (as per CRC Guidelines 2005)(^1);</td>
</tr>
<tr>
<td></td>
<td></td>
<td>– colitis surveillance for patients with increased cancer risk; and</td>
</tr>
<tr>
<td></td>
<td></td>
<td>– positive faecal occult blood test.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>○ Symptomatic patients:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>– symptoms documented on report.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>○ Date of previous colonoscopy (if applicable).</td>
</tr>
<tr>
<td>Objective 1.2: Assessment of patient risk and co-morbidity</td>
<td>The colonoscopist ensures that there is full documentation and</td>
<td>A 100 per cent documentation and reporting of the assessments for:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>○ Sedation risks with reference to the American Society of Anesthesiologists (ASA).</td>
</tr>
</tbody>
</table>
Standard Objective Performance indicators

reporting of information about patient risk and co-morbidity.

○ Action related to specific risks including:
  – the need to cease aspirin or other antiplatelet drugs or anti-coagulants;
  – the need for antibiotic prophylaxis; and
  – diabetes mellitus.

○ Patients cancelled on the day due to unforeseen co-morbidities.

Informed consent should be obtained from all patients or their parent/legal guardian, using a structured approach. Preferably, it should be obtained before the period of bowel preparation. The patient needs to understand what is involved in the procedure and the possible risks, both in general and in the patient’s specific case (Table 1.2).

What will your patients expect?

- To be given a clear explanation of what is involved in the procedure and to have an opportunity to ask for more information
- That this information will be provided before embarking on bowel preparation

Table 1.2: Clinical standards, objectives and indicators for the pre-procedure phase - patient consent

<table>
<thead>
<tr>
<th>Standard</th>
<th>Objective</th>
<th>Performance indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard 2: Patient consent</td>
<td>Objective 2.1: Patient information, education and consent</td>
<td>A Every patient (or parent/legal guardian where applicable) is provided with:</td>
</tr>
<tr>
<td></td>
<td>The colonoscopist ensures that the patient (or parent/legal guardian where applicable) provides his/her informed consent to all aspects of the procedure(s) to be undertaken by confirming that the information detailed in the performance indicators is provided at all times.</td>
<td>○ A full explanation about the requirements for adequate bowel preparation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>○ A full explanation of the procedure.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>○ A full explanation of the risks and complications involved including co-morbidity and sedation risks, and also the risks associated with not having the procedure.</td>
</tr>
</tbody>
</table>

Draft Clinical Practice Guidelines for Surveillance Colonoscopy - in adenoma follow-up, following curative resection of colorectal cancer, and for cancer surveillance in inflammatory bowel disease
Proper bowel preparation is required to allow full examination of the large bowel, to improve the outcome and to avoid the need for a repeat procedure (Table 1.3). The timing of bowel preparation also influences the quality of cleansing of the bowel38.

**Table 1.3: Clinical standards, objectives and indicators for the pre-procedure phase - bowel preparation**

<table>
<thead>
<tr>
<th>Standard</th>
<th>Objective</th>
<th>Performance indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard 3: Bowel preparation</td>
<td>Objective 3.1: Bowel preparation</td>
<td>A 100 per cent of patients receive bowel preparation education.</td>
</tr>
<tr>
<td>Bowl preparation is undertaken to a high standard.</td>
<td>The colonoscopist ensures that high quality bowel preparation is performed that is appropriate for individual patient risk factors and preferences.</td>
<td>B There is 100 per cent documentation of the type and quality of bowel preparation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C Less than 10 percent of patients require a repeat colonoscopy examination due to poor bowel preparation.</td>
</tr>
</tbody>
</table>

**1.3.2 Indicators of quality for the procedure phase**

Key indicators for competence include volume, i.e. the number of procedures performed annually39,40, caecal intubation rate41,42, instrument withdrawal time43,44, adenoma detection rate45,46, and complication rates40,47.

The European Panel on the Appropriateness of Gastrointestinal Endoscopy (EPAGE) multicentre study provided a unique opportunity to examine the quality and technical performance of a large number of colonoscopies performed at multiple centres in different countries in Europe. Consecutive patients were referred for colonoscopy from 21 centres in 11 countries and 6,004 patients were included. The study found that variations in colonoscopy practice exist. Patients from centres where over 50% of the endoscopists were of senior rank were roughly twice as likely to have an adenoma diagnosed. Longer average withdrawal duration was associated with more frequent detection of adenomas48.
The NBCSP Quality Working Group’s recommended standards, objectives and performance indicators relating to proficiency of the proceduralist are set out in Table 2.1.

<table>
<thead>
<tr>
<th>What will your patients expect?</th>
</tr>
</thead>
<tbody>
<tr>
<td>• That the colonoscopist is well trained in the procedure and meets agreed standards for competence</td>
</tr>
<tr>
<td>• That there will be skilful and thorough examination of all parts of the large bowel.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>What will histopathologists expect?</th>
</tr>
</thead>
<tbody>
<tr>
<td>• That polyps sent for examination will be identified by site within the large bowel</td>
</tr>
<tr>
<td>• That colonoscopists will carefully measure and record the size of these polyps, either in situ or after retrieval, to enable adenomas to be classified as advanced (≥10 mm in diameter) or non-advanced (&lt;10 mm in diameter) on the basis of their size</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>What will quality reviewers expect?</th>
</tr>
</thead>
<tbody>
<tr>
<td>• That colonoscopists will document the extent of the examination to be able to accurately calculate their ileo-caecal intubation rate</td>
</tr>
<tr>
<td>• That colonoscopists record instrument withdrawal times, a surrogate marker of careful examination behind folds</td>
</tr>
<tr>
<td>• That colonoscopists periodically calculate their adenoma detection rate</td>
</tr>
</tbody>
</table>

Table 2.1: Clinical standards, objectives and indicators for the procedure phase - proficiency of proceduralist

<table>
<thead>
<tr>
<th>Standard</th>
<th>Objective</th>
<th>Performance indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard 4: Proficiency of proceduralist</td>
<td>Objective 4.1: Measures of the proficiency of the proceduralist</td>
<td>A Each proceduralist performs more than 250 procedures per five years.</td>
</tr>
<tr>
<td>Proceduralists are proficient in providing high quality colonoscopies.</td>
<td>The proceduralist ensures that the following data is captured and recorded:</td>
<td>B The caecal intubation rate for each proceduralist is 90 per cent or greater for general patients and 95 per cent or greater for screening patients.</td>
</tr>
<tr>
<td></td>
<td>o Number of colonoscopies he/she performs per annum.</td>
<td></td>
</tr>
</tbody>
</table>
The literature identifies a range of complications and adverse events associated with colonoscopy. One Australian study investigated the rates of these complications. The authors conducted an audit in three teaching hospitals in Western Australia from September 1989 to December 1999. The main complications identified were post-colonoscopy bleeding and post-colonoscopy perforation of the bowel. The rates of bleeding and perforation were found to be 0.21% and 0.1% respectively. Other complications included abdominal pain, nausea/vomiting, excess sedation, cardiovascular complications, cerebrovascular complications and pulmonary aspiration. The death rate associated with colonoscopy was 0.01%.

Following an extensive Medline database search (published from 2000 onwards), Panteris et al found that the frequency of perforation is 1 in 1400 for all colonoscopies and 1 in 1000 for therapeutic colonoscopies. Advanced age, female sex, the presence of multiple co-morbidities, diverticular disease, and bowel obstruction have been shown to increase the risk of perforation. Rare complications include rupture of the spleen and acute appendicitis.

Complications arising during a procedure should be well documented and reported as proposed by the NBCSP Quality Working Group (Table 2.2)

<table>
<thead>
<tr>
<th>Standard</th>
<th>Objective</th>
<th>Performance indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective 5.1: Measures of patient complications</td>
<td>A Colonic perforations caused by colonoscopy in less than 1 in 1,000 colonoscopy procedures.</td>
<td></td>
</tr>
</tbody>
</table>

Table 2.2: Clinical standards, objectives and indicators for the procedure phase - minimisation of patient complications
1.3.3 Indicators of quality for the post-procedure phase

Several studies have found marked variation in the quality of reports describing findings at colonoscopy. The NBCSP Quality Working Group recommendations for comprehensive reporting and management in the post-procedure phase are set out in Table 3.

---

**Table 3**

<table>
<thead>
<tr>
<th>Standard</th>
<th>Objective</th>
<th>Performance indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient complications associated with colonoscopy are minimised.</td>
<td>The proceduralist ensures that the following data are captured and recorded:</td>
<td>B Post-polypectomy bleeding in less than 1 in 100 patients who have had a polypectomy.</td>
</tr>
<tr>
<td></td>
<td>○ Colonic perforations caused by colonoscopy.</td>
<td>C Sedation complications:</td>
</tr>
<tr>
<td></td>
<td>○ Post-polypectomy bleeding.</td>
<td>○ Respiratory depression or airway obstruction requiring unplanned intervention in less</td>
</tr>
<tr>
<td></td>
<td>○ Sedation complications:</td>
<td>1 in 100 patients.</td>
</tr>
<tr>
<td></td>
<td>- respiratory depression or airway obstruction requiring unplanned</td>
<td>○ Hypoxia defined as pulse oximetry greater than 10 percentage points lower than</td>
</tr>
<tr>
<td></td>
<td>intervention;</td>
<td>awake pre-procedural baseline for greater than 60 seconds consecutively during or after</td>
</tr>
<tr>
<td></td>
<td>- hypoxia defined as pulse oximetry greater than 10 percentage points</td>
<td>the procedure in less than 1 in 100 patients.</td>
</tr>
<tr>
<td></td>
<td>lower than awake pre-procedural baseline for greater than 60 seconds</td>
<td>○ Hypotension requiring drug or fluid therapy in less than 1 in 100 patients.</td>
</tr>
<tr>
<td></td>
<td>consecutively during or after the procedure;</td>
<td>○ Cardiac arrhythmia requiring intervention in less than 1 in 1,000 patients.</td>
</tr>
<tr>
<td></td>
<td>- hypotension requiring drug or fluid therapy;</td>
<td>○ Pulmonary aspiration of gastric contents in less than 1 in 1,000 patients.</td>
</tr>
<tr>
<td></td>
<td>- cardiac arrhythmia requiring intervention;</td>
<td>○ The use of reversal agents in less than 1 in 10 patients.</td>
</tr>
<tr>
<td></td>
<td>- pulmonary aspiration of gastric contents;</td>
<td>○ Patient complaint about sedation in less than 1 in 100 patients.</td>
</tr>
<tr>
<td></td>
<td>- the use of reversal agents; and</td>
<td>D Abnormal discomfort or pain in less than 1 in 100 patients.</td>
</tr>
<tr>
<td></td>
<td>- patient complaint about sedation.</td>
<td>E Procedure related death within 30 days in less than 1 in 10,000 patients.</td>
</tr>
<tr>
<td></td>
<td>○ Abnormal discomfort or pain: warranting hospital admission; delaying</td>
<td></td>
</tr>
<tr>
<td></td>
<td>discharge; or patient complaint of inadequate pain relief during</td>
<td></td>
</tr>
<tr>
<td></td>
<td>procedure.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>○ Procedure related death within 30 days.</td>
<td></td>
</tr>
</tbody>
</table>

---

9 Draft Clinical Practice Guidelines for Surveillance Colonoscopy - in adenoma follow-up, following curative resection of colorectal cancer, and for cancer surveillance in inflammatory bowel disease
What will your patients expect?

- Verbal and written information about the results of the procedure
- Verbal and written instructions about action to take if problems occur after discharge
- Information about follow-up review

What will referring doctors expect?

- Prompt receipt of a detailed report on the procedure
- A copy of any histopathology report
- Recommendations for further action

What will quality reviewers expect?

- That colonoscopists will conduct periodic audits of performance indicators
- That colonoscopists will welcome the opportunity to participate in quality improvement activities

Table 3: Clinical standards, objectives and indicators for the post-procedure phase – documentation and reporting of performance information

<table>
<thead>
<tr>
<th>Standard</th>
<th>Objective</th>
<th>Performance indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard 6: Provision of detailed performance information</td>
<td>Objective 6.1: Documenting and reporting of relevant performance information</td>
<td>A Detailed quality and performance information in relation to the Objective is documented and provided for all patients at all times.</td>
</tr>
<tr>
<td></td>
<td>The colonoscopist ensures that he/she:</td>
<td>B Self-audit and analysis of proceduralist performance on a half-yearly basis.</td>
</tr>
<tr>
<td></td>
<td>- Completes a standard structured report on the procedure, with a copy or letter provided to the referring general practitioner (and/or NBCSP) that includes information on:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- the standard of bowel preparation;</td>
<td></td>
</tr>
<tr>
<td>Standard</td>
<td>Objective</td>
<td>Performance indicators</td>
</tr>
<tr>
<td>----------</td>
<td>-----------</td>
<td>------------------------</td>
</tr>
<tr>
<td></td>
<td>– depth of insertion of colonoscope;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>– presence of pathology;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>– any intervention performed; and</td>
<td></td>
</tr>
<tr>
<td></td>
<td>– any unexpected outcomes.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Provides a written report on colonoscopy findings for patients and ensures that patients are given contact details in case of an emergency.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Completes and forwards a pathology request form to the pathologist, where applicable, with identification of the referring general practitioner and status as an NBCSP participant where applicable so that the information can be added to the National Register.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>o Completes the required NBCSP reports where applicable.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>o After a complete colonoscopy, documents a follow-up appointment with the referring general practitioner, specialist or colonoscopist and, where appropriate, provides information on the recommended time for the patient to undergo the next colonoscopy.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>o After an incomplete colonoscopy, documents a plan for repeat colonoscopy, barium enema or CT colonography, and provides information on appropriate follow up action.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Compiles an analysis of performance using the procedure indicators detailed under Standards 4 and 5 for the purpose of ongoing performance review and professional development.</td>
<td></td>
</tr>
</tbody>
</table>
2 BARIUM ENEMA

In the past, double contrast barium enema (DCBE) was indicated if there were difficulties with access to colonoscopy or when colonoscopy was incomplete. Despite the American College of Radiology drawing attention to quality issues associated with its performance, the rectum and rectosigmoid region are not well visualised on DCBE and lesions are commonly missed in the sigmoid colon, because of underlying diverticular disease, and on the right side of the colon.

In recent years, DCBE has been increasingly superseded by CT colonography as the preferred radiological method for imaging the large bowel.

3 CT COLONOGRAPHY

Computerised tomographic colonography (CTC) utilises advanced imaging that permits minimally invasive evaluation of the colon and rectum without the need for sedation. It has an established place in investigation of symptomatic patients and following incomplete colonoscopy. The risk for procedure-related complications is low, suggesting that it may be useful as a screening tool for asymptomatic people at risk for colorectal neoplasia.

CTC has been recommended for the use in surveillance following adenoma resection and for the follow-up of patients after resection of colorectal cancer. Its performance characteristics for detecting symptomatic lesions may be satisfactory but its place in the detection of asymptomatic colorectal lesions remains controversial. Some studies reported high sensitivities, but the results of the studies are heterogeneous.

In a meta-analysis of the diagnostic accuracy of CTC for the detection of polyps and colorectal cancer, based on 47 studies that contain data of 10,546 patients, overall per-polyp sensitivity of CTC was 66% (CI 64–68%) for polyps 6–9 mm in size, per-polyp sensitivity was 59% (56–61%), and for polyps larger than 9 mm it was 76% (73–79%). For polyps 6–9 mm and for lesions larger than 9 mm, per-patient sensitivity was 69% (66–72%), 60% (56–65%) and 83% (70–85%), respectively.

Data from The National CT Colonography Trial, which included 2600 asymptomatic participants aged ≥ 50 years, at 15 study centres, found that that CTC failed to detect lesions ≥10mm in 10% of people.

In a recent report on a non-randomised multicentre study involving 615 participants aged 50 years or older, Cotton et al considered that CTC is not yet ready for widespread application in surveillance and that techniques and training need to be improved. In addition, the accuracy of CTC varied considerably between centres and did not improve as the study progressed.

It should be noted that CT involves larger radiation doses than the more common, conventional x-ray imaging procedures. This raises the question of whether the benefits outweigh the risk associated with using CT in conjunction with colonography, especially in the setting of repeated surveillance examinations. For analyses of the colon the average organ dose is 15mGy which is relatively one of the higher doses used in comparison to other organs. It is well documented that there is a significant association between radiation dose and cancer. Nonetheless radiation doses from commonly performed diagnostic CT examinations are variable, highlighting the need for greater standardisation across institutions.
4  EMERGING TECHNOLOGIES

4.1  Magnetic resonance colonography

Several studies indicate that magnetic resonance colonography (MRC) could become an alternative to CTC for imaging the large bowel\textsuperscript{76,77}, not having the disadvantage of radiation exposure. At present, access to this investigation is limited by the high cost of MR equipment and competition with other MR-based investigations.

4.2  Video-capsule colonoscopy

Video-capsule endoscopy has become an important tool for investigation of disorders of the small bowel\textsuperscript{78}. While there is interest in its potential for imaging the large bowel, the place for video-capsule colonoscopy is still uncertain\textsuperscript{79,80}.
References


19. Rex DK and Helbig CC. High yields of small and flat adenomas with high-definition colonoscopes using either white light or narrow band imaging. Gastroenterology 2007; 133: 42-47.


27. Le Rhun M., Coron E, Parlier D, Nguyen JM, Canard JM, Alamdari A, Sautereau D, Chaussade S, and Galmiche JP. High resolution colonoscopy with chromoscopy versus standard colonoscopy for


45. Chen SC and Rex DK. Endoscopist can be more powerful than age and male gender in predicting adenoma detection at colonoscopy. Am J Gastroenterol 2007; 102: 856-861.


54. Lalor PF and Mann BD. Splenic rupture after colonoscopy. JSLS 2007; 11: 151-156.


75. Redberg RF. Cancer risks and radiation exposure from computed tomographic scans: how can we be sure that the benefits outweigh the risks? Arch Intern Med 2009; 169: 2049-2050.


2 MANAGEMENT OF EPITHELIAL POLYPS: COLONOSCOPIC SURVEILLANCE AFTER POLYPECTOMY

2.1 Adenomas and risk of developing colorectal cancer

Adenomas are classified as tubular, tubulovillous and villous adenomas and serrated adenomas. Adenomas with a villous component have more malignant potential and are usually larger than the more common type, tubular adenomas. In 2000, the World Health Organization (WHO) define tubular adenomas as having <20% villous component, tubulovillous as 20-80% and villous as >80% villous component. A recent WHO update made a minor adjustment to these percentages (<25%, 25-75%, >75%).

The concept of the risk of malignancy in any particular adenoma, and its relationship to size, villosity and dysplasia, and even focal malignancy, is well established. The larger the adenoma, the greater the chance of high levels of villosity, high grade dysplasia and malignancy and the higher the chance of multiple adenomas. This concept should be clearly distinguished from the predictive capacity of all these adenoma characteristics for the development of metachronous neoplasia, including cancer, in the future. Strong circumstantial evidence indicates that removal of adenomas and subsequent surveillance by colonoscopy with removal of metachronous adenomas reduces the incidence of colorectal cancer.

Good practice point:

- Determination of risks for patients with adenomas must clearly distinguish between 1. variables that relate to the likelihood of any particular adenoma having a malignant focus and 2. variables that relate to patient, pathological and epidemiological characteristics which predict a risk of future (metachronous) adenomas and cancers.

2.1.1 Identifying the risk of metachronous neoplasia after removal of adenomas

Patients with one or two adenomas <10mm in size identified at baseline, where all the adenomas are removed completely and where there are no adenomas with villous features or high grade dysplasia, are considered lower risk than patients with more than three adenomas or with adenomas of ≥10mm or adenomas with villous features or high grade dysplasia.

2.1.1.1 Adenoma size as a risk factor for future advanced adenoma and CRC

The probability of developing future advanced adenomas or cancers increases with the size of adenoma found at index examination, and ranges, depending on the study, from 1.5-7.7% for adenomas less than 5mm, 3-15.9% for adenomas of 5-20mm and 7-19.3% for adenomas >20mm. Size is usually considered a more robust marker of risk than more advanced histological characteristics (higher grades of villosity and dysplasia) with which it is closely associated.
2.1.1.2 Villous features and dysplasia grading as a risk factor for future advanced adenoma and CRC

Villousity grading of patients within the high risk group is based on the accuracy of the morphopathological assessments. Most studies identify villousity as a risk factor, with some indicating it is an independent risk factor even ahead of size, dysplasia and multiplicity. Villousity does, however, closely relate to size which is generally considered easier to measure, and less prone to inter-observer variation amongst pathologists.

High grade dysplasia (HGD) in the index examination may independently add to the risk of advanced metachronous adenomas, though in some studies this does not achieve significance in multi-variate analysis. Information on adenomas under 1 cm with and without HGD with respect to metachronous risk is lacking.

2.1.1.3 Serrated adenomas as a risk factor for future advanced adenoma and CRC

Serrated polyps are categorized as hyperplastic polyps, traditional serrated adenomas (TSAs) and sessile serrated adenomas (SSAs). SSAs are more prevalent in the proximal colon and lack classic dysplasia but may have mild cytologic atypia, whereas TSAs are more prevalent in the rectosigmoid and have cytologic dysplasia. Classification systems for these polyps are still evolving. Histological interpretation of these serrated polyp types differs between pathologists. The majority of studies suggest that TSA and SSA have significant malignant potential and are associated with subsequent development of metachronous neoplasia. Some studies suggest that SSAs have a higher potential to develop CRC, but others have indicated a similar or lower potential. This remains controversial and there is not yet sufficient evidence to warrant differentiated management pathways.

2.1.1.4 Number of adenomas as a risk factor for future advanced adenoma and CRC

The number and location of individual adenomas found at baseline colonoscopy is associated with advanced adenomas and also with the development of metachronous advanced adenomas. A recent analysis of pooled data from eight prospective studies proposed that absolute risks of metachronous advanced adenoma, colorectal cancer, and their combination (advanced colorectal neoplasia) within three to five years is higher in patients with greater than four adenomas at baseline than with <4 adenomas. The risk for metachronous advanced adenomas increased with the number of adenomas at base line and was 8.6%, 12.7%, 15.2%, 19.6% and 24.1% for one, two, three, four, and for five or more adenomas at baseline. Risk of a metachronous advanced adenoma approached 20% in patients who had four or more baseline adenomas, or whose largest baseline adenoma was 20 mm in size or greater. In another study the risk of developing colorectal cancer/advanced adenoma was increased in patients with three or more adenomas (0.8-1.1%) compared with less than three adenomas (0.5%) at baseline colonoscopy.

When the number of polyps found at baseline colonoscopy exceeds ten, familial adenomatous polyposis (FAP) or MUTYH associated polyposis may be the cause. Individually, these polyps are no more likely to develop cancer than other adenomas; the risk is high because of the number. These conditions are discussed in detail in Chapter 7 of the Clinical Practice Guidelines for the prevention, early detection and management of colorectal cancer (2005).

Whether the important parameter of number of adenomas should be calculated as cumulative lifetime adenomas, or adenomas at the current colonoscopy, for the purposes of follow up recommendations, is not clear. Pragmatically, the number at the current colonoscopy is usually assimilated into the risk assessment as the cumulative number is often difficult to ascertain in clinical practice.
2.1.1.5 Location of adenomas as a risk factor for future advanced adenoma and CRC

Location of baseline adenomas with respect to metachronous risk has been only a more recent focus of attention. Multiple adenomas located in the right colon at baseline colonoscopy are suggested to be a higher risk factor for metachronous adenomas with high grade dysplasia and colorectal cancer\textsuperscript{6, 13, 31, 38}. Ageing tends to increase the number of adenomas in the right colon, while only modestly affecting those in the left colon\textsuperscript{39}.

2.1.1.6 Location of adenomas and cancer: protection against right sided cancer in adenoma follow up

Recent evidence suggests that protection afforded by colonoscopy for right sided cancer development is significantly less than left sided cancer in a range of settings, raising questions of quality in colonoscopy as it relates particularly to the right colon (poor right sided bowel preparation, incomplete colonoscopy, anatomical configurations compromising visibility, or differential biology for right sided lesions).\textsuperscript{10, 40} Thus, endoscopists should pay particular attention to the right colon in their practices — at initial and follow up examinations. However, there is insufficient evidence to determine differential follow up intervals for right- compared to left-sided adenoma location at index colonoscopy.

Good practice point:

- Proximal location of adenomas may be a risk factor for metachronous neoplasia. The extent to which this is driven by the difficulty of detecting proximal polyps, because of their flat and unobtrusive nature (ie. sessile serrated polyps), poor bowel preparation and anatomical blind spots in the right colon, is unclear. For these reasons the right colon deserves particularly careful scrutiny at colonoscopy.

2.1.1.7 Models for risk index

A combined index based on odds ratio using regression techniques for number, size, dysplasia and grade of adenomas as well as age, gender, BMI, smoking history and family history may be used in order to quantify risk of metachronous adenomas and mortality from colorectal cancer\textsuperscript{13, 41-43}. These multivariate equations predicting risk carry a degree of complexity which is difficult to introduce into common practice but might nevertheless in the future usefully inform decision making and guidelines. The studies quoted draw attention to the importance of age and number of prior adenomas in risk assessment\textsuperscript{13, 41-43}.

Good practice point:

- Multivariate analyses offer little advantage over more pragmatic guideline-driven approaches.

2.2 Polypectomy

2.2.1 General considerations relating to polypectomy

In the absence of magnifying endoscopy combined with dye spraying, or in some studies, Narrow Band Imaging, it is often not possible to determine the histological type of a polyp by endoscopic inspection. Diminutive hyperplastic polyps and adenomas (<5 mm) may be indistinguishable. The unusual large hyperplastic polyp may mimic an adenoma.

Management of Epithelial polyps: colonoscopic surveillance after polypectomy  22
Good practice point:

- All polyps should be considered for removal. Diminutive polyps (5mm or less) may be too numerous to be cleared completely. In subjects with multiple small polyps, a sample of at least three should be taken for histological study. However, if a syndromic diagnosis is under consideration, then sampling of many more polyps is important, to guide decisions on which gene should be subjected to mutational analysis.

2.2.2 Large sessile adenomas

In most centres, large sessile polyps are removed by piecemeal endoscopic mucosal resection (EMR) although this can make histological evaluation of completion of polypectomy difficult or impossible. EMR or Endoscopic Submucosal Dissection (ESD) (which secures the specimen in one piece) can be successfully (95%) achieved when done by well trained specialists in specialised centres with the appropriate equipment.

2.2.3 Tattooing polypectomy sites

With any lesion identified at colonoscopy, the colonoscopist should assess whether the lesion can be safely removed endoscopically. For larger polyps or those with features suspicious of malignancy such as such as an irregular or ulcerated surface, tattooing of the site should be systematically considered. If there is any possibility of a need for later surgical resection of the site, the area should be tattooed, as this aids the surgeon, the pathologist’s examination of the resected specimen and the accuracy of the histopathology report. The tattoo should be placed 2-3cm distal to the lesion (to avoid submucosal fibrosis which makes any further attempt at endoscopic polypectomy more difficult, dangerous and unlikely to be complete) rather than ‘at’ or under the polyp.

This is particularly important in centres where laparoscopic resections are done, as the surgeon has no capacity to feel the polyp or polypectomy site at laparoscopy.

In the event that malignancy is identified unexpectedly in a polyp which has not been tattooed and surgery is the preferred further management strategy, early re-endoscopy is needed to tattoo the site, preferably within a week.

Good practice point:

- Tattooing any polyp site where there is a possibility that surgical resection will be needed is important at the primary colonoscopy if at all possible, or very soon after with a second procedure. This is necessary even for conventional surgery, as the site of polypectomy may well be inpalpable, but particularly important where follow-up treatment may be laparoscopic, as the surgeon has no capacity to palpate the area.

2.3 Malignant polyps

Management of malignant polyps by polypectomy alone is now standard practice and is generally acknowledged to be safe, providing that there is adherence to a strict policy of case selection and histopathological assessment recognising four key features that together identify a very low risk of lymph node metastasis

- a clear margin of excision (1 to 2mm)
- cancer which is well- or moderately-differentiated

Draft Clinical Practice Guidelines for Surveillance Colonoscopy - in adenoma follow-up, following curative resection of colorectal cancer, and for cancer surveillance in inflammatory bowel disease
• absence of lymphatic or venous invasion
• complete removal as assessed endoscopically

Malignant polyps with unfavourable features may require further treatment, but this decision should be made on the basis of the age, health and wishes of the patient. Treatment decisions will also be influenced by site, particularly in the case of low rectal lesions for which radical surgery would involve abdominoperineal excision and colostomy. For colonic polyps, excision can be achieved successfully by laparotomy with colonic resection or laparoscopically assisted colectomy.

This section should be read in conjunction with Chapter 3 - Follow-up after curative resection for colorectal cancer.

Good practice point:

• In general, malignant polyps which 1. have a clear margin of excision, 2. are well or moderately differentiated, 3. lack lymphatic or venous invasion and 4. are endoscopically assessed as totally removed can be managed without subsequent surgical resection. However, the decision needs to be individualized with respect to the particular histological and endoscopic features and the patient’s age and co-morbidities.

2.4 Follow-up surveillance for adenomas

2.4.1 Balance of risks and benefits

Colonoscopy, with or without polypectomy, is an invasive procedure with a small but not insignificant risk of major complications, either from perforation (with polypectomy: 2%; without polypectomy: 0.06%), or major haemorrhage post-polypectomy (0.2-10%), depending on size of lesion. Surveillance colonoscopies also place an important burden on endoscopy services. In the US, 22% of all colonoscopies in patients over 55 years are performed for surveillance purposes. For these reasons, surveillance colonoscopy should be targeted at those who are most likely to benefit and at the minimum frequency required to provide adequate protection against the development of cancer.

2.4.2 Quality of colonoscopy

Colonoscopy is highly operator-dependent and several aspects of the procedure (e.g. poor bowel preparation, areas hidden from view using current instruments, suboptimal technique, and ineffective polypectomy) can lead to failure to clear the colon of neoplasia. Increasing evidence suggests that adenoma detection rates differ between colonoscopists; the are related to the time taken to withdraw the colonoscope and the risk of development of subsequent cancers. Attention to quality of colonoscopy is therefore of paramount concern. Further information on quality relating to colonoscopy is covered in Chapter 1.

Good practice point:

• High quality colonoscopy is critically important for good practice and patient safety. Adenoma detection rates (ADRs) should be monitored, though they will be influenced by patient mix (e.g. age profile, indications). ADRs within the National Bowel Cancer Screening Program provide a sound basis for benchmarking.
2.4.3 Approach to adenoma follow up in surveillance

Surveillance by colonoscopy is the preferred method for patients diagnosed with colorectal adenomas, as the chance of finding metachronous adenomas requiring removal is high. However, there are no randomised controlled trials of adenoma follow up which include a control arm which does not have colonoscopy. Nevertheless, in some long term studies, of colonoscopic surveillance of patients with all types of adenomas subjected to removal, a significant reduction in risk of developing colorectal cancer has been documented when compared with various comparative cohorts such as age- and sex-matched incidences of colorectal cancer in the same communities. In many studies, this risk of developing CRC does not fall below the average risk in the community.9, 31, 63, 64

Good practice point:

- Colonoscopy surveillance intervals should be planned when the colonoscopist is satisfied that the colon has been completely cleared of polyps and the polyp histology is known.

2.4.4 Follow up for patients with low risk adenomas

As indicated previously, patients with one or two tubular adenomas less than 10 mm in size represent a low-risk group compared with other patients with colorectal neoplasia. For these patients, a follow up interval of five to ten years is proposed.6, 33, 65-67, 64. Among patients who had only one or two small tubular adenomas at a baseline examination and then no adenomas on their first surveillance colonoscopy, the probability of high-risk findings on the next surveillance examination is similar to that for patients with a negative screening examination; thus, a ten-year follow-up colonoscopy schedule may be appropriate.67. Atkin’s data confirm the low risk of subsequent cancer in patients with one or two small adenomas, supporting follow up of these patients similar to average-risk patient strategies – which includes colonoscopy in US guidelines, but only at ten yearly intervals.63

Good practice point:

- Low risk adenomas are those which lack advanced features, namely three or more adenomas at one colonoscopy, adenomas 10 mm or more in size, tubulovillous or villous histology or high grade dysplasia/cancer.
- Two small tubular adenomas do not constitute more than average risk for metachronous advanced adenomas or cancer.

<table>
<thead>
<tr>
<th>Evidence summary:</th>
<th>Level of evidence</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients with one or two small tubular (&lt;10mm) adenomas are at minimal risk for metachronous advanced neoplasia.</td>
<td>II</td>
<td>33, 64-67</td>
</tr>
</tbody>
</table>

Recommendation

In follow-up of patients with one or two small (<10 mm) tubular adenomas, surveillance colonoscopy should be performed between five and ten years.

Grade B
2.4.5 Follow up for patients with high risk adenomas

Multiple studies have indicated that advanced adenomas indicate a risk for metachronous advanced adenomas and cancers\(^4\), \(^{14}\), \(^{66}\), \(^{33}\), \(^{68}\), \(^{69}\). These studies justify surveillance stratification based on index adenoma characteristics.

The definitive study on frequency of colonoscopy in high risk adenoma patients is provided by the US National Polyp Study. In a randomised controlled trial of surveillance intervals amongst 1418 adenoma patients, this study showed no difference in detection rates of advanced or any adenoma rates in follow up colonoscopies randomised to one or three years\(^{64}\).

<table>
<thead>
<tr>
<th>Evidence summary:</th>
<th>Level of evidence</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adenomas $\geq 10$mm predict metachronous advanced neoplasia. Size is best measured by the colonoscopist with the polyp in situ. Villosity and high grade dysplasia are risk markers for metachronous advanced neoplasia; however, there is a close relationship between size, villosity and dysplasia, making the independent contribution of villosity and dysplasia not uniformly identified in adenoma follow up studies. High grade dysplasia, by definition is still confined to the epithelium and is not associated with any risk of invasion or extracolonic spread.</td>
<td>II</td>
<td>13, 14, 68</td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>7, 13, 15, 33, 64, 66, 68, 69</td>
</tr>
</tbody>
</table>

Recommendation

Surveillance colonoscopy should take place at three yearly intervals for patients with advanced neoplasia (three or more adenomas, $\geq 10$mm, or with tubulovillous, or villous histology, or high grade dysplasia).

Grade A

2.4.6 Follow up of patients with sessile adenomas and laterally spreading adenomas

High rates of residual adenoma are identified following a piecemeal resection of large and sessile adenomas\(^{21},^{31},^{70}-72\). If there is doubt about whether the index lesion has been totally removed, a second colonoscopy should be done within three to twelve months.

<table>
<thead>
<tr>
<th>Evidence summary:</th>
<th>Level of evidence</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>High rates of residual adenoma are identified following a piecemeal resection of large and sessile adenomas leading in some cases to doubts about total removal of the index lesion.</td>
<td>III</td>
<td>21, 70, 71</td>
</tr>
</tbody>
</table>
Recommendation

If sessile adenomas are removed piecemeal, follow-up colonoscopy should be at three to six months and again at twelve months to ensure complete removal. If removal is complete, subsequent surveillance should then be based on histological findings, size and number of other adenomas (as set out in 2.4.4 and 2.4.5).

Grade B

2.4.7 Follow up following resection of serrated adenomas (SA) and sessile serrated adenomas (SSA)

In one study, when a follow up examination was performed at a mean of 29 months after initial examination in patients with serrated adenomas who underwent complete colonoscopy with good preparation, 24% were diagnosed with adenomatous polyps. A control group without serrated adenomas at initial examination had no adenomas at a follow-up examination at average time of 31 months73.

There are suggestions that surveillance following complete removal of small SSA without dysplasia should take place at five to ten years as for small tubular adenomas29. The same authors suggest that three years surveillance is appropriate for TSAs of any size or number. Patients with large sessile serrated adenomas with high grade dysplasia need intense follow up between three to six months, though this depends more on the sessile nature of the polyp rather than its serrated pathology.

In summary, at present there is not enough evidence to differentiate adenoma follow up protocols for sessile serrated adenomas based on their serration alone.

Good Practice Point:

- At present there is not enough evidence to differentiate follow up protocols for sessile serrated adenomas from standard adenoma follow up guidelines. Follow up should be determined by the other more conventional parameters outlined elsewhere in this chapter.

2.4.8 Follow up for patients with multiple adenomas

Most published guidelines suggest that three or more synchronous (adenomas at baseline colonoscopy) require surveillance at three years and three to five years thereafter13, 31, 38. As mentioned above, the percentages of patients identified with new high grade adenomas at follow up within three to five years increases with multiplicity of adenomas at baseline with 8.6%, 12.7%, 15.2%, 19.6% and 24.1% if one, two, three, four, and five or more adenomas were found at baseline colonoscopy13. An analysis of 697 patients in the Cleveland Clinic Foundation Adenoma Registry68 showed that, compared with one or two small adenomas, the risk of metachronous adenomas is increased five-fold following removal of multiple (four or more) small adenomas and ten-fold following removal of multiple adenomas at least one of which is larger than 10 mm. In a meta-analysis of several colonoscopic surveillance studies74, patients with three or more adenomas at baseline were at an approximately two-fold increased risk of advanced neoplasia during surveillance compared with those with only one to two adenomas. In a more recent US pooled analysis13 which included eight studies with a combined population of 9167 men and women with previously removed colorectal adenomas, advanced adenomas were detected at follow-up within five years in 12% (n = 1082) and cancer in 0.6% (n = 58). There was a highly significant linear trend of increasing frequency of advanced neoplasia (advanced adenomas and cancers) with increasing number of
baseline adenomas detected. Compared with having a single baseline adenoma, risk was increased two-
fold in those with three to four adenomas and was increased four-fold in those with five or more
adenomas.

The high detection rate of advanced neoplasia at follow-up after removal of multiple adenomas might
result from a higher miss rate combined with a potential for such adenomas to be more advanced.

Multiplicity of ten or more adenomas could indicate the need for a further colonoscopy at three to twelve
months to secure a clean colon before surveillance colonoscopy commences. As familial adenomatous
polyposis (FAP) or MUTYH associated polyposis may be the cause, referral to a familial cancer clinic for
mutational analysis of the APC and MYH genes should be considered. If FAP has been confirmed,
lifelong follow-up after surgery, possibly including chemoprevention, needs to be tailored to patients in
relation to age, retention of the rectum and its attendant risk.

<table>
<thead>
<tr>
<th>Evidence summary:</th>
<th>Level of</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>The number of adenomas present at colonoscopy is one of the most important predictors of metachronous risk of advanced and non-advanced neoplasia. In some studies it can be identified independently of other risk factors.</td>
<td>II</td>
<td>13, 38, 69, 74</td>
</tr>
</tbody>
</table>

**Recommendation**

As multiplicity of adenomas is a strong determinant of risk of metachronous advanced and non-advanced neoplasia, follow up should be at twelve months for those with five or more adenomas and, because the likelihood of missed synchronous polyps being present, sooner in those with ten or more adenomas.

If a polyposis syndrome accounts for the findings, follow-up colonoscopy should be within one year for patients with five or more adenomas at one examination.

Grade B

**Good practice point:**

- FAP or MYH associated polyposis should be considered with as few as ten adenomas; referral to a familial cancer clinic is advisable.

### 2.4.9 Interaction of Age and Family History of Colorectal Neoplasia

The US National Polyp Study found that the subsequent risk of developing advanced adenomas in
people undergoing surveillance was increased in people aged ≥ 60 years who had a parent affected by
colorectal cancer. One other study found that having a parent with a history of colorectal cancer was
associated with an increased risk but other studies have not confirmed this finding. Detection rates
of advanced adenomas among 1287 participants in a trial of wheat bran fibre were unaffected by inclusion
of family history in a multivariate model after adjustment for adenoma characteristics at baseline. Similarly, in the recent US pooled analysis, the risk of developing advanced neoplasia during surveillance was not influenced by family history.
Thus there is no consistent evidence to suggest that recommendations on adenoma surveillance should differ for patients with a family history unless it is suspected that they have one of the inherited conditions.

<table>
<thead>
<tr>
<th>Evidence summary</th>
<th>Level of evidence</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>There is insufficient evidence to suggest that, outside genetic syndromes, family history contributes significantly to risk. Therefore, a positive family history should not influence surveillance scheduling based on patient factors and adenoma history.</td>
<td>IV</td>
<td>13, 76</td>
</tr>
</tbody>
</table>

**Recommendation**

Family history should be considered separately when planning colonoscopy surveillance. Intervals should be predominantly determined by the adenoma characteristics, unless a syndromic risk mandates more frequent surveillance.

Grade C

**2.4.10 Follow up based on two or more examinations**

Surveillance colonoscopy findings in conjunction with the baseline lifestyle and demographic risk factors should dictate the risk characteristics of patients, and suggest that patients with adenomas found at more than one screening/surveillance colonoscopy may be at higher risk than patients with adenomas on one examination but not on the next. When the second examination shows no adenomas, the prevalence of high risk adenoma (one advanced adenoma or cancer or multiple (≥ 3) of any size) at the third examination was found to be only 4.9% if the adenoma was low risk (one or two adenomas <1 cm) at baseline, and 12.3% if the adenoma was high risk at baseline. Combined risk identification of adenomas removed at baseline and at a follow up colonoscopy can be used as predictors for recurrence up to four years from baseline examination when risk level of adenomas are stratified by size, number and pathological examination. The presence of high grade adenomas identified at baseline colonoscopy increases the probability of metachronous adenomas at a surveillance procedure within one to five years from baseline investigation. Hence, a combined risk after baseline and at least one surveillance examination may be a better tool for prediction of outcome. Endoscopists therefore should be encouraged to assess not only the current colonoscopy findings but those of any previous colonoscopies.
Evidence summary

<table>
<thead>
<tr>
<th>Evidence summary</th>
<th>Level of evidence</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>There is conflicting evidence about whether screening intervals should be lengthened for patients with a history of advanced neoplasia in the colon, even with a series of normal colonoscopies. The choice should be individualized.</td>
<td>II</td>
<td>33, 67</td>
</tr>
</tbody>
</table>

Recommendation

Maintaining a three yearly schedule is prudent if advanced adenomas or multiple adenomas are found during surveillance, but the frequency may be reduced if no, or only a few small tubular adenomas are found.

Grade C

2.4.11 Stopping rules

The lead time for progression of an adenoma to cancer is around 10 to 20 years which is of the same order as the average life-expectancy of an individual aged 75 years or older, suggesting that most people over 75 years of age will not benefit from surveillance.

2.5 Hyperplastic polyposis

Many of the polyps in hyperplastic polyposis are sessile serrated adenomas (see sections 2.1.1.3 and 2.4.7). The risk of cancer may be increased if there are co-existing adenomatous lesions that may be traditional adenomas, admixed polyps or serrated adenomas, or if there is a family history of colorectal cancer. A particular association has been demonstrated between hyperplastic polyps and cancers with microsatellite instability.

It is recommended that patients with hyperplastic polyposis be offered biennial (two yearly) colonoscopy. This should also be considered for patients in whom neither of the strict definitions for the diagnosis of hyperplastic polyposis is met in full, but other risk features are present (one coexisting adenomatous lesion or a first-degree relative with hyperplastic polyposis or colorectal cancer). Colectomy should be considered when it is not possible to achieve control of polyps endoscopically. There is increasing evidence that sporadic hyperplastic type polyps also have malignant potential, particularly when they are large, proximally located, and have the morphological appearances associated with sessile serrated adenoma (see section 2.1.1.3).

Good practice points:

- Risk of cancer in hyperplastic polyposis is still being defined; however, there is sufficient evidence to identify these patients as being at high risk. Colonoscopy, with the aim of complete polyp removal, including the right sided sessile serrated polyps, should be the
aim. Risks of polypectomy, notable because of the number and sessile nature of these polyps, should be explained.
- Surgery is an acceptable alternative in patients with well defined hyperplastic polyposis.

2.6 **Issues requiring more clinical research study:**

- What is the risk of metachronous neoplasia after a series of normal surveillance investigations, stratified by risk parameters of the index adenoma(s)?
- Are sessile serrated adenomas per se indicators of excessive colon cancer risk?
- What are the characteristics of colonoscopies that precede interval cancers?
- Is the risk of early advanced adenomas related to quality of colonoscopy or biology and patient characteristics?
- Is high grade dysplasia a risk factor independent of size and other adenoma characteristics?
- Is multiplicity, independent of size, a risk factor for metachronous adenomas?
References


Draft Clinical Practice Guidelines for Surveillance Colonoscopy - in adenoma follow-up, following curative resection of colorectal cancer, and for cancer surveillance in inflammatory bowel disease


3 THE ROLE OF SURVEILLANCE COLONOSCOPY AFTER CURATIVE RESECTION FOR COLORECTAL CANCER

Preamble

After surgery for colorectal cancer (CRC), the aim of patient follow-up is to improve survival by the early detection and treatment of recurrent or metachronous neoplasia. To increase the chance of early recognition of such disease, intensive post-operative follow-up is recommended. This involves a combination of clinical review, blood tests for tumour markers (i.e. CEA), colonoscopy, radiological imaging and/or abdominal ultrasound at regular intervals after resection (the timing of which may vary according to the procedure performed and whether the cancer removed was rectal or colonic)\textsuperscript{1-4}.

This chapter focuses specifically on the use of colonoscopy in surveillance following curative resection of colorectal cancer. Complete, high-quality colonoscopy should be performed at the time of diagnosis of a CRC, to check for synchronous cancer and to clear the colon of synchronous adenomatous polyps. Surveillance colonoscopy following resection of CRC aims to improve patient outcome by finding metachronous cancers at an early stage, detecting anastomotic or intraluminal recurrences and removing metachronous adenomas. Hence, understanding the rate of development of and risk factors associated with either metachronous neoplasia or locally recurrent cancer may be important for reducing mortality from CRC.

The current chapter addresses the question of when post-operative colonoscopy should be performed following curative resection surgery.

3.1 Role of pre- or peri-operative colonoscopy in CRC patients

A complete examination of the large bowel, preferably by colonoscopy, should be performed at the time of cancer diagnosis to check for synchronous cancers and clear all synchronous polyps. A synchronous cancer is found in up to 5% of patients and synchronous adenomatous polyps in 20-40% of patients\textsuperscript{5,7}. Clearance of synchronous lesions at perioperative colonoscopy reduces the rate of metachronous CRC\textsuperscript{8,9}. If the index cancer obstructs the lumen and prevents a clearing pre-operative colonoscopy, consideration should be given to pre-operative assessment of the proximal colon by alternative means, e.g. CT colonography or air contrast barium enema. This, however, is unnecessary if the colon proximal to the cancer is to be included in the resection specimen. Failing this, colonoscopy should be performed three to six months after surgery, providing no distant metastases are found\textsuperscript{6}.

<table>
<thead>
<tr>
<th>Evidence summary</th>
<th>Level of evidence</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evidence shows that perioperative colonoscopy (whether performed preoperatively, intraoperatively or postoperatively) reduces cancer-related mortality in patients diagnosed with CRC.</td>
<td>II</td>
<td>7-10</td>
</tr>
</tbody>
</table>

**Recommendations**

A perioperative colonoscopy should be attempted in all patients with a newly diagnosed colorectal cancer (CRC).

Grade B
Colonoscopy should be performed three to six months after resection for patients with obstructive colorectal cancer in whom a complete perioperative colonoscopy was not performed and in whom there is residual colon proximal to the obstructing cancer.

Grade B

3.2 Which patients should be followed up with surveillance colonoscopy?

The Australian Clinical Practice Guidelines for the prevention, early detection and management of CRC, 2nd edition, 2005 proposed that follow-up should be offered to all patients who have undergone curative surgery and are fit for further intervention if disease is detected. This includes patients who have had malignant polypectomy or curative endoscopic resection of Stage I CRC but excludes patients with Stage IV CRC if their treatment does not offer the possibility of cure.

3.2.1 Risk Factors for local recurrence following resection for colorectal cancer

Recent studies suggest that follow-up after CRC resection could perhaps be customized according to a patient’s individual risk. For example, a number of studies have determined features of a primary CRC which increase the risk of local recurrence at the surgical anastomosis. Most importantly though, anastomotic recurrence occurs far more often in rectal cancer patients than in colon cancer patients. Local recurrence is also more likely to occur in patients undergoing local excision (including transanal endoscopic microsurgery) of their rectal primary cancers. And unfortunately, many of these recurrences are associated with extra-colonic disease or local spread and are not curable. With respect to this review, the vast majority of these rectal anastomotic recurrences are within reach of digital rectal examination or sigmoidoscopy and their detection does not require full colonoscopy.

The optimal combination and frequency of investigations in follow-up of patients after CRC resection has not been determined. Importantly, the performance of annual colonoscopy has not been shown to improve five-year survival. A meta-analysis by Tjandra et al concluded that intensive follow-up increased the re-resection rate for recurrent disease and improved overall survival but the survival advantage was not due to earlier detection of recurrence and cancer-related mortality was no better.

The focus of the current chapter is on the use of surveillance colonoscopy. Although colonoscopy allows inspection of the anastomosis in passing, the principal purpose of surveillance colonoscopy after CRC resection is the detection of metachronous neoplasia. Thus, the above-mentioned risk factors for luminal/anastomotic recurrence are of limited relevance to the question of when surveillance colonoscopy should be performed following CRC surgery.

3.2.2 Risk factors for metachronous neoplasia following resection for colorectal cancer

Having developed one CRC, patients are at risk for the development of metachronous polyps and their progression to metachronous cancers; Bouvier et al reported the incidence of metachronous cancer as being 1.8% at five years, 3.4% at 10 years, and 7.2% at 20 years with the greatest excess risk between one and five years post-surgery.

Preoperative colonoscopy is important to detect and treat synchronous polyps and cancers but may also assist in predicting which patients are more likely to develop future adenomas and cancers during follow-up. Some authors of both original studies and literature reviews have reported that the presence of synchronous polyps or cancers is a risk factor for metachronous CRC and for metachronous adenomatous polyps. However, in a recent population-based study by Bouvier et al using a cancer registry as the source of information, no patient or tumour characteristics could be identified to predict which CRC patients would develop a metachronous cancer. Other authors have likewise failed
to identify any link between synchronous adenomas and the development of subsequent metachronous CRC.

Primary tumour location is also a risk factor for the development of metachronous cancer. In a study of more than 500 CRC patients from a cancer registry database, patients whose first cancer was located proximal to splenic flexure were found to be at twice the risk for developing a metachronous cancer compared to those with a first cancer in the distal colon.

Metachronous and synchronous tumours are features of Lynch syndrome (also known as hereditary non-polyposis colorectal cancer or HNPCC). A propensity for metachronous and synchronous colorectal cancers with a predilection for the proximal colon and development of cancer at an early age are well recognised characteristics of Lynch syndrome.

Thus, reported studies have disagreed about whether patients who have undergone CRC resection can be stratified with regard to their risk of future development of metachronous polyps and cancers. Even in those studies where a positive predictive factor was identified, the strength of the association with the development of future colonic neoplasia was insufficiently strong to exclude patients without the factor from colonoscopic surveillance.

### 3.2.2.1 Patient groups at very high risk for metachronous neoplasia following resection for colorectal cancer

In certain patients who have undergone curative resection for CRC, clinical features, family history and the findings at the pre-operative colonoscopy may dictate the need for particularly intense post-operative surveillance colonoscopy (see Chapter 7 of the Clinical Practice Guidelines for the Prevention, Early Detection and Management of Colorectal Cancer, 2nd edition, 2005).

In other groups of patients considered to be at increased risk of metachronous disease, consideration may be given following surgery to continuing with more frequent surveillance than would otherwise be recommended (e.g. initial post-operative colonoscopy at one year and then annually, second-yearly or third-yearly. These patients include those (i) whose initial diagnosis was made younger than 40 years of age, (ii) with probable or possible HNPCC (i.e. patients whose tumours are MSI-high and less than 50 years old at time of initial cancer diagnosis but not proved by genetic testing to have HNPCC), (iii) with hyperplastic polyposis and BRAF mutation and (iv) with multiple synchronous cancers or advanced adenomas at initial diagnosis.

**Good practice points:**

- Patients with proved Lynch syndrome (HNPCC or hereditary non-polyposis colorectal cancer), should continue to have annual surveillance colonoscopy performed post-operatively because of the apparent rapid progression of neoplasia from adenoma to carcinoma.

- Patients including those (i) whose initial diagnosis was made younger than 40 years of age, (ii) with probable or possible HNPCC (i.e. patients whose tumours are MSI-high and less than 50 years old at time of initial cancer diagnosis but not proved by genetic testing to have HNPCC), (iii) with hyperplastic polyposis and BRAF mutation and (iv) with multiple synchronous cancers or advanced adenomas at initial diagnosis should be considered following surgery to continuing with more frequent surveillance than would otherwise be recommended (e.g. initial post-operative colonoscopy at one year and then annually, second-yearly or third-yearly.
3.3 Effectiveness of surveillance colonoscopy following resection for colorectal cancer

Surveillance colonoscopy after CRC resection has the theoretical potential to improve patient outcome by finding metachronous cancers at an early stage, detecting luminal/anastomotic cancer recurrences and removing metachronous adenomas. Nevertheless, studies have differed in their conclusions about the overall effectiveness of colonoscopic surveillance.

Several studies have demonstrated that compliance with a post-operative colonoscopy surveillance programme reduces the mortality rate of patients after CRC resection. Early detection of metachronous cancer, particularly when still asymptomatic, increases the chance that re-operation will be curative. The effectiveness of colonoscopy in detecting tumour recurrence after CRC resection has been more controversial.

Thus, while most studies show that surveillance colonoscopy improves survival, its usefulness in detecting recurrent CRC has been questioned and its benefits probably derive from detection of metachronous colorectal neoplasia.

3.4 Intervals for surveillance colonoscopy following resection for CRC

Recommendations about the timing of colonoscopy after CRC resection should be based upon the “natural history” of metachronous colonic neoplasia, in order to meet the objectives of surveillance, namely early detection of metachronous cancer and timely polypectomy for metachronous adenomas.

The natural history of metachronous cancer and polyps is best estimated by studies of the yields of colonoscopy at various timepoints after surgery, when pre- or peri-operative colonoscopy has excluded synchronous cancer and cleared synchronous polyps.

In the US, Guidelines for Colonoscopy Surveillance after Cancer Resection, the literature to 2005 was summarized with regard to metachronous cancer development. In studies incorporating more than 9000 patients, 137 metachronous cancers were detected, 57 of which were found within 24 months of surgery. It could be argued that second cancers found so soon after surgery were in many instances missed synchronous (rather than metachronous) lesions but the importance of detecting them remains undiminished. The authors argued that such a rate of cancer detection (157 colonoscopies per metachronous cancer found) was comparable to the rate of prevalent cancer detection in the setting of screening colonoscopy (as practiced in the US). It was this relatively high incidence of metachronous cancers within two years of surgery that led to the Guidelines’ recommendation to perform post-operative colonoscopy at an interval of 1 year (with subsequent colonoscopies after an interval of three years and then five years, if all surveillance examinations were normal).

In the literature prior to 2005, Barillari (1996) and Neugut (1996) found that more than one-half of metachronous adenomas and cancers arose within the first twenty-four months after surgery. In a 2000 study, Togashi et al detected twenty-two metachronous colorectal cancers in 19 out of 341 patients after CRC surgery, 14 (64%) of them within five years of surgery. Most were small, 10 mm or less in size, and many had a flat endoscopic appearance. In a study of 174 patients reported by Juhl et al in 1990, three-quarters of the colonoscopically detected neoplasms (adenomatous polyps and cancers) occurred within the first 24 months. In the period 12-30 months after surgery, four metachronous cancers and 37 advanced adenomas were detected. A retrospective review by Khoury et al (1996) concluded that annual follow-up colonoscopy for two years after CRC surgery was beneficial and that the interval between subsequent examinations be increased depending on the result of the most recent examination.
However, not all of these earlier studies advocated colonoscopy within one to two years of surgery. Among 175 patients who underwent a curative resection for CRC between 1986 and 1992, colonoscopies performed one year after surgery and then at two-year intervals revealed no metachronous cancers or advanced adenomas. The authors suggested that only patients who had had synchronous adenomas at pre-operative colonoscopy should undergo follow-up colonoscopy at three years. Similarly, Stigliano et al. conducted a retrospective study of 322 patients and found no metachronous cancers within the first two years after surgery. In their 2002 review, Berman et al. suggested that there were insufficient data to support the routine use of annual or more frequent colonoscopy to identify metachronous or recurrent CRC and they suggested post-operative colonoscopy be limited to every three to five years. The value of a large retrospective audit of patients after CRC resection by McFall et al. (2003), which concluded that most patients are at very low risk of developing significant colonic pathology in the five years after resection, was limited by the fact that less than one-third of the patients underwent post-operative colonoscopy and the mean interval between surgery and colonoscopy was more than four years. Similar reservations about the need for follow-up colonoscopy earlier than two to three years were expressed by Mathew et al. (2006); even though 10 out of 14 patients with neoplastic findings at surveillance colonoscopy were detected two years post-operatively.

A Western Australian study by Yusoff et al. audited all patients who underwent surgical resection of CRC from 1989 to 2001 and found that no metachronous cancers (and only 1 of 11 recurrent anastomotic cancers) were found by surveillance of asymptomatic patients. The three metachronous cancers were all detected in symptomatic patients, at four, eight and nine years after surgery. In a subset of their patients, the yields for adenoma were 10% at one year post-operatively, 28% at two years and none at three years.

Another Australian study published in 2005 by Platell et al. specifically evaluated the clinical utility of performing a colonoscopy 12 months after curative resection for CRC. In 253 patients who had undergone complete colonoscopy prior to resection, 90% received their first post-operative colonoscopy at a mean of 1.1 years. Although no recurrent or metachronous cancers were found, 149 polyps were detected in 30% of patients, 42% of which were adenomas and 13% of which were villous or tubulovillous adenomas. Having observed such a high prevalence of advanced adenomas at 12 months (7.9% of patients), the authors raised the possibility that, in contrast to recommendations in the NHMRC Clinical Practice Guidelines for the prevention, early detection and management of colorectal cancer 2005 at the time, that post-operative colonoscopy be performed at three to five years and a variably intense colonoscopy surveillance schedule might be justifiable. Similarly, the large study from Taipei mentioned earlier, concluded that a lifelong schedule of post-operative colonoscopic surveillance was necessary.

According to Hassan et al. (2009), who used a decision analysis model, early surveillance colonoscopy performed one year following CRC resection was clinically efficient and cost-effective in terms of cancer detection and prevention of cancer-specific death. Compared to “no early colonoscopy” following surgery, the number of one-year colonoscopies required to find one CRC was 143 and the number needed to prevent one CRC-related death was 926. In a 2007 analysis of 1002 operated CRC patients, Rulyak et al. concluded that surveillance colonoscopy within one year of surgery was warranted because (i) 9 of the 20 metachronous cancers detected during the study period were found within 18 months of surgery and (ii) the rate of metachronous advanced neoplasia was significantly lower if colonoscopy was performed within 18 months of surgery (6.9%) than if colonoscopy was delayed for three years or more (15.5%).

In a 2009 study from China, Wang et al. compared “intensive colonoscopic surveillance” (three monthly colonoscopy for the first year after surgery, then six monthly for the following two years and annually thereafter) with “routine colonoscopic surveillance” (at six, thirty and sixty months after surgery). In the intensive surveillance group, one metachronous cancer was detected in the second year of surveillance, one in the fourth year and the third more than five years after initial surgery. In the routine surveillance group, no metachronous cancers were found at six months, four were found at...
30 months, one was found at five years and one was found thereafter. The authors concluded that the routine schedule of surveillance was acceptable, with follow-up colonoscopy at one and two years after surgery and then three to five years thereafter.

Thus, while not all of the published evidence is in agreement, most studies demonstrate a significant incidence of metachronous cancers, advanced adenomas and other types of polyps after curative resection for CRC. In many studies, a high proportion of the metachronous neoplasia was detected within the first two years after surgery. Careful, high-quality colonoscopy at 12 months after surgery would be expected to detect the vast majority of this metachronous neoplasia. In turn, this should improve survival in patients operated on for CRC, by finding second cancers at a stage early enough to be cured by re-operation, and by removing metachronous adenomas while still benign. As a result, the weight of evidence from the literature would seem to support performing the initial post-operative surveillance colonoscopy at an interval of one year. If this examination does not reveal a metachronous cancer, the intervals between subsequent colonoscopies should probably be three and five years, depending on the number, size and histologic type of polyps (if any) removed.

<table>
<thead>
<tr>
<th>Evidence summary</th>
<th>Level of evidence</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Follow-up colonoscopy reduces the mortality rate of patients after CRC resection. Most studies demonstrate a significant incidence of metachronous cancers, advanced adenomas and other types of polyps after curative resection for CRC. In many studies, a high proportion of the metachronous neoplasia occurred within the first two years after surgery.</td>
<td>II, IV</td>
<td>8-10, 15, 21, 29, 31, 36-39, 44, 49, 51, 52 26</td>
</tr>
</tbody>
</table>

**Recommendations**

Colonscopy should be performed one year after the resection (or one year following the clearing colonoscopy if performed at a later time). This includes all risk categories.

Grade B

If the examination performed at one year reveals advanced adenoma or a metachronous cancer, then repeat the procedure in twelve months.

Grade B

If the examination performed at one year is normal or identifies only one or two non-advanced adenomas, then the interval before the next subsequent examination should be five years.

Grade D

**Good practice point:**

- Patients undergoing either local excision (including transanal endoscopic microsurgery) of rectal cancer or advanced adenomas or ultra-low anterior resection for rectal cancer should be considered for periodic examination of the rectum at six monthly intervals for two or three years using either digital rectal examination, rigid proctoscopy, flexible proctoscopy, and/or rectal endoscopic ultrasound. These examinations are considered to be independent of the colonoscopic examination schedule described above.
3.5 Issues requiring more clinical research study:

- What is the optimal schedule for performing surveillance colonoscopies after surgery for colorectal cancer?
- What molecular markers in the primary colorectal cancer are predictive for patients at high risk for metachronous disease?

References


4 COLONOSCOPIC SURVEILLANCE AND MANAGEMENT OF DYSPLASIA IN INFLAMMATORY BOWEL DISEASE

4.1 Introduction

An increased risk of colorectal cancer (CRC) in inflammatory bowel disease (IBD) has been recognised for many years, though the best way to manage this problem depends on a number of individual cofactors. Once IBD-associated CRC becomes symptomatic, the malignancy is usually advanced, and prognosis correspondingly poor. Prophylactic proctocolectomy avoids CRC, but is not justified in patients whose health is otherwise good due to significant post operative morbidity. Colonoscopic surveillance has been advocated as an alternative means to reduce cancer-related mortality among individuals who wish to retain their colon. For the first time, these Guidelines have included specific recommendations regarding colonoscopic surveillance in IBD. Many of the conclusions are similar to those contained in recent updates on this subject issued by the American Gastroenterological Association and the British Society of Gastroenterology and Association of Coloproctology for Great Britain and Ireland.

4.2 Efficacy of colonoscopic surveillance in IBD

Over the past three decades, the results of various colonoscopic surveillance programmes in ulcerative colitis (UC) have been reported. Although the details of these programmes have differed according to patient selection, endoscopic protocol and management strategies, the experience has generally been supportive. It has shown that CRC was averted or diagnosed at an early stage with improved prognosis in some patients, and that a majority were able to safely retain their colons. On the other hand, the development of advanced carcinoma was not always prevented, and in some series, the yield of neoplasia was so low that the value of the exercise was questioned.

No randomised study has ever been conducted to substantiate the efficacy or cost effectiveness of colonoscopic surveillance in patients with UC or Crohn’s disease (CD). However, various case-control studies provide indirect evidence supporting its efficacy in UC on the basis of improved cancer-related outcome. Specifically, these studies have shown surveillance in UC is associated with reduced overall death rates, improved cancer-related survival, and an earlier stage of cancer diagnosis. In addition, theoretical modeling analysis using a computer cohort simulation evaluating 17 different surveillance strategies predicted an improved life expectancy in patients undergoing surveillance. These combined data have resulted in qualified support for surveillance in UC by a Cochrane analysis.

Data concerning the value of colonoscopic surveillance in CD are extremely limited. One series from a private practice in New York studied patients with extensive Crohn’s colitis (affecting more than 30% of the large bowel) for more than eight years duration. Sixteen percent were diagnosed with neoplasia, half of which were detected at the time of initial screening investigation. A small case control study found a protective effect on CRC risk if a colonoscopic examination was conducted for cancer screening or surveillance purposes in Crohn’s colitis (odds ratio of 0.21, 95% C.I. 0.04-0.77; p=0.02).

<table>
<thead>
<tr>
<th>Evidence summary</th>
<th>Level of evidence</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indirect evidence supports colonoscopic surveillance in UC as a means to reduce cancer-related mortality in high risk patients.</td>
<td>III-2</td>
<td>1, 6, 8-10</td>
</tr>
</tbody>
</table>
Recommendation

Colonoscopic surveillance is recommended in high risk patients with ulcerative colitis (UC) to reduce cancer-related mortality.

Grade C

Good practice point:

- Although evidence for colonoscopic surveillance in Crohn’s disease is limited, experts recommend it be considered in at risk patients.

4.3 Clinical and endoscopic predictors of CRC in IBD

Reported estimates of overall CRC risk in UC vary substantially, with studies from tertiary referral centres generally reporting higher rates than population-based surveys. A meta-analysis of 116 international studies found an overall prevalence of CRC to be 3.7% in any patient with UC, increasing to 5.4% for those with pancolitis. The risk of CRC in CD has been less well studied, but overall seems similar to that in UC. Emerging evidence indicates that various disease-related factors significantly influence an individual’s risk for CRC in IBD.

4.3.1 Disease duration

Disease duration is recognised to be a risk factor for CRC in IBD. The development of cancer within 8-10 years of disease onset is unusual. A meta-analysis of 116 studies concluded that the risk of CRC in UC was 2% after 10 years, 8% after 20 years, and 18% after 30 years. An association between disease duration and CRC risk in CD is less clear. The development of CRC within eight years has been reported in up to 40% of some pathology series, though epidemiological studies have generally shown CD related CRC to be more common in patients with long disease duration.

4.3.2 Disease Extent

In both ulcerative colitis and Crohn’s disease, patients with more extensive disease are at increased risk of CRC. Disease extent is defined on the basis of macroscopic and histological changes at any time during a patient’s illness. In a combined British and Swedish study the relative risk for patients with total ulcerative colitis was 19.2, and for those with left-sided disease, a relative risk of 2.8 was reported. In a separate Swedish cohort study, the relative risk for patients with pancolitis, left-sided colitis, and proctitis was 14.8 (95% CI, 11.4-18.9), 2.8 (95% CI, 1.6-4.4) and 1.7 (95% CI, 0.8-3.2), respectively. In contrast, the CRC risk is not increased in UC patients with proctitis or procto-sigmoiditis or individuals with ileal or ileo-caecal CD.

4.3.3 Primary Sclerosing Cholangitis (PSC)

UC patients with co-existing PSC are especially at risk of developing colonic neoplasia. Dysplasia occurred in 45% of patients with both PSC and UC compared with 16% with UC only (p<0.002). The absolute cumulative risk of developing CRC with UC and PSC was 9%, 31% and 50% at 10 years, 20 years, and 25 years respectively. The comparative rates for CRC in patients with UC only were 2%, 5% and 10% (p<0.001). Data concerning CRC incidence in patients with CD and PSC are unknown.
4.3.4 Family History of Sporadic CRC

According to a registry-based follow-up series, a personal family history of CRC was associated with a
2.5-fold increased risk of CRC in patients with IBD (RR 2.5; 95% C.I. 1.4-4.4). Moreover, patients with
IBD who had a first-degree relative diagnosed with CRC before the age of 50 years had an even higher
risk of developing CRC themselves (RR 9.2; 95% CI, 3.7-23)\textsuperscript{24}.

4.3.5 Dysplasia

The most important predictive factor for the development of CRC in IBD is the presence of mucosal
dysplasia. Dysplasia is classified on the basis of its severity, and a progression from low grade to high
grade has been demonstrated in some (but not all cases) before malignancy ensues\textsuperscript{25}. The diagnosis and
classification of dysplasia is qualitative and subject to inter-observer variability. Preferably, its diagnosis
and grading should be confirmed by a second independent experienced gastrointestinal pathologist.\textsuperscript{26} The
Vienna classification is an internationally agreed standard which grades dysplasia in IBD based on the
severity of histological changes\textsuperscript{27}. Depending on its severity and gross appearance, dysplasia is associated
with a high risk of imminent or established colorectal cancer.

4.3.6 Severity of Endoscopic and Histologic Inflammation

Recent studies indicate that neoplastic transformation in IBD is related to the degree of mucosal
inflammation. A case-control study of 68 patients with UC showed that the degree of colonoscopic (OR
2.5; p<0.001) or histologic (OR 5.1; p<0.001) inflammation was associated with the development of
CRC\textsuperscript{28}. Importantly, this study also showed that colitic patients without evidence of inflammation did not
have an increased risk of developing CRC (OR 0.28; 95% C.I. 0.19-73)\textsuperscript{25}. Gupta reported that overall
inflammation score was positively associated with the development of high grade dysplasia and CRC but
not with low grade dysplasia\textsuperscript{29}. Other endoscopic indicators of past inflammation have been shown to be
associated with an increased CRC risk in UC, including colonic strictures, a shortened tubular colon and
the presence of post-inflammatory polyps\textsuperscript{30}.

In CD, clinical studies have consistently shown that CRC may develop in intestinal segments that have
been bypassed or complicated by strictures or fistulae. Patients with complicated anorectal disease are
particularly at risk of anorectal malignancy\textsuperscript{31}.

4.4 How is surveillance practised, and can it be improved?

In the past decade, two important developments have been applied to colonoscopic surveillance in IBD to
improve outcome. First, contemporary guidelines have incorporated clinical and endoscopic risk factors to
stratify the intensity of surveillance. Secondly, the use of improved endoscopic technology is increasingly
couraged to improve the diagnostic efficacy of colonoscopy.

Published guidelines concerning UC surveillance are generally reserved for patients with left sided or
extensive disease\textsuperscript{4,5,21}. Patients with inflammation confined to the rectum and/or sigmoid colon do not
require specific surveillance unless other risk factors for CRC co-exist\textsuperscript{20}. However, a proportion of
patients initially diagnosed with proctitis or distal colitis may develop more extensive disease over time,
and endoscopic re-assessment of disease extent is indicated in all patients with previously diagnosed
proctitis or proctosigmoiditis. If there is macroscopic or histological evidence of inflammation beyond the
sigmoid colon, colonoscopic surveillance is usually recommended.
### 4.4.1 Starting time for surveillance

Clinical experience, supported by various studies, shows that the development of CRC in IBD before ten years of disease duration is uncommon, except in individuals with PSC where malignant transformation of the colon may occur at an earlier stage. Most expert opinion and published guidelines have recommended that surveillance should commence 8–10 years after disease onset in patients with extensive UC or Crohn’s colitis, or at the time of diagnosis of PSC if it co-exists. For patients with left sided disease in whom the risk of cancer may be delayed, the recommended starting time for surveillance varies between 8–15 years after disease onset.

Until recently, these propositions had not been tested. A recent study from The Netherlands found that nearly one in five patients developed CRC in IBD earlier than recommended initiation of surveillance. Some of these patients were not known to have IBD at the time of cancer detection, some had left sided-colitis, others had PSC and a proportion had Crohn’s colitis. As a result, experts now advise that in patients with either PSC or a family history of CRC, surveillance be initiated as soon these historical co-factors are recognised, and in others, surveillance should be initiated eight years after the onset of symptoms.

<table>
<thead>
<tr>
<th>Evidence summary</th>
<th>Level of evidence</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>The risk of CRC in IBD is uncommon within eight years of disease onset except in those with co-existing PSC or a personal family history of CRC.</td>
<td>III-1</td>
<td>14, 22, 24, 32, 34</td>
</tr>
</tbody>
</table>

#### Recommendations

Patients with ulcerative colitis extending beyond the sigmoid colon and individuals with Crohn’s colitis that involves more than one-third of colon should commence surveillance no later than eight years after onset of symptoms.

Grade C

If Primary Sclerosing Cholangitis (PSC) is detected before this time, surveillance should commence at the time of its diagnosis.

Grade C

Patients with a strong personal family history of colorectal cancer (CRC) should start surveillance earlier.

Grade C

### 4.5 Optimal surveillance intervals

The ideal surveillance interval has not been tested, nor has the impact of co-existing risk factors ever been assessed. Early surveillance programmes included patients with extensive UC who were subjected to
biennial colonoscopy. In the St Mark’s series involving 600 patients with extensive UC who underwent 2627 colonoscopies at one to two yearly intervals during 5932 patient years of follow-up, 30 cancers developed of which 16 were “interval” cases. Itzkowitz and Harpaz (2004) suggested that surveillance should be conducted annually or biennially provided no dysplasia is found or suspected. Recommendations by the Crohn’s and Colitis Foundation of America (CCFA) state that surveillance intervals depend on initial biopsy findings. If the initial colonoscopy is negative for dysplasia, repeat colonoscopy should be performed every one to two years. After two negative colonoscopies further colonoscopies may be performed every one to three years until IBD has been present for 20 years, at which point surveillance colonoscopies should be repeated every one to two years. In contrast, patients found to have dysplasia on screening or surveillance colonoscopy require colectomy or more aggressive surveillance. Patients with co-existing PSC and IBD require annual surveillance colonoscopies. Although the impact of a family history of CRC on surveillance intervals in IBD has not been evaluated, both American and British guidelines recommend more frequent surveillance when this risk factor is present. The need to intensify surveillance after 20 years has been disputed by the results of the St Mark’s series, which showed a constant cancer incidence for up to 40 years of colitis duration and included a relatively large number of patients.

**Good practice points:**

- **A.** Annual colonoscopic surveillance is recommended for patients with ulcerative colitis extending proximal to the sigmoid colon or patients with Crohn’s colitis affecting more than one third of the colon and with one or more of the following risk factors:
  - active disease
  - Primary sclerosing cholangitis
  - Family history of colorectal cancer in first degree relative < 50 years old
  - colonic stricture, patients with multiple inflammatory polyps or shortened colon
  - previous dysplasia
- **B.** Three yearly colonoscopy is recommended for patients with:
  - inactive ulcerative colitis extending proximal to the sigmoid colon without any of the above risk factors
  - patients with Crohn’s colitis affecting more than one third of the colon without any of the above risk factors
  - IBD patients with a family history of colorectal cancer in a first degree relative > 50 years old
- **C.** Five yearly colonoscopy recommended for patients in whom two previous colonoscopies that were macroscopically and histologically normal.
4.6 Optimal colonoscopic protocol

In the past, most cases of dysplasia were thought to be invisible to standard diagnostic instruments, and its detection required extensive mucosal sampling from flat mucosa in each colonic segment, or as targeted biopsies from elevated suspicious lesions. International guidelines have recommended that at least two to four random biopsies should be taken from each colonic segment in order to diagnose dysplasia if it is present. However, clinical evidence shows that random colonic sampling may not necessarily facilitate the detection of all cases of invisible dysplasia. It has been estimated that 64 mucosal biopsies are required to ensure a 95% chance of detecting the highest degree of histological abnormality, but even this approach samples only a very small proportion of total colonic surface, and foci of dysplasia can possibly still escape detection.

During the last decade, studies have shown that most dysplasia in ulcerative colitis is actually visible at colonoscopy, even when standard endoscopic instruments are used. Reports from St Mark’s Hospital, Chicago and Pennsylvania have shown that the proportion of dysplastic lesions that are macroscopically visible to an endoscopist were 77.3%, 58.5%, and 87.9% respectively. When new endoscopic techniques such as chromoendoscopy, endomicroscopy, narrow band imaging or autofluorescence imaging are used, the recognition of dysplastic lesions is increased.

Data from expert centres indicate that the diagnostic yield of detecting dysplasia is greatly enhanced if targeted biopsies were obtained from visible lesions using chromoendoscopy. In a study of 100 patients with chronic extensive ulcerative colitis undergoing cancer surveillance, dysplasia was detected in 0 from 2904 random biopsies and 9 from 157 targeted biopsies. These data have prompted many experts to advocate the use of chromoendoscopy and mucosal sampling of visibly abnormal mucosa as standard practice in IBD surveillance, rather than rely on random mucosal biopsies to detect dysplasia. Other authors believe it is premature to abandon the role of random biopsies entirely until longer follow-up data are available on using chromoendoscopy. There are important practical limitations of chromoendoscopy that limit its sensitivity. The presence of mucosal inflammation or multiple pseudopolyps may affect the interpretation of chromoendoscopy, and in these circumstances, the need for random surveillance biopsies is still justified. Chromoendoscopy requires specific equipment, training and expertise that are not available at every centre. Alternatively, standard white light colonoscopy remains an acceptable and satisfactory means to conduct IBD surveillance provided the colonic mucosa is carefully inspected, and biopsies obtained from each colonic segment or suspicious lesion.

<table>
<thead>
<tr>
<th>Evidence summary</th>
<th>Level of evidence</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>The use of chromoendoscopy enhances the detection of dysplasia in UC patients.</td>
<td>III-2</td>
<td>39, 42, 45</td>
</tr>
<tr>
<td>The detection of dysplasia using standard white light endoscopy requires targeted biopsies to be taken from visibly abnormal sites and at least two to four random biopsies from flat mucosa in each colonic segment.</td>
<td>IV</td>
<td>39-41</td>
</tr>
</tbody>
</table>
**Recommendations**

If available, the use of chromendoscopy/dye spraying where targeted biopsies are obtained from visibly abnormal lesions or strictures is the preferred means to conduct colonoscopic surveillance in IBD. This is especially true for patients at high risk of colorectal cancer.

Grade C

If chromoendoscopy is unavailable, or if an endoscopist lacks sufficient expertise with this technique, or if the presence of inflammation interferes with the interpretation of chromoendoscopy, an acceptable alternative practice is using standard white light endoscopy with random non-targeted biopsies from each colonic segment and from raised lesions.

Grade D

**Good practice point:**

- When chromoendoscopy is used, random biopsies are required from each colonic segment to establish histological extent and severity of disease. More intensive mucosal sampling from each colonic segment is indicated in patients with a suspicious visible lesion or in situations where chromoendoscopic interpretation is compromised by factors such as active inflammation, inflammatory polyps or poor bowel preparation.

### 4.7 Surveillance protocol practised in Crohn’s disease, indeterminate colitis and patients with ileo-anal pouches?

On the basis of equivalent CRC risk, current guidelines recommend the same endoscopic protocol in Crohn’s colitis as in ulcerative colitis. Patients with more than one third of the colon affected by inflammation, as well as those with complicated ano-rectal disease, colonic strictures or post inflammatory polyps, may be considered for surveillance. The recommended starting times and ongoing frequency of colonoscopic surveillance are generally similar to UC, even though these proposals are not supported by evidence. The CRC risk in patients with indeterminate colitis is similar to that of ulcerative colitis. Although guidelines have not generally specified surveillance recommendations in this group, the same level of investigation is appropriate as in UC. Individuals who have previously undergone restorative proctocolectomy and ileal pouch anal anastomosis for UC may rarely develop neoplasia in the pouch or anal transition zone. Risk factors include a past history of colorectal neoplasia and PSC. There is no evidence that surveillance is preventative, though guidelines state that it is reasonable to perform an endoscopic examination and biopsy every five years.

<table>
<thead>
<tr>
<th>Evidence summary</th>
<th>Level of evidence</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimal levels of surveillance in Crohn’s disease, indeterminate colitis or ileo-anal pouches have not been defined.</td>
<td>IV</td>
<td>31,46</td>
</tr>
</tbody>
</table>
Recommendations

Based on cancer risk, experts recommend that similar colonoscopic surveillance be undertaken for Crohn’s colitis as in ulcerative colitis of equivalent extent, even though supporting evidence is sparse.

Grade D

Specific areas where surveillance is required in Crohn’s disease are patients with colonic strictures or complicated anorectal disease.

Grade D

4.8 Management of dysplasia

The management of dysplasia depends on its grade and whether it exists as a macroscopically raised lesion or in flat mucosa.

4.8.1 Elevated dysplastic lesions

Historically, elevated lesions containing dysplasia in IBD were referred to as DALM’s (dysplasia associated lesion or mass). These lesions are highly significant because they are often associated with established or imminent cancer. However, not all elevated dysplastic lesions in IBD are necessarily DALM’s. Raised lesions containing dysplasia in non-inflamed areas are sporadic adenomas that can be managed endoscopically in the same way as in the non-colitis population. Raised lesions containing dysplasia in an area of inflammation may be a sporadic adenoma or dysplastic mass lesion associated with colitis. In the former case, dysplasia is not present elsewhere in the colon. Endoscopically, it can be difficult to distinguish in an inflamed segment a DALM from a sporadic adenoma, or indeed an inflammatory polyp. In practice, all suspicious elevated lesions should be biopsied and if possible removed, and multiple biopsies obtained from flat mucosa in adjacent mucosa and from the other colonic segments. As long as the lesion is entirely removed endoscopically and there is no dysplasia elsewhere in the colon, surgery is not necessarily indicated though close surveillance must be maintained in future. Conversely, if dysplasia is detected elsewhere in the colon, or if the endoscopist is not confident the entire lesion has been removed, surgical intervention is strongly recommended.

<table>
<thead>
<tr>
<th>Evidence summary</th>
<th>Level of evidence</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long-term follow up data are reassuring that localised dysplastic lesions in IBD can be treated effectively endoscopically.</td>
<td>IV</td>
<td>49, 52</td>
</tr>
</tbody>
</table>
Recommendations

Raised lesions containing dysplasia may be treated endoscopically provided the entire lesion is removed and there is no dysplasia in flat mucosa elsewhere in the colon.

Grade D

If a raised dysplastic lesion cannot be completely removed, or if there is dysplasia elsewhere in the colon, surgical intervention is strongly recommended.

Grade D

4.8.2 High grade dysplasia in flat mucosa

If high grade dysplasia (HGD) is diagnosed in flat mucosa and confirmed by a separate pathologist, surgery is usually required. According to a review of 10 dysplasia studies, a finding of high grade dysplasia was accompanied by actual cancer in 42%, and in the rest who underwent surgery, definite dysplasia was usually detected in colectomy specimens. Experience from the 30 year St Mark’s Hospital surveillance programme found that 19/600 (3.2%) developed HGD. Of these, 11 underwent immediate colectomy and five (45%) had cancer in the operative specimen. Eight patients refused immediate surgery, of whom two subsequently developed CRC. In total, 37% of all patients with HGD eventually developed CRC.

Evidence summary

| The predictive value of HGD for imminent or established cancer is high. | II | 35, 53 |

Recommendation

High grade dysplasia in flat mucosa is a strong risk factor for established or imminent carcinoma, and colectomy is usually recommended.

Grade B

4.8.2 Low grade dysplasia in flat mucosa

The significance of low grade dysplasia (LGD) in flat mucosa is controversial. Data from tertiary referral centres have generally shown it is associated with progression to high grade dysplasia or cancer. Of 47 patients who were diagnosed with LGD at St Mark’s Hospital, 20% eventually developed CRC and 39% developed either HGD or cancer. At Mount Sinai Hospital, the rate of progression to higher grades of neoplasia was 53% at five years. These results contrast with other data which show progression from LGD to advanced neoplasia is slow, and is not invariable. A meta-analysis of 20 surveillance studies involving 508 cases of low grade dysplasia in flat mucosa or dysplastic mass lesions found the cancer...
incidence to be 14 per 1000 person years duration, and the incidence of any advanced lesion was 30 per 1000 person years duration. The positive predictive value of LGD for concurrent cancer was 25% and for progression to cancer was 8% \cite{58}.

Because of the uncertainty about the predictive value of LGD in flat mucosa, it is recommended that surgery be considered if it is multifocal. However, patients with LGD in flat mucosa who wish to avoid an operation require repeat colonoscopy at three to six months, preferably with chromoendoscopy, and thereafter at yearly intervals. A finding of unifocal low grade dysplasia in flat mucosa is less likely to be associated with imminent cancer, and follow-up colonoscopy is reasonable within six months in these cases.

### Evidence summary

| The predictive value of low grade dysplasia in flat mucosa for future cancer is controversial, but probably higher if it is located in multiple synchronous sites. | III-2 | 35, 54-58 |

### Recommendations

Multifocal low grade dysplasia is associated with a sufficiently high risk of future cancer that colectomy is usually recommended. Patients who elect to avoid surgery require follow up surveillance at three months, preferably with chromoscopy, and if this examination is normal, annually.

Grade C

Unifocal low grade dysplasia may be followed by ongoing surveillance at six months, and if this examination is normal, annually.

Grade C

### 4.8.3 Indefinite dysplasia in flat mucosa

If Indefinite dysplasia (ID) is diagnosed, the rate of progression to a higher grade of dysplasia or carcinoma is unusual. At St Mark’s Hospital, 1/23 patients with ID (4%) eventually developed carcinoma and five (22%) developed LGD after nine years follow-up \cite{35}. In contrast, data from New York showed that the five year rate of progression from indefinite dysplasia to HGD or cancer was 9% \cite{59}. If a biopsy is diagnosed as indefinite for dysplasia by two gastrointestinal pathologists, follow-up surveillance colonoscopy, preferably with chromoendoscopy, at six months is reasonable, and thereafter at annual intervals.

| The predictive value of indefinite dysplasia in flat mucosa for imminent cancer is low. | II | 35, 59 |
**Recommendation**

Indefinite dysplasia in flat mucosa does not require surgery, but follow-up colonoscopic surveillance is justified, preferably with chromoendoscopy, at more frequent intervals.

Grade B

### 4.9 Issues requiring more clinical research study:

- Is colonoscopic surveillance in Crohn’s disease using dysplasia as a marker of malignancy justified?

- Are multiple random mucosal biopsies still necessary if chromoendoscopy is used as a tool for colonoscopic surveillance in UC?

- What is the most appropriate time interval for surveillance in IBD patients with a family history of CRC but no other risk factor?

- What is the role of flexible sigmoidoscopy in cancer surveillance for IBD?
References


5 PSYCHOSOCIAL ASPECTS OF SURVEILLANCE COLONOSCOPY AFTER: COLORECTAL CANCER, POLYPS AND INFLAMMATORY BOWEL DISEASE

5.1 Introduction

These guidelines provide recommendations for the surveillance of patients who are included in one of these three clinical groups. Each patient will require some element of surveillance activity over time. The guideline recommendations are designed to underwrite evidence based quality care for each individual.

Patients should be assured of access to appropriate clinicians and facilities during their follow-up. It is suggested that entry to surveillance be facilitated by appropriate instruction from a Multidisciplinary Clinic, together with encouragement to liaise with the Clinic, GP or specialist as required, throughout their ongoing clinical course.1

It is expected that each clinician will be thoroughly aware of their responsibilities to their patient and the patient aware that a measure of compliance is expected from their side, their cooperation will be purposefully encouraged.

Patients will usually be made aware that there will be a distinct effort to oversee the milestones they will be expected to meet when under surveillance; on occasions the recommendations may require endoscopic investigation which will, on most occasions, be colonoscopy. Almost all patients will have experienced colonoscopy at the commencement of their clinical journey, its further acceptance may be expected to be straightforward. However, some patients remain concerned at the possibility of repeated colonic studies and a very small percentage will continue to have concern before each colonoscopic investigation.2

5.2 Community attitude towards colonoscopy

Colonoscopy is no longer a hidden or mysterious “medical thing”. The colonoscope is a widely used diagnostic instrument and unfortunately, has many disparaging references in the vernacular. Nevertheless, many patients are fearful or anxious of possible pain, discomfort or being hurt during the procedure.3 Patients may be averse to gastrointestinal endoscopy which is seen as invasive and possibly embarrassing over and above being discomforting.4 Information on the subject of colonoscopy is readily available on Google and Wikipedia. It has been referenced in the daily press, more frequently now as patients have been recalled in the National Bowel Screening Program.

Recently a US financier/philanthropist was in Melbourne to promote a more positive attitude to men’s cancers. The newspaper report noted “he also joked that the most relaxing day in his life, when there are no interruptions from calls or emails is a ‘colonoscopy day’!” “But, it is not so relaxing the day before”, Mr Miliken said (Richard Gluyas, Financier floats melanoma mission p6 The Australian, October 26 2010).5

While most Australians are fairly accepting of colonoscopy, not all are as relaxed as suggested in this report. It is expected that patients in the categories described in the guidelines will require colonoscopy at some time; however, it is not likely that all will accept it with equanimity. The acceptance level of 80% of patients undergoing repeat colonoscopy in the well recognised National Polyp Study6 would appear to be indicative of some element of resistance, anticipation anxiety or distrust of the procedure.

It would appear that while some element of anxiety is not uncommon, as might be expected before colonoscopy, it is more entrenched in some candidates for the procedure than it is for others.2
5.3 Colonoscopy and anxiety

The literature on colonoscopy is very extensive, only a very small percentage addresses the association of anxiety. Clearly patients in the categories addressed in the recommendations will be drawn from all aspects of society.

Low socioeconomic status (SES) is colloquially believed to be associated with discomfort in relation to medical investigations. One study identified sigmoidoscopy screening for colorectal cancer as a potential stressor. The UK Flexible Sigmoidoscopy (FS) Trial was regarded as an appropriate vehicle to test this view. A subgroup of patients (n=3,535) from the trial were assessed regarding psychosocial wellbeing by pre and post screening questionnaires. All participants in this trial (n=29,804) were sent a questionnaire three months after FS that included measures of distress, anxiety and a single item questionnaire of bowel cancer worry. SES status was coded from the Townsend Index. Worry about bowel cancer and anxiety were higher before screening in low SES patients. After screening there were reductions in the factors studied but no differences due to SES were involved in the change. Lower SES patients did not show greater adverse reactivity to FS examination than that demonstrated in higher SES participants. A key factor observed is that those with reduced education and economic resources are not necessarily more adversely affected by moderately stressful experiences.

5.4 Anxiety level before and during colonoscopy

A cross sectional study was performed to examine a possible relationship between state anxiety and trait anxiety in endoscopy in an outpatient setting (Definitions: Trait Anxiety: indicates the tendency to experience anxiety, it is considered to be a characteristic of personality that endures over time. State Anxiety: is a temporary uncomfortable experience that occurs when a person feels threatened by a situation). In effect Trait Anxiety is the potential, or tendency to experience State Anxiety. These forms of anxiety can be measured by Charles Spielberger’s State-Trait Inventory for Adults. “The use of this inventory clearly differentiates between the temporary condition of “state anxiety” and more general long-standing “trait anxiety”.” Patient response was rated at initial consultation and immediately prior to endoscopy, measured by Spielberger State-Trait Anxiety Inventory. A distinct increase in state anxiety was observed before endoscopy (upper gastrointestinal and colonoscopy), but no change was observed in trait anxiety. Females had higher anxiety levels. Overall, anxiety levels were not related to type of endoscopic procedure.

An Australian study which recognised anxiety as being common in patients undergoing invasive medical procedures, assessed the relationship between coping style of patients, precolonoscopy information, anxiety and pain associated with colonoscopy. Coping style was established and patients codified as either information seekers or information avoiders. Provision of congruent information in line with coping style was observed to reduce anxiety and ameliorate the patient’s experience of the procedure. There was, however, no effect on dose of sedation or perception of pain.

A questionnaire based study reviewed the procedural experience of patients undergoing endoscopy. Fifty five (55) consecutive patients undergoing colonoscopy had a three point evaluation of the procedural experience, one week prior to the investigation. They were assessed as to their understanding and their concerns regarding colonoscopy were recorded and rated. The second assessment occurred while awaiting commencement of the procedure and assessed preparation and fasting. The third and final questionnaire was completed 24 to 72 hours after the procedure and after recovery from sedation; it repeated the preprocedural questionnaire and addressed comfort and social disruption due to the colonoscopy. This study was also ranked. It was observed that concerns specific to colonoscopy, including anticipation of pain, had impact on acceptance of colonoscopy. This is not improved by experience of the investigation, even if procedural anxiety and pain are reduced. Taking note of the patients’ preprocedural views of the investigation should be actively addressed to improve participation in colonoscopy.
While colonoscopy is most frequently performed on adults, it may be used in the diagnostic evaluation of children with colonic disease. Teenagers with inflammatory bowel disease (IBD) will usually require surveillance colonoscopy from time to time.

A study designed to compare children aged 10-18 years with IBD or functional gastrointestinal disease (FGID) undergoing their first colonoscopy and record the levels of pain or anxiety that they experienced. These levels were assessed by means of a questionnaire recorded immediately before the procedure and through a second questionnaire 48 hours later. While no differences in anxiety were reported, it was noted that higher levels of anxiety accompanied by higher pain scores were experienced by children with IBD at the time of colonoscopy. Children with FGID observe common pain symptoms during colonoscopy and may describe more post colonoscopic pain than those with IBD. It was concluded that anxiety is associated with severity of pain after colonoscopy in children with IBD, while not observed to be a factor in children with FGID.

5.5 Compliance with surveillance colonoscopy

All patients being addressed in the recommendations of these guidelines will have a surveillance programme recommended. Not all will approach surveillance requiring colonoscopy with equanimity, even though they will almost certainly have had a previous colonoscopy.

In a cross sectional study, medical records of patients undergoing excision of colonic polyps in 1997 were reviewed. Patients were excluded from selection using the same criteria used in the National Polyp Study, 333 patients remained for review. Follow up was conducted by telephone interview. Recommendation for follow up was observed in 331 patient records. Compliance status was determined in 211 patients who had been advised to follow up in three years and all followed up at three years or longer. Where follow up colonoscopy could be determined, compliance was 85%. The 15% of patients who were non compliant had various reasons; “no time” 37.5%, there were 19% who stated “they did not know that they needed follow up”, 13% “forgot” that they had had a polyp excised and 19% were not following with colonoscopy because of a “bad” experience. Univariate analysis revealed that patients were more compliant if they had a previous colonoscopy or more than one polyp excised. The authors considered their institution to have established adequacy of follow up colonoscopy. They opine that the impact on colorectal cancer estimated in the National Polyp Study is achievable and endorse continual improvement in colorectal cancer awareness and promotion of compliance in the general public as an imperative.

5.6 Amelioration of anxiety in relation to colonoscopy

State anxiety is moderately increased in patients undergoing outpatient diagnostic endoscopy. This increase is not significantly influenced by age, sex, type of procedure or source of referral. The ability of the endoscopist to estimate patient anxiety is generally poor. It is suggested that this is because the increase in state anxiety is usually at a mild level.

An RCT explored the view that information provided before interventional clinical procedures should improve knowledge of the procedure and reduce anxiety related to it. The study involved approaching patients a week before colonoscopy, providing an information leaflet on the subject and having them complete a Speilberger State Anxiety Inventory (STAI). Patients were randomly assigned to view or not view an information video before colonoscopy, when all patients completed a second STAI and knowledge test. The study involved 150 patients; 72 video watchers and 78 non video watchers. The groups were generally similar in relation to age, sex, socioeconomic status and initial anxiety score although female patients had higher baseline STAI than those with previous experience. Patients who watched the video were less anxious and achieved a higher score on the knowledge questionnaire than those who did not. Understanding the purpose, procedural details and potential complications of colonoscopy better prepared patients for the procedure. This study is supported in a commentary as a better way to convey information about colonoscopy. It is
suggested that the technique may be cost-effective in reducing cost of sedation and post operative recovery time.

A randomised study of 201 patients undergoing colonoscopy randomised into three groups, video plus discussion, video alone or discussion only. All patients answered a thirteen item test of knowledge and all underwent State-Trait Anxiety Inventory. Those patients who were exposed to the video had statistically significant better scores (p<.001) than patients involved only with discussion, but no difference was observed between the video groups. It was concluded that understanding of colonoscopy and its risks and benefits did not increase anxiety. It was considered that the overall approach may save time for the clinician and provide opportunity for more personalised discussion and reassurance of the patient.

Another randomised study included an information video in the pre-procedural activity, control patients did not view the video. Situational anxiety was measured using the State-Trait Anxiety Inventory (STAI) questionnaire. Patient satisfaction was rated, as was their experience with pain. The colonoscopist and endoscopy nurse were blinded as to which stream a patient had entered and had completed a questionnaire as to medication employed, outcome of procedure, its level of tolerance and level of pain experienced. It was reported that midazolam dosage was the same in all patients, but that those who viewed the video used higher doses of fentanyl (p <0.2). Women found the experience to be more painful (p=0.001) and expressed less satisfaction with the procedure. It was observed that there was no impact on tolerability or anxiety among video observers, but it was suggested that gender differences warranted adjustment of information and medication associated with the procedure.

<table>
<thead>
<tr>
<th>Evidence summary:</th>
<th>Level of evidence</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colonoscopy is generally accepted as a useful and non-threatening procedure. It is still, however, regarded with some suspicion and promotes anxiety in a body of people undergoing the procedure.</td>
<td>III-3</td>
<td>8,12</td>
</tr>
<tr>
<td>Patients with reduced educational and economic resources are not more adversely affected than those with greater resources by moderately stressful experiences.</td>
<td>III-3</td>
<td>7</td>
</tr>
<tr>
<td>Patients’ pre-procedural view of colonoscopy needs to be actively addressed to improve participation in colonoscopy.</td>
<td>III-3</td>
<td>15, 12</td>
</tr>
<tr>
<td>Previous colonoscopy reduces patient anxiety when the procedure is to be repeated and increases rate of compliance.</td>
<td>II</td>
<td>15, 20, 21</td>
</tr>
<tr>
<td>Provision of congruent information in line with coping style has been observed to ameliorate patient’s experience of the procedure.</td>
<td>II</td>
<td>7</td>
</tr>
<tr>
<td>Patients provided with a preoperative video on colonoscopy were less anxious than those not shown a video.</td>
<td>II</td>
<td>16, 19, 18</td>
</tr>
<tr>
<td>Understanding the purpose, procedural details and potential complications of colonoscopy can better prepare patients for the procedure.</td>
<td>II</td>
<td>16</td>
</tr>
</tbody>
</table>
Recommendation

Pre-colonoscopic advice to patients by means of educational material, video and clinical explanation can assist in improving patient experience with the procedure and in reducing anxiety.

Grade C

5.7 Music as an aid to improving comfort of colonoscopy

A single blind RCT was used to assess the efficacy of music for patients undergoing colonoscopy. In this study, 109 patients were randomised and fitted with mute or music delivery headphones. Clinicians were blinded to the trial and sedation was provided if requested. Primary outcome was the measurement of pain and secondary endpoints were recorded as need for sedation, patient satisfaction and willingness to repeat the procedure. Those wearing music headphones recorded statistically significant pain reduction and in patients requiring sedation. Clinicians perceived less difficulty and multivariate analysis confirmed significant beneficial effect of music. The introduction of music during colonoscopy significantly reduces discomfort.

A meta-analysis of RCTs on the effect of music on patients undergoing colonoscopy, included procedure time, dose of sedation, pain scores and willingness to repeat the procedure in the future. Eight studies met the criteria and observed that patients overall experience was statistically significantly improved when music was used during the procedure. There was significant difference in pain scores, sedation levels, procedure time and willingness to repeat the procedure. Music was stated to “improve patients overall experience with colonoscopy”.

In another randomised study in a US Veterans GI Diagnostic facility, 198 patients were randomised, 98 comprised a control group, having either 25 minutes of quiet time before endoscopy and the study group (100) had music selected by the investigators, who were nurses, for 25 minutes before having endoscopy. All were evaluated by the State Trait Anxiety Inventory. Both groups reduced the anxiety scores, but after controlling for trait anxiety there was a statistically different outcome between the groups, with those listening to music having a greater reduction in anxiety. It is suggested that music, a non-invasive nursing intervention may reduce anxiety if provided prior to gastrointestinal investigative procedures.

<table>
<thead>
<tr>
<th>Evidence summary:</th>
<th>Level of evidence</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Music played to patients before and during colonoscopy improves their comfort during their experience and improves willingness to repeat the procedure.</td>
<td>I, II</td>
<td>23, 22, 24</td>
</tr>
</tbody>
</table>

Recommendation

Music provided to patients during colonoscopy may reduce their discomfort.

Grade C
5.8 Patient comfort and colonoscopy

The pre-colonoscopic preparation of patients assists in lowering anxiety levels and promoting better tolerance of colonoscopy itself\(^2,7,18,12,16,19,22,23,24\).

Sedation or analgesia is important in maintaining patient comfort, however, sedation and monitoring practice across the world is significantly variable. A study in 21 centres in 11 countries was carried out, using a standard questionnaire for each patient.\(^25\) There were 6,004 patients undergoing colonoscopy in the study, 53% received conscious/moderate sedation, 30% deep sedation while 17% received no sedation. Most commonly used agents for sedation were midazolam 47%, opioids 33%, an anaesthetist was present in 85% of colonoscopies when deep sedation was involved.

An Australian study of anaesthetists practice\(^26\) also failed to reveal a standard practice profile in this country. In this study the choice of drugs was quite wide, but propofol was used by all but one respondent, (the study sent 200 surveys to Fellows of Australian and New Zealand College of Anaesthetists – 113, 57% responded), however, only 4% used propofol exclusively. Patients undergoing colonoscopy were more likely to receive propofol/midazolam/fentanyl (\(p<0.001\)). Pulse oximetry is used in all patients in Australia for deep sedation and an anaesthetist is required to be present during the procedure. This practice of anaesthetist oversight is not necessarily practiced overseas.\(^25\)

Most studies on patient satisfaction do not address individual patient satisfaction with sedation directly, but rather satisfaction with the overall procedure.\(^20,21\) A prospective cohort study\(^20\) reports 86.6% satisfaction and a literature review,\(^21\) which reports 95% early satisfaction with colonoscopy and 73-100% of patients willing to return for repeat testing under the same conditions are seen as indicative of acceptance of the procedure. An RCT Phase III study of propofol strongly supports the agent for sedation in colonoscopy.\(^27\) A Cochrane Review\(^28\) supports propofol administration for sedation in colonoscopy for generally healthy individuals and observes that it can shorten recovery discharge times, lead to earlier discharge, meet patient satisfaction and have no increase in side-effects when compared to traditional sedatives, opioids and benzodiazepam. The review suggests that more standardised studies are needed to compare propofol sedation and its administration by anaesthetists or non-anaesthetists. A retrospective survey\(^29\) encourages less highly specialised staff for monitoring sedated patients.

5.9 Elements of clinical care available for patients undergoing colonoscopy

Carefully judged doses of sedation with appropriate monitoring of vital signs and quality technical performance of colonoscopy\(^30\), provides for a most satisfactory outcome for patients undergoing endoscopy. There are a range of other aids, coping, education and videotapes etc\(^1\), however, overall carefully controlled sedation provides patient comfort, satisfaction and successful outcome.\(^28,26,3\)
Colonoscopy rates high levels of satisfaction among patients.  

<table>
<thead>
<tr>
<th>Evidence summary:</th>
<th>Level of evidence</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controversy continues with regard to choice of drugs for sedation and monitoring patients during colonoscopy.</td>
<td>IV</td>
<td>25, 26</td>
</tr>
</tbody>
</table>

**Recommendation**

An RCT to study variations in the use of available sedative drugs and patient monitoring when sedated during colonoscopy, may allow development of an Australian Standard Practice profile.

Grade C

**Conclusions**

Sedation for colonoscopy is widely practiced and while a number of drugs are available to assist patient comfort, some services do not choose to use them and there is controversy regarding risks and benefits of available drugs and appropriate monitoring during sedation.

While clinicians appear to be fully cognisant of the relative safety of the drugs and monitoring systems they follow, controversies remain and a well designed and conducted RCT would appear necessary to find whether these variations have an effect on outcomes following colonoscopy.

**References**


6 SOCIO-ECONOMIC FACTORS
ASPECTS THAT MAY IMPACT ON SURVEILLANCE COLONOSCOPY FOLLOWING:
I. adenoma follow-up,
II. curative resection of colorectal cancer, and for
III. cancer surveillance in inflammatory bowel disease

6.1 Introduction
Social and economic circumstances are recognised determinants of access to health care.1-3 Those
who are less affluent or socially deprived have shorter lives, during which they suffer more illness
than those who are more economically favoured.1, 4, 5 However, economic affluence does not preclude
ignorance, which of itself can require special management measures in attempting to assure
appropriate outcomes.

In preparing clinical management guidelines and recommendations, it is appropriate to consider a
range of factors that may impact on patients during their ongoing care.1, 6

Whilst economic factors are of significance, there are other individual features that, while impacting
on economics, are of themselves of clinical and management importance. Income, education, literacy,
occupation or employment, level of interest, place of residence or ethnicity may individually or
collectively produce a state of deprivation that can affect patient risk factors and possibly affect access
to or compliance with health care services, as well as outcomes of care.1, 2, 3, 5, 7-13 The National Health
and Medical Research Council has recognised these factors in its Handbook, “Using Socioeconomic
evidence in clinical practice guidelines”.1

6.2 Socioeconomic factors and surveillance after i, ii and iii
impact on these guidelines
Patients in the three groups who are the subject of these surveillance based guidelines are in a position
where they will have already (i and ii) received treatment for their underlying condition or (iii) have
had a firm diagnosis of their disease. Clearly, all three groups will have accessed the health system
and have undergone appropriate treatment or assessment.

For the patients involved in these groups, any barriers to health system access and provision of
appropriate care have presumably been addressed in the course of initial management, so allowing
them to complete their primary treatment. Surveillance in these patients will in large part be fulfilled
by following the recommendations in the guidelines. Patients of low economic status and/or
derprivation would it is expected, have been identified as they were managed through the clinical and
social resources of a multidisciplinary clinic and be assured of best care available in the Australian
universal health care system (Medicare).

6.3 What impact is made by socioeconomic factors in the
three treatment groups undergoing surveillance
colonoscopy?

i. SES post curative resection of colorectal cancer
There is significant literature in relation to SES and cancer survival after treatment for colorectal
cancer,5, 6, 7, 10, 11, 14-18 Patients with lower SES have been consistently reported to have shorter survival
than those with higher SES.7, 8
The determination of SES has been based on a range of criteria including census, occupational,
domiciliary and education data.7, 8, 9
It has, however, been observed in a cohort study that, for patients undergoing consistent type and quality of treatment by the same clinical teams, there is no demonstrable relationship between SES and survival from colorectal cancer\textsuperscript{19}. An RCT\textsuperscript{20} also noted that given equal treatment, colorectal cancer outcomes do not appear to depend on SES in England and Wales, the authors suggesting that health system factors may play a part. A cohort study of white and African Americans with advanced lung and colon cancer and who had not had previous chemotherapy, had their socioeconomic and biological data collected prospectively in twelve medical centres in the US Veterans Administration System (May 1981–May 1986).\textsuperscript{21} The essential findings of the study were that lung and colon cancer outcomes ‘may be similar among black and white patients who have equal access to comparable medical care in spite of socioeconomic differences’. This study puts equal access to care as a necessary accompaniment to good clinical care.\textsuperscript{6,21} Disparities in treatment and low SES were seen in a case-only study to be a major factor in the explanation of decreased survival of African-Americans.\textsuperscript{22}

These observations which target both lower SES and deprivation as factors in poorer survival after resection of colorectal cancer, found that if the total of factors that surround treatment are equal in all respects, results are similar. Further research remains to be done, but it seems that if practitioners assist their patients to access best care, they could promote more equality of outcomes. These are special studies and have not yet necessarily been accepted. It has been observed in the UK that although the NHS cancer plan has been implemented, there remains a strong influence of social factors with regard to hospital admission and provision of care.\textsuperscript{13}

The literature searched has not in general provided significant staging, operative or surveillance information. The areas addressed have related to primary treatment and mortality or survival.

In a retrospective review of a health maintenance group’s enrollees who were diagnosed with colorectal cancer between 1993 and 1999, analysis of patients was restricted to those expected to benefit from surveillance for cancer (stages 0, I, II, III AJCC), stage IV was excluded.\textsuperscript{21} Follow up times were found to be variable, survival analysis was used to estimate the cumulative proportion undergoing surveillance, comparison between groups were based on the log rank test.\textsuperscript{24,25,26} Higher SES and being married were associated with greater utilization. Patients over 80 and those with rectal cancer were less likely to undergo surveillance. There was substantial variation of colonic surveillance examination with clinical socio-demographic factors influencing the likelihood of surveillance.

A qualitative study in the French literature\textsuperscript{27} evaluated the motivations of people having, or indeed, not having follow up following a positive result after colorectal screening. Following semi-directed interviews it was reported that the doctor-patient relationship had a strong influence on acceptance of colonoscopy. It was also necessary to persuade doctors that colonoscopy and not FOBT was the National Standard.

The frequency of colonoscopy will need to be discussed with all patients, but more specific attention will need to be directed to socio-economically deprived patients. They will benefit by being encouraged to comply with recommendations of the guidelines.
There is a body of literature consistently reporting lower cancer survival in patients with low SES.

<table>
<thead>
<tr>
<th>Evidence summary</th>
<th>Level of evidence</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>There is a body of literature consistently reporting lower cancer survival in patients with low SES.</td>
<td>III-3, IV</td>
<td>5,10,12,13,14, 15,16,17,18</td>
</tr>
<tr>
<td>Lower survival rates associated with disparities in care can be improved by eliminating disparities in the management of colorectal cancer.</td>
<td>II, III-3, IV</td>
<td>19,20,21, 22</td>
</tr>
</tbody>
</table>

Recommendation

Clinicians may assist in improving survival outcomes in curative resection for colorectal cancer by expediting access to optimal clinical care.

Grade B

ii. Surveillance after colonic polypectomy

No studies on post-colonic polypectomy addressed socioeconomic matters. A retrospective review of medical records of patients who had adenomatous polyps in 1997, included only patients who had a clearly successful polypectomy. Compliance after polypectomy is reported as being greater than 80%, regardless of age, education and family history (these observations allow speculation about inclusion of patients with lower SES). It is noted that the National Polyp Study demonstrated that removal of adenomas with a follow-up of at least three years reduced the incidence of colorectal cancer recurrence. The National Polyp Study achieved 80% compliance, but the general population compliance was not known. The study suggests that risk reduction published in the National Polyp Study is achievable through surveillance colonoscopy.

It is hoped that further studies of general population compliance will clearly address SES factors and so assist in developing methods to increase compliance of patients of lower SES.

iii. Surveillance after diagnosis of inflammatory bowel disease

A literature search listed 44 papers on colonoscopy in inflammatory bowel disease. One paper addressed socioeconomic factors and involved two studies. The study asserts that the common view is that patients with IBD are of a higher socioeconomic status and that they have reached a higher level of education. Patients from a population-based IBD database were compared with the general population in respect to employment, education and marital status. Inflammatory bowel disease patients were questioned as to their SES at the time of diagnosis and at the time of the 1995-6 survey.

In the second arm of this study the authors used a database linking health care and census variables in relation to income, occupation and marital status.

Their findings concluded that at some time in the course of their illness, those with IBD are more likely to be out of work than the general population. Based on the criteria that had been set, IBD patients were not found to be of higher SES and are equally likely to be married as the general population.
References


27. de Pauw C. Non-compliance with having a colonoscopy as a follow up to a positive result in colorectal cancer screening: a qualitative study. Sante Publique 2008;20(3):249-257.


7  ECONOMIC CONSIDERATIONS

7.1 Economic burden of colorectal cancer in Australia

In 2007 colorectal cancer was the second most common cancer reported in Australia following prostate cancer in men and breast cancer for women. The incidence rate of colorectal cancer has increased by 13% from 67 cases per 100,000 to 75 cases per 100,000 in males over the period from 1982 to 2007 but remained relatively stable in females. Colorectal cancer was the third most common cause of cancer deaths in both males and females in 2007 and was responsible for 10.1% of all cancer deaths.

In 2010, 13% of the cancer disease burden in males was attributable to colorectal cancer and in females, 12% of the cancer disease burden was due to colorectal cancer. Colorectal cancer also accounts for the second highest number of years lost of the total cancer burden due to premature death, and the third highest number of years lost of the total cancer burden due to disease, disability or injury.

The Australian Institute of Health and Welfare has estimated the costs of colorectal cancer at a macro level. In 2000–01 colorectal cancer was estimated to account for 8.17% of total cancer care costs in Australia. It ranked 4th in terms of the most ‘expensive’ cancers in Australia with total health care expenditure on colorectal cancer estimated at $235 million in 2000-01. Colorectal cancer ranks as the most costly cancer for females aged over 65 and the third most costly cancer for males aged over 65. Total treatment costs for per case of colorectal cancer were estimated at $18,246 in 2000-01, which ranks twelfth in terms of the most costly cancer to treat. However, there is relatively little micro-level information available in Australia about treatment patterns and resource use for colorectal cancer.

7.2 Economic evaluation

Economic evaluation is the comparative analysis of alternative courses of action in terms of both their costs and consequences. Cost-effectiveness analysis is the form of economic evaluation in which the consequences of interventions, procedures or programs are measured in the most appropriate natural units, such as life-years gained, hospital days prevented, complications avoided, or cases correctly diagnosed. While many cost-effectiveness evaluations consider a single measure of output, others present an array of output or outcome measures alongside cost, allowing decision makers to form their own view of the relative importance of each measure.

In a cost-utility analysis (CUA), the consequences of an intervention, procedure or program are adjusted by health-state preference scores or utility weights. This means that the quality of the life years gained can be assessed, which is particularly useful for interventions that extend life at the expense of side effects (such as some chemotherapy for cancer), or produce reductions in morbidity rather than mortality (such as some treatments for chronic conditions, e.g. arthritis). The concept combines life expectancy and quality of life. The cost-benefit analysis assesses all effects, including the health effects in monetary units.

Whatever form of economic evaluation is used, an intervention, procedure or program can be considered efficient relative to the alternatives if it can be shown to produce a given level of benefit for the minimum cost.

Role of economic evidence in the development of guidelines

The NHMRC How to compare the costs and benefits: evaluation of the economic evidence has identified two main areas where economic evidence is important in the development of clinical practice guidelines:

• determination of the most cost-effective treatment alternatives
determination of whether a proposed clinical practice guideline is cost-effective.

In the development of these guidelines, the emphasis has been in the first instance on identifying those interventions for which there is evidence of effectiveness, before addressing questions of cost-effectiveness. There is limited evidence available within Australia to assess the costs and cost-effectiveness of alternatives for screening, early diagnosis and management of Colorectal Cancer. However, there is a range of international literature that provides information about the relative cost effectiveness of alternatives. This information can be used to inform the development of these guidelines.

The approach taken in reviewing the economic evidence involved:

- identifying those areas where economic evidence is likely to be important
- identifying those areas where economic evaluation evidence is available
- reviewing and summarising the economic evaluation literature.

However, it is important to note that international literature on economic evaluation is limited in its relevance to Australia because of differences in cost structures and reimbursement arrangements, and because the comparator in international studies may not reflect current practice in Australia.

Searches were conducted using Medline and Embase databases, covering the period 1994–2010. In addition, the reference lists of retrieved articles were hand searched. Economic evaluation literature that pre-dates 1994 was considered to be of limited relevance because of changes in technology, cost structures and management practices. The searches were undertaken in three areas:

- Colonoscopic surveillance following surgical resection for colorectal cancer
  - Key words included colorectal cancer, colon cancer, colorectal neoplasms, colorectal surgery, surveillance, colonoscopy, follow-up, cost-effectiveness, cost-benefit analysis, health economics, costs and cost analysis

- Colonoscopic surveillance in people who have had adenomas removed
  - Key words included adenoma, colonic neoplasms, intestinal polyps, colorectal adenoma, colon adenoma, surveillance, colonoscopy, follow-up, health economics, cost-effectiveness, costs and cost analysis

- Colonoscopic surveillance in people with ulcerative colitis
  - Key words included ulcerative colitis, colonoscopy, surveillance, follow-up, health economics, cost-benefit analysis, cost-effectiveness, costs and cost analysis

Articles were included if they were judged to be cost analyses or economic evaluations, that is, if they involved comparison of alternative interventions in terms of costs and consequences. Studies that were reviews of economic evaluations and studies that combined costs of screening and surveillance were not included. One study was excluded because the surveillance strategies compared included identical intervals for colonoscopies.

The findings of the literature review are summarised below.

**7.3 Cost and cost-effectiveness of colonoscopy follow-up strategies after curative resection for colorectal cancer**

Eighteen economic studies were found that investigated the cost effectiveness of colonoscopic surveillance for colorectal cancer patients post curative cancer resection.

Five studies considered only the costs of various surveillance programs including four that estimated the costs of various follow-up strategies. 4-7 Graham et al (1998) 8 investigated costs of follow up with various surveillance tools including physician examination, CEA monitoring, chest w-ray and colonoscopy.
Eleven studies were cost effectiveness analyses, of which eight compared various surveillance strategies, including follow up versus no follow-up,\textsuperscript{9} simple surveillance versus intensive,\textsuperscript{10} conventional versus intensive,\textsuperscript{11} and standard (1998 French guidelines) versus minimal.\textsuperscript{12} Park and co-workers (2009)\textsuperscript{13} compared 8 surveillance strategies and Hassan and co-workers (2009)\textsuperscript{14} compared strategies with or without a 12 month surveillance colonoscopy. One study compared cost effectiveness of surveillance for a compliant versus non-compliant cohort of patients\textsuperscript{15} and Staib and co-workers (2000)\textsuperscript{16} compared a local intensive surveillance strategy against proposed programs from the literature. Other studies compared the cost effectiveness of various diagnostic tools, including CEA, chest radiography, colonoscopy and physical examination in detecting recurrent disease\textsuperscript{17} and investigated cost-effectiveness of the Norwegian Gastrointestinal Cancer Group (NGICG) guidelines for surveillance after cancer resection.\textsuperscript{18} Cost utility analyses were also undertaken in two studies which were further investigations of the NGICG and 1998 French guidelines.\textsuperscript{18, 19}

The studies reviewed provide some evidence that more frequent or intensive follow-up strategies are cost effective compared to strategies with minimal follow-up. However, because of the variability in the timing of follow-up schedules and surveillance tools employed between studies, it is not possible to determine which follow-up schedule represents the most cost effective strategy.
<table>
<thead>
<tr>
<th>Author, year</th>
<th>Country</th>
<th>Study Questions</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virgo et al 1995</td>
<td>USA</td>
<td><strong>Cost analysis</strong>&lt;br&gt;Economic analysis of the costs associated with 11 separate surveillance strategies for follow-up after CRC selected from the literature.</td>
<td>• Medicare-allowed charges varied widely across 5 year follow-up strategies from US$1,885 to $16,492, based on 1992 US charge data (direct costs).&lt;br&gt;• Conversion of Medicare allowed charges to a proxy for actual charges, (using a conversion ratio of 1.62), gave a range of actual charges from $3,054 to $26,717.&lt;br&gt;• Strategies using frequent colonoscopy throughout the 5 year period were more costly&lt;br&gt;• There was no indication that higher cost strategies increase survival or quality of life.</td>
</tr>
<tr>
<td>Audisio et al 1996</td>
<td>Italy</td>
<td><strong>Cost effectiveness analysis</strong>&lt;br&gt;Comparison of follow-up program versus no follow-up after curative surgery for CRC. Cohort study following 505 patients who had curative surgery for CRC for at least 4 years.</td>
<td>• Overall follow-up costs was US$1,914,900 for 505 patients: $13,589 for each recurrence, $59,841 for each case treated for cure, and $136,779 for those effectively cured based on 1994 US (direct costs).&lt;br&gt;• The cost for each patient cured was $106,383</td>
</tr>
<tr>
<td>Norum et al 1997</td>
<td>Norway</td>
<td><strong>Cost effectiveness and cost utility analysis</strong>&lt;br&gt;Cost effectiveness analysis of the recommended post curative cancer resection follow-up programme of the Norwegian Gastrointestinal Cancer Group (NGICG) compared with no follow-up.</td>
<td>• The basic cost of the NGICG recommended programme was £1,232 per patient based on British pounds (converted from NOK at the rate of £1 = NOK 10.00).&lt;br&gt;• When extended investigation due to suspected relapse in 45% of cases is included, the cost increased to £1,943.&lt;br&gt;• The cost per life year saved was £9,525 - £16,192. The cost per QALY was £11,476 - £19,508. Using a cut off point of about £20,000, the NGICG follow-up programme is cost effective.</td>
</tr>
<tr>
<td>Castells 1998</td>
<td>Spain</td>
<td><strong>Cost effectiveness analysis</strong>&lt;br&gt;Determination of the effectiveness of systematic follow-up in patients with CRC who had a curative resection. Comparison of a compliant cohort (&gt;70% adherence rate for each of the follow-up strategies) with a non-compliant cohort.</td>
<td>• Cost of the surveillance programme with regard to recurrence in the compliant cohort was $US3,018 per patient compared to $1,546 in the noncompliant cohort (direct costs) based on 1996 $US.&lt;br&gt;• Cost per cure was $23,474 in the compliant cohort compared to $30,397 in the noncompliant cohort.&lt;br&gt;• Cost per year of life extended in the compliant cohort was $1,162 compared with $1,257 in the noncompliant cohort.&lt;br&gt;• A higher patient compliance with an average-intensity protocol does not imply a more expensive cost when the curative-intent reoperation rate and survival are considered.</td>
</tr>
<tr>
<td>Graham et al</td>
<td>USA</td>
<td><strong>Cost analysis</strong>&lt;br&gt;The detection rate of resectable recurrences was:</td>
<td></td>
</tr>
</tbody>
</table>

*Economic considerations*
<table>
<thead>
<tr>
<th>Author, year</th>
<th>Country</th>
<th>Study Questions</th>
<th>Conclusion</th>
</tr>
</thead>
</table>
| 1998 | | Examination of the relative and absolute costs of physician examination vs CEA assessment vs chest x-ray vs colonoscopy in detecting recurrent disease in 421 patients who have undergone surgical resection for primary colon cancer. | - Physician exam – 0%  
- CEA – 2.2%  
- Chest x-ray – 0.9%  
- Colonoscopy – 1.0%  

Estimated mean cost to detect recurrent disease based on 1995 $ US:  
- Physician exam $US83,723 (not resectable)  
- CEA – $ 1,304 (not resectable) vs. $ 5,696 (resectable)  
- Chest x-ray – $ 7,558 (not resectable) vs. $ 10,078 (resectable)  
- Colonoscopy – $ 42,756 (not resectable) vs. $ 45,810 (resectable)  

The total costs were:  
- Physician exam – $ 418,615  
- CEA – $ 170,880  
- Chest x-ray – $ 120,934  
- Colonoscopy – $ US 641,344  

The rank order of cost effectiveness was: CEA> chest x ray> colonoscopy> physician examination |
| Staib et al 2000 | Germany | Cost effectiveness analysis  
Cost and efficacy analysis of existing (intensive) and proposed colorectal cancer follow-up programs by comparison of data from 1054 CRC patients followed for 10 years with data from the literature. | - Costs per patient were € 2,220 (colon) or € 4,851 (rectum) based on 1998 €. Data from the literature (5 randomised studies) gave costs ranging from €616 (for minimal follow-up) to €5,049 (for intensive follow-up undertaken at the author’s local institution).  
- For the 1054 patients followed for 10 years, €6.3 million was spent for follow-up.  
- The total follow-up cost for 21 cured recurrence patients was €126,000.00, resulting in a cost effectiveness ratio of 50:1.  
- Total follow-up direct costs included personnel, infrastructure and test costs. |
| Bleeker et al 2001 | Netherland | Cost effectiveness analysis  
Assessment of costs and clinical outcomes of diagnostic tools used for follow-up in 496 patients with resected Duke’s C CRC. | - 213 patients had recurrent disease and 42 treated with curative intent.  
- The mean cost of diagnostic procedures per curative resected recurrence for patients amenable to salvage surgery was US$9,011.  
- Recurrences were detected by the following diagnostic tools:  
  - 87 recurrences detected by ultrasonography/CT with 14/42 resectable at a cost of $9,983 per curative resection  
  - 49 recurrences detected by evaluation of symptoms only with 12/42 resectable  
  - 13 recurrences detected by colonoscopy with 8/42 resectable at a cost of $14,952 per curative resection  
  - 40 recurrences detected by CEA measurement with 3/42 resectable at a cost of $5,200 per curative resection  
  - 7 recurrences detected by chest radiography with 2/42 resectable at a cost of |
<table>
<thead>
<tr>
<th>Author, year</th>
<th>Country</th>
<th>Study Questions</th>
<th>Conclusion</th>
</tr>
</thead>
</table>
| Ketteniss et al 2001 5 | Germany | Cost analysis Evaluation of expenses and benefit of a standardized oncological follow-up program after resection, with 726/1003 patients who had undergone CRC resection between 1987 and 1999 and were free of metastases at the time of resection. (focusing on patients with liver metastases) | • A “small” follow-up program, consisting of medical history, physical assessment and examination, abdominal ultrasound and CEA measurement, cost at least 129 DM (1,155 follow ups in 726 patients).  
• A “large” follow-up program (with an additional colonoscopy and radiological examinations, especially chest radiography) cost at least 370 DM (2,278 follow-ups in 726 patients).  
• The overall cost of the program was 991,853 DM (841,943 for 2278 “large” follow-up programs and 149,910 DM for 1155 small follow-up programs).  
16 of 60 patients who developed liver metastases during the follow up underwent resection of the metastases. Resection of the liver metastases achieved a benefit of 35.1 life years for the 16 patients with the cost per life year save 28,258 DM.  
• The mean cost for the discovery of a liver metastasis was 16,400 DM and the mean cost per patient with R0 status after liver metastasis resection was 62,000 DM. |
| Borie et al 2004 19 | France  | Cost-utility study An assessment of the cost and effectiveness of standard follow-up (1998 French guidelines) vs minimal follow up used during the 5 years after surgical resection for CRC and its recurrences. Used data from 256 patients from the Herault tumour registry who underwent curative surgical resection in 1992 | • For all patients the 7 year CER was €3,114 per QALY in favour of the standard follow up (direct costs based on 1998 €)  
• For Duke’s A patients the 7 year CER was €4,693 per QALY in favour of the standard follow up  
• For Duke’s B patients the 7 year CER was €10,068 per QALY in favour of the standard follow up  
• For Dukes C patients the CER was €1,058 per QALY in favour of the standard follow-up.  
• There was high variability in CERs indicating no differences between the strategies. |
| Borie et al 2004 12 | France  | Cost effectiveness analysis Comparison of cost effectiveness of follow-up tests in 256 patients registered in the Herault Tumor Registry who received follow-up with CEA monitoring (1998 French guidelines) or a more minimal | Cost effectiveness ratios were:  
• €2,123 in Dukes’ stage A patients (costs calculated using 1998 cost coefficients)  
• €4,306 in Dukes’ stage B patients  
• €9,600 Dukes’ stage C patients  
Cost effectiveness ratios for CEA per patient alive were 1238 in the standard follow-up group and 1478 in the minimal follow up group. For abdominal ultrasound the cost effectiveness ratios were 2261.5 per patient alive in the standard follow-up group and 573 in the minimal |
<table>
<thead>
<tr>
<th>Author, year</th>
<th>Country</th>
<th>Study Questions</th>
<th>Conclusion</th>
</tr>
</thead>
</table>
| Renehan et al 2004 | United Kingdom  | **Cost effectiveness analysis** of intensive follow-up compared to conventional  | • The number of years gained through intensive surveillance over five years is 0.73 to 0.82 for each patient.  
• For the five trial model adjusted net cost for each patient was £2,479 and for each life year gained was £3,402 (direct, indirect and overhead cost estimates based on 2002 UK prices), substantially lower than the NHS threshold of cost acceptability (£30,000).  
• Corresponding values for four trials using targeted surveillance were £2,529 and £3,077, suggesting this approach may be more expensive but improves cost effectiveness. |
|                   |                 | follow-up schedule.                                                             | follow up group. There were no survivors in either the standard or minimal follow-up group 5 years after a recurrence was found if it had been detected by physical exam, chest x-ray or colonoscopy. It was concluded that follow-up tests should only include CEA monitoring and abdominal ultrasonography. |
| Korner et al 2005 | Norway          | **Cost effectiveness analysis** Effectiveness, cost and compliance analysis of  | • The total program cost was €228,117 (for 314 consecutive unselected patients from a single large institution undergoing curative resection for CRC between 1996 -1999).  
• The cost for one surviving patient treated successfully for recurrent disease was €20,530. Costs were based on hospital charges. Conversion rates of currencies were calculated in June 2003 (1 € = 7.88 Norwegian Crowns). |
| Rodriguez et al   | Spain           | **Cost effectiveness analysis** Comparison of the simple surveillance versus intensive | • Overall cost of follow-up was higher in the intensive strategy group (€300,315) than in the simple strategy group (€188,630).  
• The cost per resectable tumour recurrence was €15,684 in the intensive surveillance group and €18,863 in the simple surveillance group.  
• The intensive strategy was more efficient when resectability was considered.  
• Direct costs established according to Hospital Clinic current billing. Changes in costs during study or differences among centers not considered. |
|                   | Romania         | surveillance arms of RCT of patients who have undergone curative resection for CRC |                                                                             |
|                   |                 | **Cost estimation** Estimation of the cost and procedural burden of CRC surveillance | • Of 466/882 patients scheduled for surveillance colonoscopy:  
  - 338 had curative resection for CRC  
• The estimated cost for colonoscopy surveillance was:  
  - €11,650 /9.4 months (median time for performing scheduled colonoscopies) for all surveillance colonoscopies  
  - €8,450 /8.8 months for surveillance colonoscopies for curative resection of CRC |

*Draft Clinical Practice Guidelines for Surveillance Colonoscopy - in adenoma follow-up, following curative resection of colorectal cancer, and for cancer surveillance in inflammatory bowel disease*
<table>
<thead>
<tr>
<th>Author, year</th>
<th>Country</th>
<th>Study Questions</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Park et al 2009</td>
<td>Korea</td>
<td><strong>Cost effectiveness analysis</strong>&lt;br&gt;Identification of a cost-effective strategy of second primary CRC screening for cancer survivors.&lt;br&gt;Comparison of eight screening strategies for a simulated cohort of 50 year old male CRC survivors.</td>
<td>• The ICER for COL3 (colonoscopy every 3 years) in cancer survivors was $US 5593/life-year saved, and did not exceed $10,000 life year saved in one way sensitivity analyses.&lt;br&gt;• More strict and frequent recommendations for colonoscopy such as COL3 and COL5 (colonoscopy every 5 years) can be considered as economically reasonable second primary CRC strategies. If the risk of CRC in cancer survivors is at least two times higher than in the general population, COL5 had an ICER of less than $10,500 per life-year saved.&lt;br&gt;• If the age of cancer survivors starting CRC screening was decreased to 40 years, the ICER of COL5 was less than $7,400 per life-year saved regardless of screening compliance.&lt;br&gt;• Direct costs only were expressed in US dollars and the exchange rate was 955 Korean Won for $1 US dollar in 2006.</td>
</tr>
<tr>
<td>Lejeune et al 2009</td>
<td>France</td>
<td><strong>Cost analysis.</strong>&lt;br&gt;Calculation of the observed surveillance costs for 385 patients followed up over a 3 year period following the French guidelines.</td>
<td>• The average surveillance cost per patient was €713. Fourteen percent of the total cost of surveillance for the 3 years was associated with procedures that were not recommended by the guidelines.&lt;br&gt;• Strict application of the French guidelines would result in a mean cost of between €680 and €1,069, depending on the frequency of abdominal ultrasound.&lt;br&gt;• Only direct costs included.</td>
</tr>
<tr>
<td>Hassan et al 2009</td>
<td>USA</td>
<td><strong>Cost effectiveness analysis</strong>&lt;br&gt;Comparison of a strategy of 1 year colonoscopic surveillance versus no early colonoscopic surveillance following resection for CRC.</td>
<td>• The number of early 1 year colonoscopies needed to detect one CRC and to prevent one CRC-related death was 143 and 926, respectively.&lt;br&gt;• The incremental cost-effectiveness ratio of the early 1 year colonoscopy as compared to a policy of not performing it was $40,313 (based on direct and indirect costs in $ US 2007) per life-year gained.&lt;br&gt;• An early 1 year colonoscopy after resection for CRC is clinically efficient and cost effective in terms of cancer detection and cancer-specific death prevention.</td>
</tr>
</tbody>
</table>

1 Eleven different studies selected from the literature were used in an analysis that calculated charges for a single CRC patient during 5 years of follow-up. Eight of these studies investigated surveillance strategies that included colonoscopy; the charges shown represent the Medicare-allowed and actual charges only for the studies that included colonoscopies as part of the surveillance strategy.

2 The follow-up strategy included physical examination, CEA, and ultrasound every 3 months for 5 years, as well as annual colonoscopy and chest radiograph.

3 NGIGG guidelines include regular CEA monitoring (every 3 months for 2 years, then twice a year), colonoscopy at 1 and 4 years, chest radiograph every 6 months for 2 years and then annually; the guidelines also include liver ultrasound and rectoscopy for particular patient groups.

4 Systematic follow-up includes medical history, physical examination and laboratory studies, CEA levels and abdominal ultrasound or CT every 6 months, annual chest radiograph and colonoscopy.

5 Intensive surveillance strategy at the author’s local institution including physical examination, CEA, blood profile, FOBT, abdominal ultrasound, chest radiography, colonoscopy or barium enema.

6 Follow-up included physical examination, liver ultrasonography or computed tomography (CT) every 3 months in the first year, every 6 months in the second and third year, and annually thereafter, colonoscopy or barium enema after 2 years and 5 years, chest radiography performed after 6 and 12 months, CEA level measurement as per the CT schedule.

7 1998 French Consensus Conference (standard guidelines – carcinoembryonic antigen (CEA) monitoring every 4-6 months for 3 years, then every 6 months for 3 years, a colonoscopy every 3 years, an ultrasonography exploration every 4-6 months, and an annual chest x-ray) vs. simplified follow-up (At most, CEA monitoring and ultrasonography exploration annually for 3 years, a colonoscopy every 3 years, and chest x-ray annually for 2 years).

8 NGIGG guidelines includes regular CEA monitoring (every 3 months for 2 years, then every 6 months, colonoscopy at 1 and 5 years, chest radiograph every 6 months for 5 years, and liver ultrasonography every 6 months for 5 years.)

**Economic considerations**

84
9 Simple strategy: including clinical evaluation, serum carcinoembryonic monitoring, colonoscopy at year 1 and year 3; Intensive strategy: clinical evaluation, serum carcinoembryonic monitoring, abdominal computed tomography or ultrasonography, chest radiograph and colonoscopy annually for 5 years

10 a. No screening; b. annual FOBT; c. 2 yearly FOBT; d. sigmoidoscopy every 5 years; e. double contrast barium enema every 5 years; f. colonoscopy every 10 years; g. colonoscopy every 5 years; colonoscopy every 3 years

11 French guidelines: clinical examination every 3 months for the first 2 years, then every 6 months for the next 3 years; abdominal ultrasound every 3-6 months for the first 3 years, then annually for 2 years; annual chest x-ray for 5 years; colonoscopy after 3 years or after 1 year if the initial colonoscopy detected ≥3 adenomas with one > 1 cm diameter or with a villous component
7.4 Cost and cost-effectiveness of colonoscopy follow-up strategies after removal of adenomas

Eight studies were found that investigated the costs or cost effectiveness of colonoscopic surveillance following polypectomy (summarised in Table 7.2).

Two studies considered only the costs of various surveillance programs: a simulation model of statistical analyses that estimated the cost and procedural burden of colonoscopy surveillance in patients who had had endoscopic removal of adenomas; 7 and an estimation of the total cost of a surveillance program involving flexible sigmoidoscopy and colonoscopy at intervals varying from annually to five yearly. 21 A study by Sieg and Brenner (2007) 22 separately evaluated the costs of surveillance as part of the total costs of screening and surveillance and concluded that the net savings from CRC prevention due to screening would offset screening and surveillance costs.

Four further studies were cost effectiveness analyses. Only one of these analyses compared various colonoscopy surveillance strategies, 23 with a comparison of colonoscopy surveillance at one year versus three years after polypectomy. In this study the authors concluded that the high prevalence of CRC at one year post polypectomy did not support initial surveillance at three years after advanced adenoma removal, nor did it support the 5-10 year surveillance interval for patients with non-advanced adenoma. Three other cost effectiveness analyses compared therapeutic agents with surveillance colonoscopy. Arguedas and co-workers (2001) 24 compared surveillance (three yearly if adenomas detected and five yearly if no polyps detected) with COX-2 inhibitors, while Dupont and co-workers (2007) 25 compared aspirin alone and in combination with surveillance. Finally, Shaukat and co-workers (2009) 26 compared surveillance colonoscopy with and without calcium supplementation as well as supplementation alone and no intervention.

The remaining study was a cost utility modelling study that compared the cost effectiveness of four different surveillance scenarios (no surveillance; three yearly surveillance for all patients; three year surveillance for high risk patients and five year surveillance for low risk patients; three year surveillance for high risk patients and 10 year surveillance for low risk patients) for patients diagnosed with adenoma. 27 The authors concluded that surveillance is cost effective as long as intensive (three yearly) surveillance was limited to high risk patients and that intensive follow-up for low risk patients was not cost effective, and even likely to be harmful. On the basis of the results presented, ten yearly surveillance was considered as cost effective for low risk patients.

Given the lack of economic comparisons of surveillance colonoscopy strategies, it is not possible to draw conclusions about its cost effectiveness in patients after removal of adenomas. The two cost effectiveness studies that do compare surveillance colonoscopy strategies reach opposite conclusions about the value of the surveillance strategies often recommended for advanced and non-advanced adenomas.
<table>
<thead>
<tr>
<th>Author, Country</th>
<th>Country</th>
<th>Study Questions</th>
<th>Conclusion</th>
</tr>
</thead>
</table>
| Arguedas et al 2001 USA | Cost effectiveness analysis | of celecoxib to surveillance colonoscopy on average risk patients with prior polypectomy | - No surveillance was associated with a cost of \$US1,016 per patient and colonoscopic surveillance with a cost of \$1,813 per patient. Celecoxib use was associated with a total cost of \$13,187 (based on 1999 Medicare reimbursement rates).  
- The incremental cost effectiveness ratio for colonoscopic surveillance vs. no surveillance was $27,970 per life year saved and $27,900 per high grade lesion prevented (discounted).  
- The incremental cost effectiveness ratio for celecoxib use vs. colonoscopic surveillance was $141,871 per high grade lesion prevented and $1,715,199 per life year saved.  
- Long-term celecoxib therapy in average risk post-polypectomy patients is not cost effective compared to colonoscopic surveillance. |
| Lund et al 2001 UK | Cost analysis | Comparison of costs of adenoma surveillance in a randomised trial of flexible sigmoidoscopy and colonoscopy at one, two and five year intervals. | - In a trial of 776 patients the cost of detecting one adenoma was at least £1,500 and the cost of detecting an adenoma > 1 cm was > £4000 (based on 1998 £UK).  
- Costs were reported as total procedure costs for the study (£121,008), and one cancer was detected directly by surveillance. It was concluded that this was expensive compared to a cost per cancer detected by faecal occult blood testing a general population of £2000. |
| Dupont et al 2007 USA | Cost effectiveness analysis | comparing aspirin chemoprevention alone and in combination with colonoscopy surveillance in patients with prior adenoma resection | - The incremental cost effectiveness ratio of aspirin chemoprevention compared to no intervention was $ US87, 609 per life year saved.  
- The ICER of colonoscopic surveillance compared to aspirin chemoprevention was $ 78, 226 per life year saved, and the ICER of combined colonoscopy surveillance and aspirin chemotherapy was $60,942.  
- The incremental cost-effectiveness ratios per case of CRC prevented were $74,615 for colonoscopy, $134,333 for aspirin chemoprevention and $140,167 for the combination strategy. |
| Sieg and Brenner 2007 Germany | Cost analysis | of surveillance after polypectomy using online data from the German registry of 109,989 screening colonoscopies. | - Over a 10 year period the discounted cost of surveillance was €7,401,692 (41,881 surveillance colonoscopies in 109,989 individuals; 30,639 without histology and 11,242 with histology/polypectomy) |
| Gheorge et al 2008 Romania | Cost estimation | of cost and procedural burden | - Of 466/882 patients scheduled for surveillance colonoscopy:  
  - 101 had had a polypectomy  
- The estimated cost for colonoscopy surveillance was: |
<table>
<thead>
<tr>
<th>Author, year</th>
<th>Country</th>
<th>Study Questions</th>
<th>Conclusion</th>
</tr>
</thead>
</table>
| Hassan et al 2009 | USA/Italy | **Cost effectiveness analysis** Comparing early colonoscopy surveillance, one year after polypectomy with colonoscopy three years after polypectomy. | • To detect one cancer and prevent one cancer-related death, 354 and 1,437 early 1 year colonoscopies were needed, respectively.  
• The incremental cost-effectiveness ratio of performing early one-year colonoscopy compared to not performing it was $US 66,136 per life year gained (based on 2007 $US).  
• Discount not applied as all costs assumed to occur in the year of treatment. |
| Shaukat et al 2009 | USA | **Cost effectiveness analysis** Comparison of 4 surveillance strategies in 50 year old patients post-polypectomy. | Compared with no intervention, Incremental cost effectiveness ratios were:  
• $49,900/ LYG for calcium supplementation (in 2006 $US)  
• $20,600/ LYG for surveillance colonoscopy  
• $30,300/ LYG for calcium supplementation and surveillance colonoscopy  
Compared to calcium supplementation, incremental cost effectiveness ratios were:  
• $15,900/ LYG for surveillance colonoscopy  
• $27,200/ LYG for calcium supplementation and surveillance colonoscopy  
Compared to surveillance alone, the incremental cost effectiveness ratio for calcium supplementation and surveillance was $3,090,000/ life year gained. |
| Saini et al 2010 | USA | **Cost -utility analysis** cost-effectiveness of USA guideline-recommended surveillance by modelling cohort of 50 year old patients with newly diagnosed adenoma until death: | • Compared with no intervention (10/10 strategy), the 3/10 strategy had an ICER of $5,743 (adjusted to 2008 $US) per QALY gained  
• The 3/5 strategy had an ICER of $296,226 per additional QALY compared to no intervention.  
• The 3/3 strategy resulted in fewer cancers, cancer-related deaths and fewer QALYs than the less expensive 3/5 strategy  
• 3 year surveillance was cost-effective for high risk patients and 10 year surveillance for low risk patients. |

1. Four surveillance strategies: No intervention; Calcium supplementation (1200mg/day from 50 -80 years); Surveillance colonoscopy from age 50-80 every 5 years (3 years for large adenomas); Calcium supplementation plus surveillance.

2. 3/3 strategy: patients undergo surveillance colonoscopy every 3 years; 3/5 strategy: high risk patients undergo surveillance colonoscopy at 3 years intervals and low-risk patients at 5 year intervals; 3/10 strategy high risk patients undergo surveillance colonoscopy at 3 years intervals and low-risk patients at 10 year intervals; no surveillance

---

**Economic considerations**

- Conclusion
  - €11650 /9.4 months (median time for performing scheduled colonoscopies) for all surveillance colonoscopies
  - €2525 /24.9 months for surveillance colonoscopies after polypectomy
7.5 Costs and cost-effectiveness of colonoscopy follow-up strategies in ulcerative colitis

Six studies were found that investigated the costs or cost effectiveness of colonoscopic surveillance in ulcerative colitis (summarised in Table 7.3). Two studies were cost-utility studies that compared surveillance scenarios, including various follow up regimes versus no follow up\textsuperscript{28}, and enhanced surveillance versus immediate total colectomy\textsuperscript{29}. A further cost utility study compared surveillance alone and surveillance plus 5-ASA therapy with no surveillance and 5-ASA therapy alone\textsuperscript{30}. One study compared the cost-effectiveness of surveillance for ulcerative colitis with that of other standard endoscopic procedures\textsuperscript{31}. Two further studies were cost analyses; a population-based study that assessed the costs associated with annual surveillance for a small cohort of patients with primary sclerosing cholangitis\textsuperscript{32} and a simulation model of statistical analyses that estimated the cost and procedural burden of colonoscopy surveillance in patients with inflammatory bowel disease\textsuperscript{7}.

The findings suggest that follow up for ulcerative colitis is expensive, especially when compared to other endoscopic procedures. However, it was generally concluded that surveillance is effective, particularly when there is a substantial risk of cancer. There is no clear consensus about the timing of surveillance, with annual surveillance being the most effective strategy in two studies\textsuperscript{28, 30}, but with a high incremental CER in one study\textsuperscript{28}. The most recent study concluded that immediate colectomy was slightly more cost effective than enhanced surveillance in the management of low-grade dysplasia; however it was acknowledged that patient preference towards the post-colectomy state had a significant influence on its cost effectiveness compared to surveillance\textsuperscript{29}.
Table 7.3. Results of studies investigating costs and cost-effectiveness of follow-up strategies in patients with ulcerative colitis

<table>
<thead>
<tr>
<th>Author, year</th>
<th>Country</th>
<th>Study Questions</th>
<th>Conclusion</th>
</tr>
</thead>
</table>
| Provenzale et al 1998 | USA | **Cost-utility analysis** Comparing no surveillance (colonoscopy for symptoms suggesting cancer and colectomy for high grade dysplasia or cancer) to surveillance with colectomy for low grade dysplasia | Surveillance with colectomy for low grade dysplasia is effective.  
- No surveillance cost $US8,934 and provided 17.4 discounted years of life  
- Yearly surveillance cost $ 16,000 and provided 17.59 discounted years of life (ICER = $247,700/life year gained)  
- 2 yearly surveillance cost $ 13,500 and provided 17.58 discounted years of life (ICER = $159,500/life year gained)  
- 3 yearly surveillance cost $ 11,500 and provided 17.56 discounted years of life (ICER = $111,600/life year gained)  
- 4 yearly surveillance cost $ 10,400 and provided 17.55 discounted years of life (ICER = $83,700/life year gained)  
- 5 yearly surveillance cost $ 9,539 and provided 17.54 discounted years of life (ICER = $4,700/life year gained)  
- Variable interval surveillance ICER = $155,400/life year gained  
- Yearly surveillance was the most effective strategy but the incremental CER was expensive compared to mammography breast screening (ICER estimated at $22,000 life years gained). |
| Harewood 2004 | USA | **Cost effectiveness analysis** comparison and ranking of four currently accepted endoscopic procedures (including surveillance of chronic ulcerative colitis) from the payer perspective | Compared to the other endoscopic procedures, surveillance for ulcerative colitis ranked relatively poorly in terms of cost effectiveness.  
Average cost effective ration (CER) :  
- Ulcerative colitis surveillance =$US47,638/case of dysplasia detected (4 biopsy bottles) or $14,119/case of dysplasia detected (1 biopsy bottle)  
- Barrett's surveillance = $ 5,310/case detected  
- Microscopic colitis surveillance = $ 2,447/case detected  
- Small bowel biopsy for Sprue (diarrhoea)= $ 3900/case detected  
- Small bowel biopsy for Sprue (anaemia) = $ 2982/ case detected  
- Small bowel biopsy for Sprue (1st degree relative) = $ 3042/ case detected |
<table>
<thead>
<tr>
<th>Author, year</th>
<th>Country</th>
<th>Study Questions</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kaplan et al 2007 32</td>
<td>Canada</td>
<td><strong>Cost analysis</strong> of annual surveillance of PSC patients.</td>
<td>The local cost of surveillance colonoscopy for 45 PSC patients in the cohort over 5 years from 2000 and 2005 was $52,990. The direct cost of surveillance to detect 1 additional case of dysplasia in PSC patients was $26,495. Costs reported in Canadian dollars adjusted to the year 2005.</td>
</tr>
</tbody>
</table>
| Gheorge et al 2008 7 | Romania | **Cost estimation** of the cost and procedural burden of CRC surveillance using colonoscopy in a cohort of patients at higher than average risk for CRC. | Of 466/882 patients that were scheduled for surveillance colonoscopy:  
- 7 had long lasting ulcerative colitis (average 17.7±3.9 years)  
The estimated cost for colonoscopy surveillance was:  
- 525 €/6.8 months for surveillance colonoscopies in IBD (costs were not reported separately for Crohn’s disease and ulcerative colitis) |
| Rubenstein et al 2009 30 | USA | **Cost -utility analysis** Comparison of twenty two strategies 2: natural history (no 5-ASA or surveillance), surveillance without 5-ASA at intervals of 1-10 years, 5-ASA plus surveillance every 1-10 years, and 5-ASA alone using a simulated cohort of 35 year old men with chronic ulcerative colitis followed to 90 years. | Without 5-ASA, annual surveillance was the ideal strategy, preventing 89% of CRC at cost of $ US69,100 per QALY gained compared with surveillance every 2 years (direct costs adjusted to 2007 US$).  
With 5-ASA, surveillance every 3 years cost $ 63,400 per additional QALY compared with surveillance every 4 years.  
With patients already taking 5-ASA, endoscopic surveillance might be safely carried out every 2 years or less. Annual endoscopic surveillance for these patients costs nearly $ 1 million per additional QALY gained. |
| Nguyen et al 2009 29 | USA | **Cost-utility analysis** of the relative costs and effectiveness of immediate colectomy and enhanced colonoscopic surveillance3 for the management of low grade dysplasia (LGD) in ulcerative colitis | The total lifetime cost associated with immediate colectomy was $US 75,900 compared to $83,900 associated with enhanced surveillance based on 2005 $US.  
For the immediate colectomy cohort the average number of unweighted life-years accrued was 22.5 compared to 22.3 for the enhanced surveillance cohort.  
Management of LGD with immediate colectomy resulted in 20.1 QALYs compared to 19.9 QALYs for enhanced surveillance.  
Immediate colectomy was preferable to enhanced surveillance as it was less expensive and produced slightly more QALYs. |
<table>
<thead>
<tr>
<th>Author, year</th>
<th>Country</th>
<th>Study Questions</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Patient preference toward and perception of the postcolectomy state was the only factor that could potentially make enhanced surveillance cost effective.</td>
<td></td>
</tr>
</tbody>
</table>

1 Including: a. annual surveillance, b. surveillance every 2 years, c. surveillance every 3 years, d. surveillance every 4 years, e. surveillance every 5 years, f. surveillance every 3 years for the first 20 years, every 2 years for the next 8 years and annually thereafter.

2 The twenty two strategies included: Natural history (the reference strategy; natural history of ulcerative colitis without any 5-ASA or surveillance); Surveillance colonoscopy alone (intervals ranging from one to ten years); 5-ASA alone (with no surveillance); and surveillance plus 5-ASA (intervals ranging from one to ten years).

3 Enhanced surveillance: Colonoscopy repeated at 3 months after the initial detection of LGD and at 6, 12 months and annually thereafter if the 3 month colonoscopy is negative for LGD. If LGD, high grade dysplasia or cancer were detected during the enhanced surveillance period, immediate referral for colectomy resulted.
7.6 Cost-effectiveness Analysis of Proposed Surveillance Guidelines

A summary of the results of the cost-effectiveness analyses undertaken to support surveillance colonoscopy according to the proposed guidelines is presented for

- patients who have undergone curative resection for colorectal cancer
- patients who have had adenoma(s) detected.

This section also includes a summary of the cost of colonoscopy surveillance for patients with ulcerative colitis.

A detailed summary of each analysis and costs are provided in the Appendix.

Estimations of the annual incidence of advanced adenoma, non-advanced adenoma and recurrent colorectal cancer amongst patients having previous curative resection for colorectal cancer who were undergoing colonoscopic surveillance were largely obtained from the literature forming the evidence base that supports the surveillance recommendations in Chapter 3. Estimations of the annual incidence of advanced adenoma and non-advanced adenoma amongst patients having prior removal of adenoma and who were undergoing colonoscopic surveillance were obtained from the literature forming the evidence base that supports the surveillance recommendations in Chapter 2. Estimations of the proportion of ulcerative colitis patients at high and low risk for colorectal cancer were largely obtained from the literature forming the evidence base that supports the surveillance recommendations in Chapter 4.

Only direct medical costs (2010 Australian dollars) for colonoscopy surveillance from a health services perspective were considered. These include costs associated with bowel preparation and the colonoscopy procedure. The estimated cost for the bowel preparation was approximately $10.00. It was assumed that 30.2% of colonoscopies would be performed in the private sector and 69.8% in the private sector. This was based on the breakdown of separations for AR-DRG version 5.1 or 5.2 for colonoscopy codes G44 (G44A, G44B, G44C) across the public and private sector in 2008–2009. Colonoscopy costs for the public patients were based on costs provided by a Melbourne Teaching hospital. Colonoscopy costs for the private patients were based on costs provide by a major Private Health Insurer.

7.6.1 Cost-effectiveness of colonoscopy surveillance following CRC resection

Using a health service perspective we estimated the costs of surveillance colonoscopies for 14 years following post curative resection for colorectal cancer comparing the surveillance strategy recommended in the 2005 Guidelines for the Prevention, Early Detection and Management of Colorectal Cancer with the surveillance strategy recommended in the proposed new guidelines. The proposed guidelines included a colonoscopy at 1 year following cancer resection whilst the 2005 guidelines had the first colonoscopy at 3 years post curative resection.

The analysis was based on a cohort of 7,700 patients who had resection for colorectal cancer and who would be eligible for an initial surveillance colonoscopy at 1 year (proposed guidelines) or 3 years (2005 guidelines). For the analysis using the proposed guidelines patients would then be followed by five yearly surveillance if they had a non-advanced adenoma(s) or normal colonoscopies or yearly if they had an advanced adenoma(s). For the 2005 guidelines patients would then be followed by five yearly surveillance if they had a non-advanced adenoma(s) or normal colonoscopies or three yearly if they had...
an advanced adenoma(s). A detailed description of the colonoscopies and costs is presented in the appendix.

The estimated cost of surveillance colonoscopy for CRC follow up with the proposed guidelines which include a 1 year post resection colonoscopy is $26,693,175 (2010 Aus $) for a cohort of 7700 patients followed over a period of 14 years and $25,639,078 using the 2005 guidelines for the same period (see table below).

Table 7.4: Summary of Colonoscopies and Costs for 7700 patients Post CRC Resection over a 14 year Period

<table>
<thead>
<tr>
<th>Colonoscopies</th>
<th>Total</th>
<th>Recurrent cancer or advanced adenoma(s)</th>
<th>Advanced adenoma(s) (% total)</th>
<th>Non-advanced adenoma(s) or normal colonoscopies (% total)</th>
<th>Total cost for program</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proposed Guideline (1 year post CRC resection)</td>
<td>21700</td>
<td>1572</td>
<td>319 (1.5%)</td>
<td>20128 (93%)</td>
<td>$26,693,175</td>
</tr>
<tr>
<td>2005 Guideline (3 years post CRC resection)</td>
<td>20813</td>
<td>1952</td>
<td>484 (2.3%)</td>
<td>18861 (91%)</td>
<td>$25,639,078</td>
</tr>
<tr>
<td>Increments*</td>
<td>887</td>
<td>-380</td>
<td>-165</td>
<td>1267</td>
<td>$1,054,097</td>
</tr>
<tr>
<td>Incremental cost per additional outcome #</td>
<td>$1,188</td>
<td>-$2,774</td>
<td>-$6,388</td>
<td>$832</td>
<td></td>
</tr>
</tbody>
</table>

* Increments estimated by subtracting 2005 guidelines from proposed guidelines; # Incremental cost per additional outcome estimated by dividing the increment (total cost for program) by the respective increment

On average $83,677.66 would be spent for every advanced adenoma detected with the proposed surveillance colonoscopy guidelines compared to $52,973.30 with the 2005 guidelines. With the proposed new guidelines for an additional $2774 an additional advanced adenoma or recurrent cancer could be avoided or for an additional $6,388 an additional advanced adenoma could be avoided. For an additional $832 a additional non-advanced adenoma(s) or normal colonoscopy would be detected with the new guidelines.

### 7.6.2 Summary of cost-effectiveness results for colonoscopy surveillance following detection of adenomas

Using a health service perspective costs were estimated for 20 years of follow-up after removal of adenoma(s). All analyses were based on the incidence and distribution of advanced and non-advanced adenomas that would be expected from a full initial national roll-out of the National Bowel Cancer Screening Program (NBCSP).

For the purposes of this analysis, the total number of people with adenomas detected was rounded to 100,000 (i.e. advanced adenomas and non-advanced adenomas). It was also assumed that all people with advanced non-advanced adenomas or no adenomas (no neoplasia) detected at follow-up colonoscopies would continue with surveillance colonoscopies at periods recommended for non-advanced adenomas.
The analyses undertaken for patients diagnosed with adenomas compared the surveillance strategy recommended in the 2005 Guidelines for the Prevention, Early Detection and Management of Colorectal Cancer\textsuperscript{33} with each of two potential new surveillance strategies:

- **2005 guidelines**
  - Advanced adenomas - three yearly surveillance; non-advanced adenomas/no neoplasia - five yearly surveillance
- **New guidelines**
  - Option A: Advanced adenomas – three yearly surveillance; non-advanced adenomas/no neoplasia - 5 year initial surveillance followed by 10 yearly surveillance
  - Option B: Advanced adenomas - three yearly surveillance; non-advanced adenomas/no neoplasia - 10 yearly surveillance

A detailed description of the number and frequency of the colonoscopies performed and the costs is presented in Appendix 4.

**2005 Guidelines vs Proposed New Guidelines option A**

- Over a 20 year period, a higher proportion of patients (7\% of those patients tested in Option A vs. 5\% of those patients tested under the 2005 Guidelines) with advanced adenoma would be detected by surveillance colonoscopies performed as per the new guidelines (option A) than would be detected from surveillance performed as per the 2005 guidelines (see Table 7.5).
- The cost per advanced adenoma detected over 20 years would be $18,840 with the new guidelines Option A compared to $26,907 with the 2005 guidelines.
- If Option A were adopted the cost of surveillance colonoscopies performed would be less expensive than the current 2005 Guidelines. Although Option A is less expensive it also is less effective in capturing less severe disease therefore, imposing a greater health burden on patients.

**2005 Guidelines vs Proposed New Guidelines option B**

- Over a 20 year period, a higher proportion of patients (9\% of those patients tested in Option B vs. 5\% of those patients tested under the 2005 Guidelines) with advanced adenoma would be detected by surveillance colonoscopies performed as per the new guidelines (option B) than would be detected from surveillance performed as per the 2005 guidelines (see Table 7.5).
- The cost per advanced adenoma detected over 20 years would be $14,240 with the new guidelines Option B compared to $26,907 with the 2005 guidelines.
- If Option B were adopted the cost of surveillance colonoscopies performed would be less expensive than the current 2005 Guidelines. Again although Option B is less expensive it also is less effective in capturing less severe disease therefore, imposing a greater health burden on patients.
Table 7.5. Summary of Colonoscopies and Costs for 100,000 pts with adenomas over 20 years

<table>
<thead>
<tr>
<th>Guideline version</th>
<th>Guideline Changes</th>
<th>Costs of Guideline Changes</th>
<th>Calculations of Outcomes</th>
<th>Calculations of Incremental Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Total 20 year cost of program</td>
<td>Total number of colonoscopies over 20 years</td>
<td>Total number of patients with advanced adenoma detected over 20 years</td>
</tr>
<tr>
<td>2005</td>
<td>3 yearly</td>
<td>497,276,106</td>
<td>401,117</td>
<td>18,481</td>
</tr>
<tr>
<td>New option A</td>
<td>3 yearly</td>
<td>306,612,394</td>
<td>246,145</td>
<td>16,275</td>
</tr>
<tr>
<td></td>
<td>Initial at 5 years, then 10 yearly</td>
<td>260,040,245</td>
<td>207,648</td>
<td>18,261</td>
</tr>
<tr>
<td>New option B</td>
<td>5 yearly</td>
<td>260,040,245</td>
<td>207,648</td>
<td>18,261</td>
</tr>
</tbody>
</table>

Economic considerations
7.6.3 Summary of cost results for colonoscopy surveillance in patients with ulcerative colitis

Since there are no existing guidelines for the management of surveillance for patients with ulcerative colitis, we estimated a 20 year perspective of costs of performing surveillance colonoscopy at intervals recommended in the proposed new guidelines for a cohort of 2,517 people diagnosed with ulcerative colitis. The number of patients in the cohort represents the number of newly diagnosed ulcerative colitis patients expected in Australia in one year based on an incidence of 11.2 per 100,000 \(^{34}\) and the March 2010 Australian population estimates.

Amongst the 2,517 people diagnosed with ulcerative colitis:

- 53.8% of patients have extensive disease, of these 3% have PSC and 3% have a positive family history of CRC and require yearly surveillance.
  - All other patients with extensive disease begin three yearly surveillance at 8 years after diagnosis
    - 20% of patients with extensive disease will have surgery for cancer, dysplasia or active disease and will not continue with surveillance
    - 80% of patients with extensive disease continue to undergo three yearly surveillance, with approximately 1/3 of patients at high risk of CRC requiring more frequent (yearly) surveillance
- 46.2% of patients have limited disease
  - 80% will not require surveillance but will follow the general population guidelines for colorectal cancer screening
  - 20% of patients with limited disease will progress to extensive disease, inflammatory polyps or stricture and will also require three yearly surveillance beginning 8 years after diagnosis

The costs for the procedure were based on same day rates of $865.32 in public sector and $1,472 in the private sector with a further $10 added to the cost of each procedure for the cost of the bowel preparation.

Over a period of 20 years of surveillance, a total of 14,584 colonoscopies would be performed in 1,285 people with ulcerative colitis including the following:

- 4764 colonoscopies in 794 people with inactive disease, of which 1439 would be performed in the public sector at a cost of $1,259,585 and 3,325 would be performed in the private sector at a cost of $4,927,650.
- 9820 colonoscopies in 491 people with active disease, of which 2966 would be performed in the public sector at a cost of $2,596,199 and 6,854 would be performed in the private sector at a cost of $10,157,628.

The total cost for of 20 years of surveillance for the 794 people with inactive disease would be $6,187,235 assuming complete physician and patient compliance with three yearly colonoscopy surveillance. For the 491 high risk patients, the total cost of surveillance over 20 years would be $12,753,827, assuming complete compliance with the recommended yearly surveillance regime. The total cost for 20 years of surveillance colonoscopy for a cohort of 2,517 people diagnosed with ulcerative colitis 8 years earlier, where 51.1% of people undergo surveillance according to the new guidelines, would be $18,941,062.
Limitations

In all cases it was assumed that there was total compliance with surveillance recommendations by physician and patients. There are several limitations with the analysis including the costs were based on charges; the lack of data from long term follow-up in the literature and the use of constant annual rates for adenoma or cancer. In the cost estimations mortality rates, post colonoscopy medical review and complication or perforation rates were not considered. There was no consideration of discounting and no sensitivity analysis was undertaken.

References


27. Saini SD, Schoenfeld P, Vijan S. Surveillance colonoscopy is cost-effective for patients with adenomas who are at high risk of colorectal cancer. Gastroenterology 2010;138(7):2292-9, 2299 e1.


APPENDIX 1 GUIDELINE DEVELOPMENT PROCESS

A1.1 Introduction

The Cancer Council Australia (CCA) was commissioned by the Screening Section of the Department of Health and Ageing (DoHA) to review sections of several chapters of the “Clinical Practice Guidelines for the prevention, early detection and management of colorectal cancer” approved by the NHMRC in 2005 with a specific focus on colonoscopic surveillance. Cancer Council Australia then submitted a proposal to the National Health and Medical Research Council (NHMRC) to develop the Clinical Practice Guidelines for Surveillance Colonoscopy - in adenoma follow-up, following curative resection of colorectal cancer, and for cancer surveillance in inflammatory bowel disease.

A Working Party composed of clinical specialists, a consumer and a Project Officer carried out the work. The Project Officer conducted literature searches, assisted in the critical evaluation of the literature and extracted the relevant data. Funding was provided by the Screening Section of the Department of Health and Ageing.

The development program was designed to meet the standards of scientific rigour required by the NHMRC guideline development process, which is the subject of a series of handbooks on the main stages involved in the development of clinical practice guidelines.1-8 The eight NHMRC handbooks have been condensed previously into a single volume—Development of clinical practice guidelines for the management of cutaneous melanoma and melanoma in special sites: a handbook for chapter leaders and expert working groups9—which outlines the major steps and expectations involved in developing guidelines and provides a clear path for everyone involved in the project. This handbook provides the definitions and protocols for developing research questions and search strategies, conducting searches and critical appraisal, summarising and assessing the relevant literature and, finally, formulating the recommendations. It includes checklists and templates created to satisfy NHMRC legislative requirements and designated standards of quality and process. This condensation of all the NHMRC handbooks has been a most useful aid in the demanding and, for some, new process of developing guidelines.

At its initial meetings the Guidelines Working Party prepared a table of topics and developed questions to address identified clinical needs. The questions were identified with the specific focus of the revision being the role of surveillance colonoscopy in chapters 8, 9, 17, and 23 of the Clinical Practice Guidelines for the prevention, early detection and management of colorectal cancer 2005 and also in a new chapter dealing with surveillance colonoscopy in the management of patients with inflammatory bowel disease (IBD). Subcommittees of the Guidelines Working Party were formed to address topics in their areas of expertise.

A2.1 Steps in preparing the guideline

A clear strategy was developed for every topic and each expert group followed the appropriate steps in preparing the guidelines. While each subcommittee received significant assistance from the Project Officer skilled in methodology, the subcommittees themselves oversaw the synthesis of the evidence and formulation of the recommendations for their topics.

The strategic steps followed are outlined below:

1. Structure the research questions
2. Develop a search strategy
3. Search the literature
4. Select, assess and summarise the literature

Draft Clinical Practice Guidelines for Surveillance Colonoscopy - in adenoma follow-up, following curative resection of colorectal cancer, and for cancer surveillance in inflammatory bowel disease
5. Critically appraise and summarise each selected article

6. Assess the body of evidence and formulate recommendations

**A2.1.1 Structure the research questions**

A wide range of questions was proposed for research. The questions focussed on interventions rather than diagnosis or prognosis. All proposed questions were reviewed on the basis of their purpose, scope and clinical importance to the target audience and were structured according to the PICO (populations, interventions, comparisons, outcomes) formulation.

The Guidelines for all three components are designed to answer the question as to how frequently patients require surveillance colonoscopy to achieve maximal protection against the development of colorectal cancer, in their individual circumstances.

The clinical questions asked:

- What are the appropriate intervals between colonoscopies after polypectomy?
- What are the appropriate intervals between colonoscopies after colorectal cancer resection?
- What are the appropriate intervals between colonoscopies in patients diagnosed with inflammatory bowel disease?

**A2.1.2 Develop a search strategy**

Each research question was submitted to a search strategy based on the PICO formulation.

Most searches were directed to prostate cancer as a generic base. Searches were limited or widened as necessary, but all maintained the PICO structure. Keywords were selected during the PICO process. Further sources for keywords or MESH and subject terms were derived from evidence-based material, systematically reviewed articles and appropriately relevant literature. A single systematic search strategy was derived from these terms and applied to all included electronic databases.

**A2.1.3 Search the literature**

NHMRC specifies that clinical practice guidelines should be based on systematic identification and synthesis of the best available scientific evidence. All literature searches were conducted systematically using electronic databases concluding 31 December 2009. Examples include:

- **Medline**: bibliographic references and abstracts to articles in a range of languages on topics such as clinical medical information and biomedicine, and including the allied health fields, biological and physical sciences
- **EMBASE**: major pharmacological and biomedical database indexing drug information from 4550 journals published in 70 countries
- **Cinahl**: bibliographic references and abstracts to journal articles, book chapters, pamphlets, audiovisual materials, software, dissertations, critical paths, and research instruments on topics including nursing and allied health, biomedicine, consumer health, health sciences librarianship, behavioural sciences, management, and education
- **Cochrane Library**: regularly updated collection of evidence-based medicine databases, including The Cochrane Database of Systematic Reviews
Psychinfo: Bibliographic references and abstracts to journal articles, book chapters, dissertations and technical reports on psychology; social, clinical, cognitive and neuropsychology; psychiatry, sociology, anthropology and education, with source material from a wide range of languages.

The literature review process of this document includes a systematic search of sites such as PubMed-Medline, Embase, Cinahl and Cochrane to select published guidelines, systematic reviews and primary studies assessing the use of colonoscopy for surveillance after endoscopic resection of colonic polyps and for surveillance after curative-intent resection of colorectal cancer (CRC) for the years 2003–2009 and inflammatory bowel disease (IBD) for the years 1990–2009. An additional search was done for the years 1990–2002 on surveillance after endoscopic resection of colonic polyps and for surveillance after curative-intent resection of colorectal cancer (CRC) to add relevant articles which were not included in the literature included in the Clinical Practice Guidelines for the prevention, early detection and management of colorectal cancer, approved by the NHMRC in 2005.

Dates searches were performed and the results were as follows:

Embase:


4/11/09: colonoscopy AND (surveillance OR follow up) and colorectal – 27

4/11/09: colonoscopy AND (surveillance OR follow up) AND (colorectal OR bowel cancer – 86


27/1/10: (colorectal OR colon OR rectum) AND (cancer OR neoplasm) AND (surveillance OR follow up) AND (surgery OR resection) – 48

8/5/10: #4'cancer'/exp/mj OR 'neoplasm'/exp/mj AND (colorectal OR 'colon'/exp/mj OR 'rectum'/exp/mj OR 'bowel'/exp/mj) AND (surveillance OR 'follow up'/mj) AND colonoscopy AND [humans]/lim AND [English]/lim AND [1980-2002]/py – 354

8/5/10: articles selected for relevance (omitted articles with no abstract, non-studies, screening and familial cancer) #4'cancer'/exp/mj OR 'neoplasm'/exp/mj AND (colorectal OR 'colon'/exp/mj OR 'rectum'/exp/mj OR 'bowel'/exp/mj) AND (surveillance OR 'follow up'/mj) AND colonoscopy AND [humans]/lim AND [English]/lim AND [1980-2002]/py – 88

17/11/10: 'adenoma'/exp AND ( 'cost'/exp AND effectiveness OR economic) AND (surveillance OR follow AND up)– 1
17/11/10: (surveillance OR follow AND up) AND ('cost'/exp AND effectiveness OR costing OR 'economics'/exp) AND ('cancer'/exp OR 'neoplasm'/exp) AND (colorectal OR 'colon'/exp OR 'rectum'/exp OR 'bowel'/exp) AND [humans]/lim AND [english]/lim - 27

17/11/10: ulcerative AND 'colitis'/exp/mj) AND ('cancer'/exp OR 'neoplasm'/exp) AND (surveillance OR follow AND up) AND('cost'/exp AND effectiveness OR economic)- 2

PubMed:

7/10/09: "Adenoma/diagnosis"[Major] AND (colonoscopy[Title/Abstract]. visually restricted to 2005 or later. Visually checked for articles relating to rates of diagnosis, failure to diagnose or missed diagnoses – 46


21/10/09: colorectal neoplasms AND diagnosis AND colorectal AND (surveillance OR follow-up) for 2003 and 2004. This yielded 226 articles, which were visually reduced to 11 by checking title and/or abstract

21/10/09: chronic inflammatory bowel disease AND colorectal AND (surveillance OR follow up) 2003-2009 – 52 articles visually restricted to 8


3/11/09: Search: ("2003"[Publication Date]: "3000"[Publication Date]) AND (((cancer[Title/Abstract]) AND colorectal[Title/Abstract]) AND surveillance[Title/Abstract]) AND "resection"[Title/Abstract]) Limits: Humans, English, Core clinical journals – 13

3/11/09: "2003"[Publication Date]: "3000"[Publication Date]) AND (polypectomy[Title/Abstract]) AND surveillance[Title/Abstract]) AND colorectal cancer[MeSH Major Topic] Limits: Humans, English, Core clinical journals – 28

19/11/09: (Inflammatory Bowel Disease) AND neoplasm (Mesh) AND (surveillance OR follow-up) 1990-2009 Humans, English, Clinical journals Original unsorted search which yielded 147 articles

7/1/10: ("barium"[MeSH Terms] OR "barium"[All Fields]) AND ("enema"[MeSH Terms] OR "enema"[All Fields]) AND ("neoplasms"[MeSH Terms] 2004-presentVisually restricted to studies examining methods. Excluded articles dealing with screening only 5

29/12/09: ("2003"[Publication Date]: "3000"[Publication Date]) AND (sessile adenomas and colorectal cancer) Limits: Clinical Trial, Meta-Analysis, Practice Guideline, Randomized Controlled Trial, Review, Comparative Study, Controlled Clinical Trial, Government Publications, Guideline, Journal Article, English – 124

31/12/09: ("2003/01/01"[Publication Date]: "3000"[Publication Date]) AND (Colorectal cancer and multiple adenomas) Limits: Humans, Male, Female, Clinical Trial, Meta-Analysis, Practice Guideline, Randomized Controlled Trial, Review, Comparative Study, Controlled Clinical Trial, Multicenter Study, English, MEDLINE, PubMed Central, All Adult: 19+ years – 81

4/1/10: MYH-associated polyposis and surveillance – 11

Appendices 104
Familial adenomatous polyposis (FAP) and polypectomy – 19

FAP guidelines – 1

Surveillance in patients with FAP

Randomized Controlled Trial, Review, Case Reports, Comparative Study, Controlled Clinical Trial, Guideline, English, MEDLINE, PubMed Central, All Child: 0-18 years, All Adult: 19+ years – 32

FAP guidelines – 1

Colonoscopy: 86

Colonography, computed tomographic: 39

Sigmoidoscopy: 1

Search strategy: colorectal neoplasms (MESH term) AND diagnosis (MESH term) AND (surveillance OR follow up) (Title/abstract) with limits as below. ((#2 AND #3) AND #6) AND #7

Colonoscopy Limits: Humans, English, Core clinical journals, Cancer, MEDLINE, PubMed Central – 85

Draft Clinical Practice Guidelines for Surveillance Colonoscopy - in adenoma follow-up, following curative resection of colorectal cancer, and for cancer surveillance in inflammatory bowel disease
Appendices


13/11/2010: (((#3) AND #4) AND #5 AND #6) AND #7) #3 Limits: Humans, Clinical Trial, Meta-Analysis, Randomized Controlled Trial, Review, Clinical Trial, Phase I, Clinical Trial, Phase II, Clinical Trial, Phase III, Clinical Trial, Phase IV, Comparative Study, Controlled Clinical Trial, Multicenter Study, English, Core clinical journals, Cancer, MEDLINE, PubMed Central.#4 colorectal OR colon OR rectum OR bowel[Title/Abstract] #5 cancer OR neoplasm[Title/Abstract] #6 surveillance OR follow up[Title/Abstract] #7 economics (Mesh term, includes cost effectiveness)- 41 selected out of 277


Searching on Inflammatory bowel disease instead of ulcerative colitis yielded the same one article.

CINAHL:
18/11/09: Inflammatory bowel disease AND colorectal cancer AND surveillance 4 records selected out of – 13
7/5/10: (AB cancer or AB neoplasm) AND (AB colorectal or AB bowel or AB rectum or AB colon) AND (AB surveillance or AB follow up) 1980-2002 Only found one study that seemed useful out of 102 articles
7/5/10: colonoscopy AND (colorectal OR bowel OR colon OR rectum) AND (surveillance OR follow up) 1980-2002 articles selected visually (most on screening, family history or prevention) – 3

Cochrane Library:
18/11/09: Inflammatory bowel disease AND colorectal cancer AND surveillance – 3
1/1/10: colonoscopy – 11
1/1/10: CT colonography – 4
7/5/10: (colorectal OR bowel cancer) AND colonoscopy before 2002-24 articles reduces to 4 (most to do with screening and methods of colonoscopy) – 4
13/11/2010: colorectal cancer in Economic evaluations database 12 out of 142- 12

Additional search was using PubMed which included the following:

Sessile adenomas and colorectal cancer Limits: Clinical Trial, Meta-Analysis, Practice Guideline, Randomized Controlled Trial, Review, Comparative Study, Controlled Clinical Trial, Government Publications, Guideline, Journal Article, English resulting in 124 records

Colorectal cancer and multiple adenomas Limits: Humans, Male, Female, Clinical Trial, Meta-Analysis, Practice Guideline, Randomized Controlled Trial, Review, Comparative Study, Controlled Clinical Trial, Multicenter Study, English, MEDLINE, PubMed Central, All Adult: 19+ years resulting in 81 records

MYH-associated polyposis and surveillance resulting in 11 records

107 Draft Clinical Practice Guidelines for Surveillance Colonoscopy - in adenoma follow-up, following curative resection of colorectal cancer, and for cancer surveillance in inflammatory bowel disease
Surveillance in patients with FAP) Limits: only items with links to full text, Humans, Clinical Trial, Meta-Analysis, Practice Guideline, Randomized Controlled Trial, Review, Case Reports, Comparative Study, Controlled Clinical Trial, Guideline, English, MEDLINE, PubMed Central, All Child: 0-18 years, All Adult: 19+ years resulting in 32 records

Familial adenomatous polyposis (FAP) and polypectomy resulting in 19 records

For each search, the following details were provided in topic- or question-specific reports (available on request from the Cancer Council Australia):

- electronic databases searched
- terms used to search the databases
- search inclusion or exclusion criteria
- language
- study type.

Studies published before 31 December 2009 could be included in the systematic reviews. Studies published after this date could not be included in the evidence base for the recommendations but could be referred to in the text and were described in the Appendices to the topic- or question-specific reports (available on request from the Cancer Council Australia). The project team also hand-searched the reference lists of the relevant articles to identify additional articles that had not been detected through searches of the electronic databases. Bi-annual meetings of the guidelines Working Party provided a forum for discussing and sharing overlapping evidence, the discovery of unpublished literature and information from other key organisations or individuals.

**A2.1.4 Select, assess and summarise the literature**

The literature identified by the electronic database searches was assessed for relevance to each question. The following steps were taken to select and sort the literature, with the details and results summarised in topic- or question-specific reports (available on request from the Australian Cancer Network):

1. Define the inclusion criteria:

   The search was limited to English language and to the heading appearing in the title and abstract of articles. Reviews, instructive guidelines, comments and letters are not referred to when critical analyses of the data is performed. These were used to refer the reader to further information and for comparative analyses (for example, international view of guidelines for adenoma and colorectal cancer surveillance). The literature search focussed on diagnoses of colorectal lesions and inflammatory bowel disease at the time of baseline examination and during surveillance colonoscopy. Also, in PubMed searches (dated 1 May 2010), several search strategies were combined to one single search.

   No limitation on date was used when searching databases for articles on cost effectiveness related to colonoscopy surveillance following adenoma resection, CRC resection and IBD diagnosis. Studies for cost effectiveness were selected based on titles and abstracts and omitting any studies that did not deal directly with the topic (eg screening rather than surveillance after cancer, other cancers with colorectal cancer mentioned incidentally, treatment rather than surveillance).

2. Review titles and abstracts of retrieved citations to identify potentially relevant articles
3. Obtain the full text of potentially relevant articles

4. Determine whether the study described in each collected article met the pre-defined inclusion criteria

5. Determine whether systematic reviews accounted for all preceding literature

6. Prepare folders to file searches, background papers and reviewed articles for each question addressed

Two independent assessors then assessed the quality of each of the included studies according to pre-defined criteria for the various study types. Any disagreements were adjudicated by a third reviewer. The quality criteria were:

- **randomised controlled trials (RCTs):** blinding, allocation concealment, follow up and intention-to-treat analysis and mode of randomisation

- **systematic reviews:** search strategy used, the inclusion criteria and their application, study quality assessment, summary descriptive tables, pooling methods and examination of heterogeneity

- **quasi-randomised and cohort studies:** subject selection, group comparability, comparability of outcome measurement, blinding and completeness of follow up.

Criteria for the critical appraisal process are available on the Cancer Council Australia website (www.cancer.org.au).

Summaries of the studies were tabulated in PICO format and the relevant data extracted and summarised in tables. The data extraction was checked by a second assessor. These tables of study characteristics and evidence are included in the topic- or question-specific reports (available on request from the Cancer Council Australia). The reports also contain lists of collected studies that did not meet the inclusion criteria and the reason for their exclusion.

### A2.1.5 Critical appraisal and summary

For each clinical question, the included studies and their results were summarised in a template (Template 1 in the Handbook9). Each study was submitted to further critical appraisal. The level of the evidence, the quality of evidence as determined above, the size of effect and relevance of the evidence of each included study was documented.

Details of the templates, rating systems, and criteria for the critical appraisal process are available on the Cancer Council Australia website (www.cancer.org.au). Levels of evidence are outlined below.
Table 1  Designations of levels of evidence according to type of research question  
(NHMRC, 2005)

<table>
<thead>
<tr>
<th>Level</th>
<th>Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>A systematic review of level II studies</td>
</tr>
<tr>
<td>II</td>
<td>A randomised controlled trial</td>
</tr>
<tr>
<td>III-1</td>
<td>A pseudo-randomised controlled trial (ie alternate allocation or some other method)</td>
</tr>
</tbody>
</table>
| III-2 | A comparative study with concurrent controls:  
|       | • non-randomised, experimental trial  
|       | • cohort study  
|       | • case-control study  
|       | • interrupted time series with a control group |
| III-3 | A comparative study without concurrent controls:  
|       | • historical control study  
|       | • two or more single-arm studies  
|       | • interrupted time series without a parallel control group |
| IV    | Case series with either post-test or pre-test/post-test outcomes |

Source: Development of clinical practice guidelines for the management of cutaneous melanoma and melanoma in special sites: Handbook for chapter leaders and expert working groups9, p186

A2.1.6  Assess the body of evidence and formulate recommendations

The body of literature was assessed by each expert sub-committee in regard to the volume of the evidence, its consistency, clinical impact, generalisability and applicability. These aspects were graded and documented in a second template (Template 2 in the Handbook9).

Following grading of the body of evidence, expert sub-committees were asked to formulate a recommendation that related to the summarised body of evidence. This recommendation also had to be graded as follows:

<table>
<thead>
<tr>
<th>Grade of recommendation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Body of evidence can be trusted to guide practice</td>
</tr>
<tr>
<td>B</td>
<td>Body of evidence can be trusted to guide practice in most situations</td>
</tr>
<tr>
<td>C</td>
<td>Body of evidence provides some support for recommendations but care should be taken in its application.</td>
</tr>
<tr>
<td>D</td>
<td>Body of evidence is weak and recommendation must be applied with caution</td>
</tr>
</tbody>
</table>

A2.2  Writing the chapter

All the expert sub-committees were asked to write their guidelines chapter using the following format:  
• background  
• review of the evidence
A2.3 Review of the chapters

The body of evidence and recommendations for each chapter were reviewed by the Guidelines Working Party and final recommendations agreed to, based on the evidence.

A2.4 Public consultation

A complete draft of the guidelines was sent out for public consultation in Australia in May 2011. The consultation process included soliciting public review of the document through advertisement in a national newspaper, and alerting professional societies and groups and sponsors.

All feedback on the draft received during the consultation period in Australia was reviewed by the Guidelines Working Party. Subsequent changes to the draft were agreed by consensus, based on consideration of the evidence. A final independent review of experts in their fields was conducted before the final draft was submitted to NHMRC.

A2.5 Dissemination and implementation

The Cancer Council Australia will take the lead in disseminating the guidelines in Australia. This will include a campaign to raise awareness of the new guidelines that incorporates organised media coverage through multiple outlets and an official launch. The Guidelines will be distributed directly to relevant professional and other interested groups and through meetings, national conferences, and other CME events. A significant effort will be made to have the Guidelines introduced to senior undergraduate medical students and to encourage the relevant learned Colleges (surgeons, radiation oncologists and pathologists), to support the Guidelines and to foster their integration into hospital and community practice through resident and registrar education activities.

The scope of implementation activities will depend on the availability of funding. Use of the Guidelines as part of core curriculum in specialty exams will be encouraged. It is recognised that a planned approach is necessary to overcome specific barriers to implementation in particular settings and to identify appropriate incentives to encourage uptake of guideline recommendations.

Implementation of the Guidelines will require a combination of effective strategies and may include further CME initiatives and interactive learning, the development and promotion of computer-assisted decision aids and electronic decision-support systems, and the creation of audit and other clinical tools.

References


Draft Clinical Practice Guidelines for Surveillance Colonoscopy - in adenoma follow-up, following curative resection of colorectal cancer, and for cancer surveillance in inflammatory bowel disease


APPENDIX 2 WORKING PARTY MEMBERS AND CONTRIBUTORS

Surveillance Colonoscopy Working Party to develop Clinical Practice Guidelines for Surveillance Colonoscopy - in adenoma follow-up, following curative resection of colorectal cancer, and for cancer surveillance in inflammatory bowel disease

Dr Cameron Bell (Chair) Gastroenterologist – Royal North Shore Hospital, Sydney NSW

A/Professor Terry Bolin Gastroenterologist - A/Professor Medicine UNSW, Emeritus Consultant - Prince of Wales Hospital, President – Gut Foundation, Sydney NSW

Dr Andrew Clouston Anatomical Pathologist - Envoi Specialist Pathologists, Brisbane QLD

Dr William Connell Gastroenterologist – Chairman, Gastroenterological Society of Australia IBD section, VIC

Dr Katie Ellard Gastroenterologist - Royal North Shore Hospital, Sydney NSW

Professor James Kench (NSW) Anatomical Pathologist – Royal Prince Alfred Hospital, Sydney NSW

Dr Orly Lacham Kaplan Project Officer, Working Party, VIC

Dr Andrew Luck Colorectal surgeon – Adelaide SA

Professor Finlay Macrae Gastroenterologist – Royal Melbourne Hospital, Melbourne VIC

Professor Ian Olver AM Convenor, Working Party/ CEO, Cancer Council Australia, Sydney NSW

Professor Cameron Platell Colorectal surgeon – Winthrop Professor of Surgery, University of Western Australia, Perth WA

Emeritus Professor Tom Reeve AC CBE Convenor Working Party until 2 July 2010

A/Professor James St John AM Gastroenterologist – Cancer Council Victoria, Melbourne VIC

Mr John Stubbs Consumer - Cancer Voices Australia, Sydney NSW

Ms Christine Vuletich Manager, Clinical Guidelines Network - Cancer Council Australia, Sydney NSW
Chapter subcommittees

1. Advances in colonoscopy, CT colonography and other methods of investigations

James St John AM (chapter leader) – Gastroenterologist, VIC
Gregor Brown – Gastroenterologist, VIC

2. Management of epithelial polyps: colonoscopic surveillance after polypectomy

Finlay Macrae (chapter leader) – Gastroenterologist, VIC
Peter Bampton – Gastroenterologist, SA
Terry Bolin – Gastroenterologist, NSW
Gregor Brown – Gastroenterologist, VIC
Andrew Clouston – Anatomical Pathologist, QLD
Katie Ellard – Gastroenterologist, NSW
James Kench – Anatomical Pathologist, NSW
Barbara Leggett – Gastroenterologist, QLD
Andrew Luck – Colorectal Surgeon, SA

3. The role of surveillance colonoscopy after curative resection for colorectal cancer

Cameron Platell (chapter leader) – Colorectal Surgeon, WA
Cameron Bell – Gastroenterologist, NSW
Andrew Luck – Colorectal Surgeon, SA
James St John AM – Gastroenterologist, VIC

4. Colonoscopic surveillance and management of dysplasia in inflammatory bowel disease (IBD)

William Connell (chapter leader) – Gastroenterologist, VIC
Michael Kamm – Gastroenterologist, VIC
James Kench - Anatomical Pathologist, NSW
Rupert Leong - Gastroenterologist, NSW
Alissa Walsh – Gastroenterologist, NSW

Appendices 114
5. **Psychosocial aspects of surveillance colonoscopy after colorectal cancer, polyps and inflammatory bowel disease (IBD)**

Emeritus Professor Tom Reeve AC CBE

6. **Socio-economic factors**

Emeritus Professor Tom Reeve AC CBE

7. **Cost effectiveness**

John McNeil – Epidemiologist, Monash University, VIC
Lisa Demos - Epidemiologist, Monash University, VIC
Andrea Curtis - Epidemiologist, Monash University, VIC

**Appendix 1 - Guidelines development process**

Cameron Bell
Orly Lacham Kaplan
Christine Vuletich

**Expert review panel**

TBC

**Acknowledgments**

Special thanks to:

Ms Philippa Thomson for assisting with the literature searches and the referencing of the chapters.

Ms Jane Young for reviewing each chapter prior to public consultation.
Dr Cameron Bell (Chair) Gastroenterologist – Royal North Shore Hospital, Sydney NSW  
No conflict of interest to declare

A/Professor Terry Bolin Gastroenterologist - A/Professor Medicine UNSW, Emeritus Consultant - Prince of Wales Hospital, President – Gut Foundation, Sydney NSW  
No conflict of interest to declare

Dr Andrew Clouston  
Anatomical Pathologist - Envoi Specialist Pathologists, Brisbane QLD  
No conflict of interest to declare

Dr William Connell  
Gastroenterologist – Chairman, Gastroenterological Society of Australia IBD section  
No conflict of interest to declare

Dr Katie Ellard  
Gastroenterologist - Royal North Shore Hospital, Sydney NSW  
No conflict of interest to declare

Professor James Kench (NSW)  
Anatomical Pathologist – Royal Prince Alfred Hospital, Sydney NSW  
No conflict of interest to declare

Dr Orly Lacham Kaplan  
Project Officer  
No conflict of interest to declare

Dr Andrew Luck  
Colorectal surgeon – Adelaide SA  
No conflict of interest to declare
Professor Finlay Macrae  
Gastroenterologist – Royal Melbourne Hospital, Melbourne VIC  

Professor Macrae is a Board member of Genetic Health Services Victoria, and the Human Variome Project International Pty Ltd and is a Director for the International Society for Gastrointestinal Hereditary Tumours. He is a Consultant for CSIRO (Australia), S.L.A. Pharmac AG and Endogen Pty and an international advisory faculty consultant to Given Imaging.

He is involved in clinical trials with
- Abbott Australasia
- Centocor
- ChemoCentryx
- Endogene Pty Ltd
- Given Imaging
- Glutenon Pty Ltd
- MerckSharpe Dohme
- Optiscan
- Pentax
- Shire
- UCB
- Bristol Myer

No conflict of interest to declare

Professor Ian Olver AM  
Convenor, Working Party/ CEO, Cancer Council Australia, Sydney NSW

No conflict of interest to declare

Professor Cameron Platell  
Colorectal surgeon – Winthrop Professor of Surgery, University of Western Australia, Perth WA

No conflict of interest to declare

Emeritus Professor Tom Reeve AC CBE  
Convenor Working Party until 2 July 2010

No conflict of interest to declare

A/Professor James St John AM  
Gastroenterologist – Cancer Council Victoria, Melbourne VIC

No conflict of interest to declare

Mr John Stubbs  
Consumer - Cancer Voices Australia, Sydney NSW

No conflict of interest to declare

Ms Christine Vuletich  
Manager, Clinical Guidelines Network - Cancer Council Australia, Sydney NSW

No conflict of interest to declare
APPENDIX 4: ECONOMIC EVALUATION OF SURVEILLANCE COLONOSCOPIES

INTRODUCTION

Estimation of Costs

Only direct medical costs (2010 Australian dollars) for colonoscopy surveillance were considered. Costs are from a health services perspective. These include costs associated with bowel preparation and the colonoscopy procedure. It was assumed that patients and physicians were compliant with guidelines.

A limitation of this analysis is that the costs were based on charges. In the cost estimations mortality rates, post colonoscopy medical review and complication or perforation rates were not considered.

Bowel preparation and cleansing

Patients are required to ingest oral lavage solutions and/or laxatives prior to undergoing colonoscopy to clear the bowel. The estimated cost for bowel preparation is approximately $10.00 and may include any of the following products: GlycoPrep C; GlycoPrep and Bisacodyl; ColonLYTELY; PrepKit C; Picolax and a laxative; magnesium citrate with GlycoPrep and Bisacodyl.

Colonoscopy Procedure

In the 2009/10 financial year there were 462,375 colonoscopies performed in Australia according to Medicare Australia (colonoscopy item numbers 32090 and 32093). 1

It was assumed that 30.2% of colonoscopies would be performed in the private sector and 69.8% in the private sector. This was based on the breakdown of separations for AR-DRG version 5.1 or 5.2 for colonoscopy codes G44 (G44A, G44B, G44C) across the public and private sector in 2008–2009. 2

The 2008–09 sample included 262 public hospitals (52% of large public hospitals), 110 participating private hospitals (49% of all private hospitals) and 59 private day hospital facilities (26% of all facilities) with a total of 70,402 patient separations in the Public Sector, 101,945 in the Private Sector and a further 60,714 in Private Day Hospital Facilities.

Public Sector colonoscopy costs were provided by a major Melbourne teaching hospital using Australian Refined Diagnostic Related Groups (AR-DRG) version 6.0. 3 The costs are based on the estimated reimbursements from WIES 17 2010–11 Victorian Cost weights 4 which include the colonoscopy procedure as well as sedation, medical, pathology and other related costs. Chromocolonoscopy was included for Ulcerative colitis patients.

The colonoscopy costs for private sector patients were provided by Medibank Private using AR-DRG 5.1 for the 2010 calendar year. Relevant DRGs include G43 and G44 (i.e. G43Z, G44A, G44B, G44C); these were combined to DRG G48 in AR-DRG version 6. Costs included hospital (Medibank hospital benefits and member hospital out-of-pocket), and medical (Medicare, Medibank and member out-of-pocket) costs.

1. POST COLORECTAL CANCER RESECTION

Using a health service perspective we estimated costs of surveillance colonoscopies for 14 years following post colorectal cancer resection. The total costs of surveillance colonoscopies across this period were compared for the proposed guidelines which included a colonoscopy at one year following cancer resection and the 2005 guidelines which had the first colonoscopy at three years following resection. 5
Colonoscopy Costs

Public Patients

The estimated reimbursement for a same day colonoscopy procedure in patients with a past history of CRC with no recurrence is $865.32:

- DRG: Z40Z Endoscopy with Diagnoses of other contacts with Health Services
- ACHI Principle Procedure: 32090 fibreoptic colonoscopy to caecum
- ICD-10-AM Principle Diagnosis: Z087 Follow-up examination after combined treatment for malignant neoplasm

The estimated reimbursement for a same day colonoscopy procedure in patients with a past history CRC with recurrence is $1,140.22:

- DRG: G48C Colonoscopy Same day
- ACHI Principle Procedure: 3209001 fibreoptic colonoscopy to caecum with biopsy
- ICD-10-AM Principle Diagnosis: C189 Malignant neoplasm of colon, unspecified part

If patients experiencing a perforation or blood loss but had no recurrence the estimated reimbursement ranged from $1,700.46 for same day discharge, $10,073.52 for an overnight admission to $14,911.55 for a multi-stay admission (i.e. length of stay of 3 days). For patients who experienced a perforation or blood loss and had a recurrence the estimated reimbursement ranged from $5,168.07 where they were discharged on the same day, $6,862.94 when they had an overnight admission and $13,275.90 if they were hospitalised for three days.

Private Patients

The average total cost for a same day patients without a recurrence was $1,365 and $1,387 for all patients (i.e. same day, overnight or multi-stay).

The average total cost for same day patients who had a recurrence was $1,362 and $1,611 for all patients (i.e. same day, overnight or multi-stay).

Incidence Colorectal Cancer

The incidence of bowel cancer in the Australian population aged <80 years was 10,124 in 2005 and 11,102 in 2007. This cost analysis was based on the 2007 population data with 11,202 people newly diagnosed with colorectal cancer.

The distribution of patients by Dukes’ staging was estimated using the proportions provided by Bishop and co-workers (2008) see table below. Approximately 1% of patients in each Dukes’ group were likely to have a total colectomy and would not undergo surveillance. These patients were excluded from the analysis. A further 30% of patients with Dukes’ Stage C and all patients with Dukes’ stage D who would be likely to have advanced cancer and not undergo surveillance were also excluded from the analysis. Therefore 7,700 patients would be eligible for colonoscopy surveillance.

<table>
<thead>
<tr>
<th>Dukes’ stage</th>
<th>Proportion Pts</th>
<th>Total Pts#</th>
<th>Pts -total colectomy (1%)</th>
<th>Pts not having colectomy</th>
<th>Pts eligible for 1y colonoscopy</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.0910</td>
<td>1010</td>
<td>10</td>
<td>1000</td>
<td>1000</td>
</tr>
<tr>
<td>B</td>
<td>0.2680</td>
<td>2975</td>
<td>30</td>
<td>2945</td>
<td>2945</td>
</tr>
<tr>
<td>C</td>
<td>0.4880</td>
<td>5418</td>
<td>54</td>
<td>5364</td>
<td>3755*</td>
</tr>
<tr>
<td>D</td>
<td>0.1540</td>
<td>1710</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7700</td>
</tr>
</tbody>
</table>
The distribution of colonoscopies with advanced adenoma(s), non-advanced adenoma(s) and normal results over the 14 year surveillance period were largely based on the published literature that was used as the evidence base for the recommendations in Chapter 3.

**Incidence and Distribution of CRC Patients using New Guidelines**

The cohort of 7,700 patients who had resection for colorectal cancer would be eligible for an initial surveillance colonoscopy at one year followed by five yearly surveillance if they had a non-advanced adenomas or normal colonoscopies or yearly if they had an advanced adenoma. The distribution of patients and colonoscopies in each category (Figure 1a) was based on the following:

A. At the one year surveillance colonoscopy post CRC resection the estimated number of patients diagnosed with advanced adenomas was 316 based on a weighted mean of 4.1% of patients. The patients would then have another colonoscopy in a year.

B. Using a cancer recurrence rate of up to 15% it was assumed that 10% of patients (N=770) had a recurrent cancer (local or metastatic) at one year (B1) and a further 5% (N=331) by five years (B2). These patients would no longer be eligible for surveillance colonoscopy.

C. The remaining 6614 patients were assumed to have non-advanced adenomas or normal colonoscopies at one year (i.e. 7700 - [A+B] or 7700 - [316 +770]). These patients would then have surveillance colonoscopy five yearly unless they had a subsequent diagnosis of advanced adenoma.

D. It was assumed that the rate of advanced adenomas was a 1% per year therefore of the 316 patients with advanced adenomas at one year (A), a further 1% would be diagnosed with advanced adenoma at the next surveillance colonoscopy (2 years post resection) i.e. 3 patients. As this number was small it was assumed that all patients subsequently had non-advanced adenomas or normal colonoscopies and would undergo five yearly surveillance colonoscopies.

E. Of the 316 patients who had advanced adenoma detected at the one year surveillance, the remaining 313 patients had non-advanced adenomas or normal colonoscopies at 2 years. These patients would then have five yearly surveillance colonoscopy.

F. At the five year surveillance colonoscopy it was assumed that 2.3% of the 6614 patients with normal or non-advanced adenomas at one year would subsequently be diagnosed with advanced adenomas i.e. 152 patients. These patients would then have a surveillance colonoscopy at three years and then five yearly.

G. At the five year surveillance colonoscopy 6131 had non-advanced adenomas or normal colonoscopies and continued to have five yearly surveillance colonoscopy (i.e. 6614 - [B2+F])

Assuming total compliance with the proposed guidelines for both physicians and patients a total of 21,700 colonoscopies would be performed over 14 years for patients diagnosed with CRC who had a curative resection and were eligible for a one year surveillance colonoscopy (Table 1a).

**Table 1a: Colonoscopies in Post CRC resection Patients eligible for 1 year surveillance colonoscopy**

<table>
<thead>
<tr>
<th>Time (years) post CRC Resection</th>
<th>Total colonoscopies</th>
<th>Colonoscopies with recurrent cancer or advanced adenoma</th>
<th>Colonoscopies with non advanced adenoma or normal colonoscopy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7700</td>
<td>1086</td>
<td>6614</td>
</tr>
<tr>
<td>2</td>
<td>316</td>
<td>3</td>
<td>313</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

Appendices 120
<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6614</td>
<td>483</td>
</tr>
<tr>
<td></td>
<td>313</td>
<td>313</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>152</td>
<td>152</td>
</tr>
<tr>
<td></td>
<td>6131</td>
<td>6131</td>
</tr>
<tr>
<td></td>
<td>313</td>
<td>313</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>152</td>
<td>152</td>
</tr>
</tbody>
</table>

Total colonoscopies 21700

Assuming that 30.2% of colonoscopies were performed in the public sector and 69.8% in the private sector and using $865.32 for the costs for a same day procedure in the public sector and $1,365 in the private sector for non-advanced adenoma(s) or normal colonoscopy. For patients with recurrent cancer or advanced adenoma the cost used for the public sector was $1,140.22 for a same day admission and $1,365 in the private sector. A further $10 was added to the procedure costs for the bowel preparation and cleansing.

- For the 1,575 colonoscopies where patients were diagnosed with recurrent cancer or advanced adenoma it was assumed that 475 would be performed in the public sector at a rate of $1,150.22 per procedure and 1,097 in the private sector at a rate of $1,375 per procedure giving a total cost for these colonoscopies of $2,054,730.
- For the 20,128 colonoscopies where patients were diagnosed with non-advanced adenomas or normal colonoscopies it was assumed that 6,079 were performed in the public sector at a rate of $875.32 per procedure and 14,049 in the private sector at a rate of $1,375 per procedure. Therefore the cost for these colonoscopies was $24,638,445.
- If all the patients had a same day procedure and there were no complications the total cost for 21,700 surveillance colonoscopies in a cohort of 7,700 patients over a period of 14 years would be $26,693,175. The average cost of surveillance over 14 years per patient found to have advanced adenoma or recurrent cancer was $16,980.

**Incidence and Distribution of CRC Patients using 2005 Guidelines**

Using the 2005 guidelines it was assumed that the total cohort of 7700 patients would have a surveillance colonoscopy at three years following cancer resection. The distribution of patients in each category (Figure 1b) was based on the following:

A. An estimated 470 patients were diagnosed with advanced adenomas at three years post resection based on a weighted mean of 6.1% of advanced adenomas at three years (i.e. 4.1% advanced adenoma rate at one year and further 1% per annum). These patients would then have a surveillance colonoscopy in another three years.

B. Using a cancer recurrence rate of 15%, an estimated 1155 patients would have cancer recurrence at the three year surveillance colonoscopy. These patients would no longer be eligible for surveillance.

C. The remaining 6075 patients were assumed to have non-advanced adenomas or normal colonoscopies at three years (i.e. 7700 - [A+B] or 7700 - [470 +1155]). These patients would then have a surveillance colonoscopy in five years.
D. Of the 470 patients (A) with advanced adenomas at the three year colonoscopy it was assumed that a further 1% of patients would develop an advanced adenoma every year.\textsuperscript{10, 11} Therefore at the six year surveillance colonoscopy 3% or 14 patients would be diagnosed with advanced adenoma(s). As this number was small it was assumed that all patients subsequently had non-advanced adenoma(s) or normal colonoscopies and thereafter had five yearly surveillance colonoscopy.

E. Of the 470 patients (A) with advanced adenoma(s) at three years the remaining 456 patients had non-advanced adenomas or normal colonoscopies at six years (i.e. A-D). These patients would then have five yearly surveillance colonoscopy.

F. Of the 6075 patients (C) who had non-advanced adenomas or normal colonoscopy at three years a further 5% \textsuperscript{10, 11} would subsequently be diagnosed with advanced adenomas at 8 years i.e. 304 patients. These patients would have another surveillance colonoscopy in three years.

G. At 8 years post CRC resection the remaining 5771 of the 6075 patients with normal or non-advanced adenomas at the three year surveillance colonoscopy would again have non-advanced adenoma(s) or a normal colonoscopy (C-F). These patients would continue to have five yearly colonoscopies.

H. Of the 304 patients with advanced adenomas at 8 years a further 3% (n=9 patients) would have advanced adenomas at 11 years. As the numbers are small it was assumed that all 9 patients would then have five yearly surveillance colonoscopy.

I. The remaining 259 patients of the 304 patients with advanced adenomas at 8 years had normal or non-advanced adenomas at 11 years. These patients would then continue to have five yearly colonoscopies.

Assuming total patient and physician compliance with the 2005 guidelines a total of 20,813 colonoscopies would be performed over 14 years for a cohort of 7700 patients diagnosed with CRC who had a curative resection and had their first surveillance colonoscopy at three years post resection (Table 1b).

<table>
<thead>
<tr>
<th>Time (years) post CRC Resection</th>
<th>Total colonoscopies</th>
<th>Colonoscopies in patients with recurrent cancer or advanced adenoma</th>
<th>Colonoscopies in patients with non advanced adenoma or normal colonoscopy</th>
</tr>
</thead>
</table>
| 1
| 2
| 3
| 7700  
| 1625
| 6075
| 4
| 5
| 470  
| 14
| 456
| 6
| 7
| 6075  
| 304
| 5771
| 8
| 9
| 14
| 14
| 10
| 760  
| 9
| 751
| 11
| 12
| 5771
| 5771
| 13
| 14
| 23
| 23
| Total colonoscopies  | 20813  
| 1952
| 18861

Table 1b: Colonoscopies in Post CRC resection Patients eligible for 3 year surveillance colonoscopy
The colonoscopy procedure costs were estimated using the costs described previously for patients in the public and private sectors (proposed guidelines) and a distribution of 30.2% of total colonoscopies in the public sector and 69.8% in the private sector.

- For 1,952 colonoscopies where an advanced adenoma or recurrent cancer was detected an estimated 590 were performed in the public sector at a rate of $1,150.22 per procedure and 1,362 in the private sector at a rate of $1,375 per procedure at a total cost of $2,551,380 for these colonoscopies.
- For the 18,861 colonoscopies where a non-advanced adenoma or normal colonoscopy was diagnosed an estimated 5,696 were performed in the public sector at a rate of $875.32 per procedure and 13,165 in the private sector at a rate of $1,375 per procedure. Therefore the cost for these colonoscopies was $23,087,698.
- If all patients had a same day procedure and no complications the total cost for surveillance colonoscopy over a period of 14 years would be $25,639,078.
- The average cost of surveillance over 14 years for each patient found to have advanced adenoma or recurrent cancer was $13,134.

**COSTS EFFECTIVENESS**

The estimated cost of surveillance colonoscopy for CRC follow up with the proposed guidelines which include a one year post resection colonoscopy is $26,693,175 (2010 Aus $) for a cohort of 7700 patients followed over a period of 14 years and $25,639,078 using the 2005 guidelines for the same period (see table below).

**Table 1c: Summary of Colonoscopies and Costs for 7700 pts over 14 years**

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Recurrent cancer or advanced adenoma(s)</th>
<th>Advanced adenoma(s) (% total)</th>
<th>Non-advanced adenoma(s) or normal colonoscopies (% total)</th>
<th>Total cost for program</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proposed Guideline</td>
<td>21700</td>
<td>1572</td>
<td>319 (1.5%)</td>
<td>20128 (93%)</td>
<td>$26,693,175</td>
</tr>
<tr>
<td>(1 year post CRC resection)</td>
<td>20813</td>
<td>1952</td>
<td>484 (2.3%)</td>
<td>18861 (91%)</td>
<td>$25,639,078</td>
</tr>
<tr>
<td>2005 Guideline</td>
<td>887</td>
<td>-380</td>
<td>-165</td>
<td>1267</td>
<td>$1,054,097</td>
</tr>
<tr>
<td>(3 years post CRC resection)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increments*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incremental cost per additional outcome #</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$1,188</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Increments estimated by subtracting 2005 guidelines from proposed guidelines; # Incremental cost per additional outcome estimated by dividing the increment (total cost for program) by the respective increment

Incremental costs with the proposed surveillance colonoscopy guidelines for patients who have had resection of colorectal cancer: Additional $2774 per advanced adenoma or recurrent cancer avoided or additional $6,388 per advanced adenoma avoided and $832 for non-advanced adenoma(s) or normal colonoscopy detected.
Figure 1a: Summary of Post CRC Resection Patients Requiring Colonoscopy Surveillance based on New Guidelines

- **Pts <80 years with CRC**
  - N=11,102 pts

- **Pts advanced cancer/total colectomy (i.e. Stage D, 30% Stage C)**
  - N=3402 pts
  - No surveillance

**Colonoscopy at 1 year post resection (T=1)**
- **N=7700 pts**

- **A. Advanced adenoma 4.1% or N=316**
  - next colonoscopy at 1 year

- **B1. Recurrent cancer (local or metastatic) 10% or N=770 pts**
  - No further surveillance

- **B2. Recurrent cancer (local or metastatic) 5% or N=331 pts**
  - No further surveillance

- **C. N=6614 pts**
  - Normal/non-advanced adenoma(s): next colonoscopy at 5 years

- **D. Advanced adenoma 1% or N=3 pts**
  - next colonoscopy at 1 year

- **E. N=313 pts**
  - Normal/non-advanced adenoma: go to 5 yearly surveillance colonoscopy
  - N=3 pts: go to 5 yearly surveillance colonoscopy

- **F. Advanced Adenoma(s) 2.3% or N=152 pts**
  - next colonoscopy at 3 year
  - N=152 pts Normal/non-advanced adenoma(s): go to 5 yearly surveillance colonoscopy

- **G. Normal/non-advanced adenomas(s) N=6131 pts**
  - go to 5 yearly surveillance colonoscopy

- **H. Normal/non-advanced adenoma(s) N=152 pts**
  - go to 5 yearly surveillance colonoscopy

- **Appendices 124**
Figure 1b: Summary of Post CRC Resection Patients Requiring Surveillance based on 2005 Guidelines

Pts <80 years with CRC
N=11,102 pts

Pts advanced cancer/total colectomy (all Stage D, 30% Stage C) N=3402 pts
No surveillance

Colonoscopy at 3 years post CRC resection (T=3) N=7700 pts

A. Advanced adenoma(s) 6.1% or N=470 pts: next colonoscopy in 3 years

D. Advanced adenoma(s) 3% N=14 pts: 3 year surveillance colonoscopy then 5 yearly surveillance colonoscopy

E. N=456 pts Normal/non-advanced adenoma: go to 5 yearly surveillance colonoscopy

F. Advanced Adenoma(s) 5% or N=304 pts: next colonoscopy in 3 years

G. Normal/non-advanced adenoma(s) N=5771: go to 5 yearly surveillance colonoscopy

H. Advanced Adenoma(s) 3% or N=9 pts: next colonoscopy in 3 years then 5 yearly surveillance colonoscopy

I. Normal/non-advanced adenoma(s) N=295 pts: go to 5 yearly surveillance colonoscopy

C. N=6075 pts Normal/non-advanced adenoma(s): next colonoscopy in 5 years

B. Recurrent cancer (local or metastatic) 15% or N=1155: No further surveillance
2. ADENOMAS

Surveillance scenario comparisons

The analyses undertaken for patients diagnosed with adenomas compared the surveillance strategy recommended in the 2005 Guidelines for the Prevention, Early Detection and Management of Colorectal Cancer with each of two potential new surveillance strategies:

- 2005 guidelines
  - Advanced adenomas - three yearly surveillance; non-advanced adenomas/no neoplasia - five yearly surveillance

- New guidelines
  - Option A: Advanced adenomas – three yearly surveillance; non-advanced adenomas/no neoplasia - five year initial surveillance followed by 10 yearly surveillance
  - Option B: Advanced adenomas - three yearly surveillance; non-advanced adenomas/no neoplasia - 10 yearly surveillance

Colonoscopy Costs

Public Patients

The estimated reimbursement for a same day colonoscopy procedure in patients with past history of polyps or adenoma(s) and no recurrence is $865.32:

- DRG: Z40Z Endoscopy with Diagnoses of other contacts with Health Services
- ACHI Principle Procedure: 32090 fibreoptic colonoscopy to caecum
- ICD-10-AM Principle Diagnosis: Z090 Follow-up examination after surgery for other conditions

The estimated reimbursement for a same day colonoscopy procedure in patients with a past history polyps or adenoma(s) with recurrence is $1,140.22:

- DRG: G48C Colonoscopy Same day
- ACHI Principle Procedure: 32093 fibreoptic colonoscopy to caecum with polypectomy
- ICD-10-AM Principle Diagnosis: D010 Carcinoma in situ of colon OR K6358 Other polyp of colon

Private Sector

The average total costs for same day patients with past history of polyps or adenoma(s) who have not had a recurrence was $1,367 and $1,379 for all patients (i.e. same day, overnight or multistay admissions)

The average total costs for same day patients with past history of polyps or adenoma(s) who have had a recurrence was $1,685 and $1,718 for all patients (i.e. same day, overnight or multistay admissions)

Incidence and distribution of advanced and non-advanced adenomas

Baseline distribution of advanced and non-advanced adenomas

Using a health service perspective costs were estimated for 20 years of follow-up after removal of adenoma(s). All analyses were based on the incidence and distribution of advanced and non-advanced adenomas that would be expected from a full initial national roll-out of the National Bowel Cancer Screening Program (NBCSP).

The following assumptions were made in these estimations, with eligible population estimates based on June 2010 demographic statistics from the Australian Bureau of Statistics. The rate of participation in the
screening program and the distribution of cancer, advanced adenoma and non-advanced adenoma amongst people with positive FOBT results undergoing colonoscopy were based on the results of the phase 1 evaluation of the Queensland Bowel Cancer Screening Program. The rate of positive FOBT results was based on results of the Queensland Bowel Cancer Screening Program reported by the AIHW. 

• Full national roll out of the NBCSP for people aged 55-74 years
  o 5,628,882 people eligible for screening
• 45.5% of eligible people participate in the NBCSP
  o 2,555,512 people screened
• 7% of people undergoing screening will return a positive FOBT result
  o 178,886 people return a positive FOBT
• 100% of people with a positive FOBT undergo a baseline colonoscopy
  o 178,886 people undergoing colonoscopy
• Of the 178,886 people undergoing baseline colonoscopy:
  o 5.0% of people will have colorectal cancer detected (8,944)
  o 18.9% of people undergoing colonoscopies will have an advanced adenoma detected (33,809)
  o 33.4% of people undergoing colonoscopies will have non-advanced adenoma detected (59,748)
  o 93,557 people will have an adenoma detected
• Patients having advanced adenomas were defined as those with ≥2 adenomas, or with adenomas ≥10 mm or with villous/tubulovillous histology or with high grade dysplasia
• Patients having non-advanced adenomas were defined as those with 1-2 small (<10mm), tubular adenomas.
• Patients with no neoplasia were those with no adenomatous polyps

For the purposes of this analysis, the total number of people with adenomas detected was rounded to 100,000 (i.e. advanced adenomas and non-advanced adenomas). It was also assumed that all people with advanced non-advanced adenomas or no adenomas (no neoplasia) detected at follow-up colonoscopies would continue with surveillance colonoscopies at periods recommended for non-advanced adenomas. The distribution of colonoscopies with advanced adenoma(s), non-advanced adenoma(s) and normal results over the 20 year surveillance period were based on the published literature used as the evidence base for the recommendations in Chapter 2.

**Incidence of advanced adenomas at three year surveillance following advanced adenomas at baseline colonoscopy**

The estimated percentage of patients with advanced adenoma at the baseline colonoscopy who were found to have an advanced adenoma at the three year surveillance colonoscopy was based on a weighted mean of 11.1% from four studies that stratified adenoma findings at three year surveillance by the baseline findings.
Incidence of advanced adenomas at five year surveillance following non-advanced adenomas at baseline colonoscopy

The estimated percentage of patients with non-advanced adenoma at the baseline colonoscopy who had advanced adenoma at the five year surveillance colonoscopy was 4.9% based on Lieberman et al. 2007.  

Incidence of advanced adenomas at six year surveillance following advanced adenomas at three year surveillance colonoscopy

The estimated percentage of patients with advanced adenoma at three year surveillance colonoscopy who had advanced adenoma at the six year surveillance colonoscopy was 18.2% based on Robertson and co-workers 25 where 8 of 44 (18.2%) patients with high risk findings at the second surveillance examination (mean 37.4 months from baseline) had high risk findings at the third surveillance examination (mean 39.5 months between 2nd and 3rd surveillance examination). All of the 44 patients in the high risk finding stratum at the second surveillance also had high risk findings at the baseline examination.

Incidence of advanced adenomas beyond six years surveillance following advanced adenomas at 6 and three year surveillance and baseline colonoscopy

There were no studies with follow-up beyond six years that estimated the percentage of patients with advanced adenoma stratified by previous surveillance findings. Therefore it was assumed that 18.2% of patients undergoing three yearly surveillance for advanced adenomas would have advanced adenomas detected at subsequent surveillance colonoscopies. 25

For incidence of advanced adenomas at all other surveillance intervals, the numbers of patients with advanced adenomas or non-advanced adenomas /normal results were estimated using the annual incidences for advanced adenoma calculated from information provided in Jorgensen and co-workers. 27

For the annual incidence rate for advanced adenoma(s) a weighted mean of 1.45% was used for the first four years of follow-up and 0.7% for follow-up after four years. A limitation of this approach is that Jorgensen and co-workers 27 did not stratify the numbers of adenomas detected at surveillance by the type of adenoma detected at the baseline colonoscopy.

Incidence and distribution of adenomas detected at follow-up surveillance

2.1: 2005 Guidelines

It was assumed that the total cohort of 100,000 patients with adenomas detected at baseline colonoscopy would undergo surveillance colonoscopy the following intervals:

- Patients with advanced adenoma – surveillance colonoscopy at three yearly intervals
- Patients with non-advanced adenoma or no neoplasia – surveillance colonoscopy at five yearly intervals

Figure 2.1a shows the distribution of patients in each category which were based on the following:

A. Total number of people with adenomas at baseline colonoscopy estimated from a full national roll-out of the Bowel Cancer Screening Program for people aged 55-74 years (100,000)
B. Total number of people with advanced adenomas at baseline colonoscopy (36,000)
C. (36,000 (B) x 11.1% =3,996): 2007: 11.1% incidence rate for advanced adenomas at 3 year surveillance based on weighted mean from 4 studies 23-26
D. (36,000(B) – 3,996(C) = 32,004(D)): non-advanced adenoma or normal results
E. \((3,996 (C) \times 18.2\% = 727)\): based on 18.2 % incidence rate 25 for advanced adenomas at 6 year surveillance

F. \((3,996 (C) - 727(H) = 3,269 (F))\): non-advanced adenoma or normal results

G. \((32,004 (D) \times 4.25\% = 1,360(G))\): The number of people with advanced adenomas at 8 year surveillance was based on an annual incidence rates of 1.45% (up to 4 years post baseline colonoscopy) and 0.7% (for follow-up beyond 4 years) for advanced adenomas 27: Advanced adenoma incidence at 13 y = \((1x1.45) + (4x0.7) = 4.25\%\).

H. \((32,004 (D) - 1,360(G) = 30,644 (H))\): non-advanced adenoma or normal results

I. \((727 (E) \times 18.2\% = 132 (I))\): based on 18.2 % incidence rate for advanced adenomas at 9 year surveillance 25

J. \((727 (E) - 132 (I) = 595(J))\): non-advanced adenoma or normal results

K. \((3,269 (F) \times 3.5\% = 114(K))\): The number of people with advanced adenomas at 11 year surveillance was based on an annual incidence rates of 0.7% (for follow-up beyond 4 years) for advanced adenomas 27: Advanced adenoma incidence at 11 y = \((5x0.7) = 3.5\%\).

L. \((3,269 (F) - 114(K) = 3,155 (L))\): non-advanced adenoma or normal results

M. \((1,360(G) \times 2.1\% = 29 (M))\): The number of people with advanced adenomas at 11 year surveillance was based on an annual incidence rates of 0.7% (for follow-up beyond 4 years) for advanced adenomas 27: Advanced adenoma incidence at 11 y = \((3x0.7) = 2.1\%\).

N. \((1,360(G) - 29 (M) = 1,331 (N))\): non-advanced adenoma or normal results

O. \((30,644 (H) \times 3.5\% = 1,073(O))\): The number of people with advanced adenomas at 13 year surveillance was based on an annual incidence rates of 0.7% (for follow-up beyond 4 years) for advanced adenomas 27: Advanced adenoma incidence at 13 y = \((5x0.7) = 3.5\%\).

P. \((30,644 (H) - 1,073(O) = 29,571 (P))\): non-advanced adenoma or normal results

Q. \((132 (I) \times 18.2\% = 24 (Q))\): based on 18.2 % incidence rate for advanced adenomas at 6 year surveillance 25

R. \((132 (I) - 24 (Q) = 108 (R))\): non-advanced adenoma or normal results

S. \((595 (J) \times 3.5\% = 21(S))\): The number of people with advanced adenomas at 14 year surveillance was based on an annual incidence rates of 0.7% (for follow-up beyond 4 years) for advanced adenomas 27: Advanced adenoma incidence at 14 y = \((5x0.7) = 3.5\%\).

T. \((595 (J) - 21(S) = 574 (T))\): non-advanced adenoma or normal results

U. \((114 (K) \times 2.1\% = 2 (U))\): The number of people with advanced adenomas at 14 year surveillance was based on an annual incidence rates of 0.7% (for follow-up beyond 4 years) for advanced adenomas 27: Advanced adenoma incidence at 14 y = \((3x0.7) = 2.1\%\).

V. \((114 (K) - 2 (U) = 112 (V))\): non-advanced adenoma or normal results

W. \((3,155 (L) \times 3.5\% = 110 (W))\): The number of people with advanced adenomas at 16 year surveillance was based on an annual incidence rates of 0.7% (for follow-up beyond 4 years) for advanced adenomas 27: Advanced adenoma incidence at 16 y = \((5x0.7) = 3.5\%\).

X. \((3,155 (L) - 110 (W) = 3,045 (X))\): non-advanced adenoma or normal results

Y. \((29 (M) \times 2.1\% = 1 (Y))\): The number of people with advanced adenomas at 14 year surveillance was based on an annual incidence rates of 0.7% (for follow-up beyond 4 years) for advanced adenomas 27: Advanced adenoma incidence at 14 y = \((3x0.7) = 2.1\%\).

Z. \((29 (M) - 1 (Y) = 28 (Z))\): non-advanced adenoma or normal results

AA. \((1,331 (N) \times 3.5\% = 47 (AA))\): The number of people with advanced adenomas at 16 year surveillance was based on an annual incidence rates of 0.7% 27: Advanced adenoma incidence at 16 y = \((5x0.7) = 3.5\%\).

BB. \((1,331 - 47 (AA) = 1284 (BB))\): non-advanced adenoma or normal results

CC. \((1,073 (O) \times 2.1\% = 23 (CC))\): The number of people with advanced adenomas at 16 year surveillance was based on an annual incidence rates of 0.7% 27: Advanced adenoma incidence at 16 y = \((3x0.7) = 2.1\%\).

DD. \((1,073 (O) - 23 (CC) =1,050 (DD))\): non-advanced adenoma or normal results

EE. \((29,571 (P) \times 3.5\% = 1035 (EE))\): The number of people with advanced adenomas at 18 year surveillance was based on an annual incidence rates of 0.7% 27: Advanced adenoma incidence at 18 y = \((5x0.7) = 3.5\%\).

FF. \((29,571 (P) -1035 (EE) =28,536 (FF))\): non-advanced adenoma or normal results

GG. \((24(Q) \times 18.2\% = 4 (GG))\): based on 18.2 % incidence rate for advanced adenomas at 6 year surveillance 25

HH. \((24(Q) - 4 (GG) = 20 (HH))\): non-advanced adenoma or normal results

II. \((108 (R) \times 3.5\% = 4 (II))\): The number of people with advanced adenomas at 17 year surveillance was based on an annual incidence rates of 0.7% 27: Advanced adenoma incidence at 17 y = \((5x0.7) = 3.5\%\)
Appendices

JJ. $(108 \text{ (R)} - 4 \text{ (II)} = 104 \text{ (JI)})$: non-advanced adenoma or normal results

KK. 21 people with non-advanced adenoma or normal results.

LL. $(574 \text{ (T)} \times 3.5\% = 20 \text{ (LL)})$: The number of people with advanced adenomas at 19 year surveillance was based on an annual incidence rates of 0.7\% 27: Advanced adenoma incidence at 19 y = $5 \times 0.7 = 3.5\%$.

MM. $(574 \text{ (T)} - 20 \text{ (LL)} = 554 \text{ (MM)})$: non-advanced adenoma or normal results

NN. Two people with non-advanced adenoma or normal results.

OO. $(112 \text{ (T)} \times 3.5\% = 4 \text{ (LL)})$: The number of people with advanced adenomas at 19 year surveillance was based on an annual incidence rates of 0.7\% 27: Advanced adenoma incidence at 19 y = $5 \times 0.7 = 3.5\%$.

PP. $(112 \text{ (T)} - 4 \text{ (LL)} = 108 \text{ (PP)})$: non-advanced adenoma or normal results

QQ. $(110 \text{ (W)} \times 2.1\% = 2 \text{ (QQ)})$: The number of people with advanced adenomas at 19 year surveillance was based on an annual incidence rates of 0.7\% 27: Advanced adenoma incidence at 19 y = $3 \times 0.7 = 2.1\%$.

RR. $(110 \text{ (W)} - 2 \text{ (QQ)} = 108 \text{ (RR)})$: non-advanced adenoma or normal results

SS. One person with non-advanced adenoma or normal results.

TT. $(28 \text{ (Z)} \times 3.5\% = 1 \text{ (TT)})$: The number of people with advanced adenomas at 19 year surveillance was based on an annual incidence rates of 0.7\% 27: Advanced adenoma incidence at 19 y = $5 \times 0.7 = 3.5\%$.

UU. $(28 \text{ (Z)} - 1 \text{ (TT)} = 27 \text{ (UU)})$: non-advanced adenoma or normal results

VV. $(47 \text{ (AA)} \times 2.1\% = 1 \text{ (VV)})$: The number of people with advanced adenomas at 19 year surveillance was based on an annual incidence rates of 0.7\% 27: Advanced adenoma incidence at 19 y = $3 \times 0.7 = 2.1\%$.

WW. $(47 \text{ (AA)} - 1 \text{ (VV)} = 46 \text{ (WW)})$: non-advanced adenoma or normal results

XX. 23 people with non-advanced adenoma or normal results.

YY. 4 people with non-advanced adenoma or normal results.

ZZ. $(20 \text{ (HH)} \times 3.5\% = 1 \text{ (ZZ)})$: The number of people with advanced adenomas at 20 year surveillance was based on an annual incidence rates of 0.7\% 27: Advanced adenoma incidence at 20 y = $5 \times 0.7 = 3.5\%$.

α $(20 \text{ (HH)} - 1 \text{ (ZZ)} = 19 \text{ (α)})$: non-advanced adenoma or normal results

β Four people with non-advanced adenoma or normal results
Figure 2.1a: Distribution of adenomas over 20 years amongst patients with advanced adenoma(s) at baseline according to 2005 Guidelines

AA = number of patients with advanced adenoma
NAA/NN = number of patients with non-advanced adenoma or no neoplasia
T = surveillance period (years)
Figure 2.1b: Distribution of adenomas over 20 years amongst patients with non-advanced adenoma(s) at baseline according to 2005 Guidelines

AA = number of patients with advanced adenoma
NAA/NN = number of patients with non-advanced adenoma or no neoplasia
T=surveillance period (years)
Figure 2.1b shows the distribution of patients in each category which were based on the following:

A. Total number of people with adenomas at baseline colonoscopy estimated from a full national rollout of the Bowel Cancer Screening Program for people aged 55-74 years (100,000)
B. Total number of people with non-advanced adenomas at baseline colonoscopy (64,000)
C. (64,000 (B) x 4.9%) = 3,136; 2007: 4.9% incidence rate for advanced adenomas at 5 year surveillance after non-advanced adenomas at baseline
D. (64,000 (B) – 3,136 (C) = 60,864 (D): non-advanced adenoma or normal results
E. (3,136 (C) x 2.1% = 66 (E): The number of people with advanced adenomas at 8 year surveillance was based on an annual incidence rates of 0.7%: Advanced adenoma incidence at 8 y = (3x0.7) = 2.1%.
F. (3,136 (C) – 66 (E) = 3,070 (F)): non-advanced adenoma or normal results
G. (60,864 (D) x 3.5% = 2,130 (G): The number of people with advanced adenomas at 10 year surveillance was based on an annual incidence rates of 0.7%: Advanced adenoma incidence at 10 y = (5x0.7) = 3.5%.
H. (60,864 (D) – 2,130 (G) = 58,735 (F)): non-advanced adenoma or normal results
I. (66 (E) x 2.1% = 1.4): Roudned to advanced adenoma detected in 1 person. The number of people with advanced adenomas at 11 year surveillance was based on an annual incidence rates of 0.7%
J. (66 (E) – 1(l) = 65 (J)): non-advanced adenoma or normal results
K. (3,070 (F) x 3.5% = 107 (K): The number of people with advanced adenomas at 13 year surveillance was based on an annual incidence rates of 0.7%
L. (3,070 (F) – 107 (K) = 2,963 (L): non-advanced adenoma or normal results
M. (2,130 (G) x 2.1% = 45 (M)): The number of people with advanced adenomas at 13 year surveillance was based on an annual incidence rates of 0.7%
N. (2,130 (G) – 45 (M) = 2,085 (N)): non-advanced adenoma or normal results
O. (58,735 (H) x 3.5% = 2,056 (O)): The number of people with advanced adenomas at 15 year surveillance was based on an annual incidence rates of 0.7%
P. (58,735 (H) - 2,056 (O) = 56,679 (P)): non-advanced adenoma or normal results
Q. (1 (l) x 2.1% = 0.02): No people with advanced adenoma at 14 y surveillance, therefore this 1 person has non-advanced adenoma or normal result at 14 year surveillance.
R. (65 (J) x 3.5% = 2 (R)): The number of people with advanced adenomas at 16 year surveillance was based on an annual incidence rates of 0.7%
S. (65 (J) – 2 (R) = 63 (S)): non-advanced adenoma or normal results
T. (107 (K) x 2.1% = 2 (T)): The number of people with advanced adenomas at 16 year surveillance was based on an annual incidence rates of 0.7%
U. (107 (K) – 2 (T) = 105 (U)): non-advanced adenoma or normal results
V. (2,963 (L) x 3.5% = 104 (V)): The number of people with advanced adenomas at 18 year surveillance was based on an annual incidence rates of 0.7%
W. (2,963 (L) – 2 (T) = 2859 (W)): non-advanced adenoma or normal results
X. (45 (M) x 2.1% = 1 (T)): The number of people with advanced adenomas at 16 year surveillance was based on an annual incidence rates of 0.7%
Y. (45 (M) – 1 = 44 (T)): non-advanced adenoma or normal results
Z. (2,085 (N) x 3.5% = 73 (Z)): The number of people with advanced adenomas at 18 year surveillance was based on an annual incidence rates of 0.7%
AA. (2,085 (N) – 73 (Z) = 2,012 (Aa)): non-advanced adenoma or normal results
BB. (2056 (O) x 2.1% = 43 (Bb)): The number of people with advanced adenomas at 18 year surveillance was based on an annual incidence rates of 0.7%
CC. (2056 (O) - 43 (Bb) = 2013 (Cc): non-advanced adenoma or normal results
The number of people with advanced adenomas at 20 year surveillance was based on an annual incidence rates of 0.7%: Advanced adenoma incidence at 20 y = (5x0.7) = 3.5%.

non-advanced adenoma or normal results

1 person with non-advanced adenoma or normal result.
2 people with non-advanced adenoma or normal result.
2 people with non-advanced adenoma or normal result.
1 person with non-advanced adenoma or normal result.

Assuming total compliance with the new guidelines a total of 401,135 surveillance colonoscopies would be performed over 20 years for patients with adenoma detected at baseline colonoscopy. This includes:

- 18,481 colonoscopies that detect advanced adenomas (combined results from Figure 2.1a and 2.1b)
  - At 3 year surveillance – 3,996 colonoscopies
  - At 5 year surveillance – 3,136 colonoscopies
  - At 6 year surveillance – 727 colonoscopies
  - At 8 year surveillance – 1,426 colonoscopies
  - At 9 year surveillance – 132 colonoscopies
  - At 10 year surveillance – 2,130 colonoscopies
  - At 11 year surveillance – 144 colonoscopies
  - At 12 year surveillance – 24 colonoscopies
  - At 13 year surveillance – 1,225 colonoscopies
  - At 14 year surveillance – 24 colonoscopies
  - At 15 year surveillance – 2,060 colonoscopies
  - At 16 year surveillance – 185 colonoscopies
  - At 17 year surveillance – 4 colonoscopies
  - At 18 year surveillance – 1,255 colonoscopies
  - At 19 year surveillance – 28 colonoscopies
  - At 20 year surveillance – 1,985 colonoscopies

- 382,696 colonoscopies that detect non-advanced adenomas or no neoplasia (combined results from Figure 2.1a and 2.1b)
  - At 3 year surveillance – 32,004 colonoscopies
  - At 5 year surveillance – 60,864 colonoscopies
  - At 6 year surveillance – 3,269 colonoscopies
  - At 8 year surveillance – 33,714 colonoscopies
  - At 9 year surveillance – 595 colonoscopies
  - At 10 year surveillance – 58735 colonoscopies
  - At 11 year surveillance – 4,551 colonoscopies
  - At 12 year surveillance – 108 colonoscopies
  - At 13 year surveillance – 34,619 colonoscopies
  - At 14 year surveillance – 715 colonoscopies
  - At 15 year surveillance – 56,699 colonoscopies
  - At 16 year surveillance – 5591 colonoscopies
Assuming that 30.2% of colonoscopies were performed in the public sector and 69.8% in the private sector and using $865.32 for the costs for a same day colonoscopy reporting non-advanced adenoma(s) or normal colonoscopy in the public sector and $1,367 in the private sector. For patients who had an advanced adenoma the cost for the colonoscopy in the public sector was $1,140.22 for a same day admission and $1,685 in the private sector. A further $10 was added to the cost of each procedure to account for the cost of the bowel preparation and cleansing.

- Of the 18,481 colonoscopies that detected advanced adenomas, 5,581 were performed in the public sector at a cost of $1,150.22 per procedure and 12,900 in the private sector at a cost of $1,695 per procedure. The total cost for colonoscopies detecting an advanced adenoma was $28,284,878.
- Of the 382,696 colonoscopies that detected non-advanced adenomas or no neoplasia, 115,574 were performed in the public sector at a cost of $875.32 per procedure and 267,122 were performed in the private sector at a cost of $1,377 per procedure. The total cost of these colonoscopies was $468,991,228.
- For a patient cohort of 100,000 patients with adenoma detected at the baseline colonoscopy, the total cost of surveillance over 20 years of follow-up would be $497,276,106 if all patients had a same day procedure and no complications.
- A total of 401,117 colonoscopies were performed for $497,276,106 and advanced adenoma were detected in 18,481 patients.

Using a complication rate of 0.1%, in this cohort of patients over 20 years there would be 208 colonoscopies that resulted in perforation or other major complications. The cost of a complication varies from $1700 for a same day discharge to $14,911.55 for a multi stay hospitalisation. Therefore the additional costs for complications from colonoscopies could range from $682,000 to $5,982,170.

### 2.2 Proposed New guidelines – Option A

It was assumed that the total cohort of 100,000 patients with adenomas detected at baseline colonoscopy would undergo surveillance colonoscopy according to the following intervals:

- Patients with advanced adenoma – surveillance colonoscopy at three year intervals.
- Patients with non-advanced adenoma or no neoplasia – initial surveillance colonoscopy five years and subsequent surveillance colonoscopies at 10 yearly intervals.

Figures 2.2a and 2.2b show the distribution of patients in each category.
colonoscopy) and 0.7% (for follow-up beyond 4 years) for advanced adenomas. Advanced adenoma incidence at 8 year = (1x1.45) + (4x0.7) = 4.75%.

H. (32,004 (D) = 1,360 (G) = 30,644 (H)): non-advanced adenoma or normal results

I. (727 (E) x 18.2% = 132 (I)): based on 18.2% incidence rate for advanced adenomas at 9 year surveillance

J. (727 (E) = 132 (I) = 595 (J)): non-advanced adenoma or normal results

K. (3,269 (F) = 3.5% = 114 (K)): The number of people with advanced adenomas at 11 year surveillance was based on an annual incidence rates of 0.7%. Advanced adenoma incidence at 11 y = (5x0.7) = 3.5%.

L. (3,259 (F) = 114 (K) = 3,155 (L)): non-advanced adenoma or normal results

M. (1,360 (G) x 2.1% = 29 (M)): The number of people with advanced adenomas at 11 year surveillance was based on an annual incidence rates of 0.7%.

N. (1,360 (G) = 29 (M = 1,331 (N)): non-advanced adenoma or normal results

O. (30,644 (H) x 7.0% = 2,145 (O)): The number of people with advanced adenomas at 18 year surveillance was based on an annual incidence rate of 0.7%.

P. (30,644 (H) = 2,145 (O) = 28,499 (P)): non-advanced adenoma or normal results

Q. (132 (I) x 18.2% = 24 (Q)): 18.2% incidence rate for advanced adenomas at 6 year surveillance

R. (132 (I) = 24 (Q) = 108 (R)): non-advanced adenoma or normal results

S. (595 (J) x 3.5% = 21 (S)): The number of people with advanced adenomas at 14 year surveillance was based on an annual incidence rates of 0.7%.

T. (595 (J) = 21 (S) = 574 (T)): non-advanced adenoma or normal results

U. (114 (K) x 2.1% = 2 (U)): The number of people with advanced adenomas at 14 year surveillance was based on an annual incidence rates of 0.7%.

V. (114 (K) = 2 (U) = 112 (V)): non-advanced adenoma or normal results

W. (29 (M) x 2.1% = 1 (W)): The number of people with advanced adenomas at 14 year surveillance was based on an annual incidence rates of 0.7%.

X. (29 (M) = 1 (W) = 28 (X)): non-advanced adenoma or normal results

Y. (1331 (N) x 3.5% = 47 (Y)): The number of people with advanced adenomas at 16 year surveillance was based on an annual incidence rates of 0.7%.

Z. (1331 (N) = 47 (Y) = 1,284 (Z)): non-advanced adenoma or normal results

AA. (24 (O) x 18.2% = 4 (W)): 18.2% incidence rate for advanced adenomas at 15 year surveillance

BB. (24 (O) = 4 (W) = 20 (Bb)): non-advanced adenoma or normal results

CC. (108 (R) x 3.5% = 4 (Cc)): The number of people with advanced adenomas at 17 year surveillance was based on an annual incidence rates of 0.7%.

DD. (108 (R) = 4 (Cc) = 104 (Dd)): non-advanced adenoma or normal results

EE. 21 people with non-advanced adenoma or normal results.

FF. 2 people with non-advanced adenoma or normal results.

GG. (112 (V) x 3.5% = 4 (V)): The number of people with advanced adenomas at 19 year surveillance was based on an annual incidence rates of 0.7%.

HH. (112 (V) = 4 (V) = 108 (Hh)): non-advanced adenoma or normal results

II. 1 person with non-advanced adenoma or normal results.

JJ. (28 (X) x 3.5% = 1 (Jj)): The number of people with advanced adenomas at 19 year surveillance was based on an annual incidence rates of 0.7%.

KK. (28 (X) = 1 (Jj) = 27 (Kk)): non-advanced adenoma or normal results

LL. (47 (Y) x 2.1% = 1 (Ll)): The number of people with advanced adenomas at 19 year surveillance was based on an annual incidence rates of 0.7%.

MM. (47 (Y) = 1 (Ll) = 46 (Mm)): non-advanced adenoma or normal results
NN. 4 people with non-advanced adenoma or normal results.
OO. 20 people with non-advanced adenoma or normal results.
PP. 4 people with non-advanced adenoma or normal results.
Figure 2.2a: Distribution of adenomas over 20 years amongst patients with advanced adenoma(s) at baseline according to proposed Guidelines- Option A

AA = number of patients with advanced adenoma
NAA/NN = number of patients with non-advanced adenoma or no neoplasia
T= surveillance period (years)

A. Total adenoma

B. T=0
   AA = 36,000
   N/N = 32,004

C. T=3
   AA = 3,996

D. T=3
   N/N = 3,269
   N/N = 3,269

E. T=6
   AA = 727
   N/N = 3,269

F. T=6
   AA = 1,360
   N/N = 1,360

G. T=8
   AA = 1,360
   N/N = 3,269

H. T=8
   AA = 1,360
   N/N = 3,269

I. T=9
   AA = 132
   N/N = 595

J. T=9
   AA = 132
   N/N = 595

K. T=11
   AA = 114
   N/N = 3,155

L. T=11
   AA = 114
   N/N = 3,155

M. T=11
   AA = 29
   N/N = 1,331

N. T=11
   AA = 29
   N/N = 1,331

O. T=12
   AA = 1
   N/N = 28
   N/N = 28

P. T=12
   AA = 1
   N/N = 28
   N/N = 28

Q. T=12
   AA = 24
   N/N = 108

R. T=12
   AA = 24
   N/N = 108

S. T=14
   AA = 3
   N/N = 104

T. T=14
   AA = 3
   N/N = 104

U. T=14
   AA = 2
   N/N = 2

V. T=14
   AA = 2
   N/N = 2

W. T=14
   AA = 1
   N/N = 2

X. T=14
   AA = 1
   N/N = 2

Y. T=16
   AA = 47
   N/N = 1,284

Z. T=16
   AA = 47
   N/N = 1,284

Aa. T=18
   AA = 4
   N/N = 20

Bb. T=15
   AA = 4
   N/N = 20

Cc. T=17
   AA = 4
   N/N = 20

Dd. T=17
   AA = 4
   N/N = 20

Ee. T=17
   AA = 4
   N/N = 20

Ff. T=17
   AA = 4
   N/N = 20

Gg. T=19
   AA = 4
   N/N = 20

Hh. T=19
   AA = 4
   N/N = 20

Ii. T=19
   AA = 4
   N/N = 20

Jj. T=19
   AA = 4
   N/N = 20

Kk. T=19
   AA = 4
   N/N = 20

Ll. T=19
   AA = 4
   N/N = 20

Mm. T=19
   AA = 4
   N/N = 20

Nn. T=19
   AA = 4
   N/N = 20

Oo. T=20
   AA = 4
   N/N = 20

Pp. T=20
   AA = 4
   N/N = 20

Appendices  138
Figure 2.2b: Distribution of adenomas over 20 years amongst patients with non-advanced adenoma(s) at baseline according to proposed Guidelines- Option A

The cohort of patients in each category of adenoma patients (Figure 2.2b) was based on the following:

A. Total number of people with adenomas at baseline colonoscopy estimated from a full national roll-out of the Bowel Cancer Screening Program for people aged 55-74 years (100,000)
B. Total number of people with non-advanced adenomas at baseline colonoscopy (64,000)
C. (64,000 (B) x 4.9% = 3,136 (C)): Number of people with advanced adenoma at 5 year colonoscopy – based on 5-5 year cumulative incidence rate of 4.9% (45 people with advanced adenomas at 5.5 years / 920 people with no neoplasia or non-advanced adenoma at baseline colonoscopy) 26.
D. (64,000 (B)-3,136 (C)= 60,864 (D)): non-advanced adenoma or normal results
E. (3,136 x (C) x 2.1%= 66 (E)): The number of people with advanced adenomas at 8 year surveillance was based on an annual incidence rates of 0.7% (for follow-up beyond 4 years) for advanced adenomas 27: Advanced adenoma incidence at 8y = (3x0.7= 2.1%).
F. (3,136 (C) – 66 (E) =3,070 (F)): non-advanced adenoma or normal results
G. (60,864 (D) x 7.0%) =4,260 (H)): The number of people with advanced adenomas at 10 year surveillance was based on an annual incidence rate of 0.7% 27: Advanced adenoma incidence at 10y = (10x0.7= 7.0%).
H. \( (60,864 \text{ (D)} - 4,260 \text{ (G)} = 56,604 \text{ (H)}) \): non-advanced adenoma or normal results

I. \( (66 \text{ (E)} \times 2.1\% = 1 \text{ (I)}) \): The number of people with advanced adenomas at 11 year surveillance was based on an annual incidence rates of 0.7\% \(^2\). Advanced adenoma incidence at 11y = \( (3\times0.7= 2.1\%)\).

J. \( (66 \text{ (E)} - 1 \text{ (I)} = 65 \text{ (J)}) \): non-advanced adenoma or normal results

K. \( (3,070 \text{ (F)} \times 3.5\% = 107 \text{ (K)}) \): The number of people with advanced adenomas at 13 year surveillance was based on an annual incidence rates of 0.7\% \(^2\). Advanced adenoma incidence at 13y = \( (5\times0.7= 3.5\%)\).

L. \( (3,070 \text{ (F)} - 107 \text{ (K)}) = 2,963 \text{ (L)}) \): non-advanced adenoma or normal results

M. \( (4,260 \text{ (G)} \times 2.1\% = 89 \text{ (N)}) \): The number of people with advanced adenomas at 18 year surveillance was based on an annual incidence rates of 0.7\% \(^2\). Advanced adenoma incidence at 18y = \( (3\times0.7= 2.1\%)\).

N. \( (4,260 \text{ (G)} - 89 \text{ (M)} = 4,171 \text{ (N)}) \): non-advanced adenoma or normal results

O. 1 person with non-advanced adenoma or normal results.

P. \( (65 \text{ (J)} \times 3.5\% = 2 \text{ (Q)}) \): The number of people with advanced adenomas at 16 year surveillance was based on an annual incidence rates of 0.7\% \(^2\). Advanced adenoma incidence at 16y = \( (5\times0.7= 3.5\%)\).

Q. \( (65 \text{ (J)} - 2 \text{ (Q)} = 63 \text{ (Q)}) \): non-advanced adenoma or normal results

R. \( (107 \text{ (K)} \times 2.1\% = 2 \text{ (R)}) \): The number of people with advanced adenomas at 16 year surveillance was based on an annual incidence rates of 0.7\% \(^2\). Advanced adenoma incidence at 16y = \( (3\times0.7= 2.1\%)\).

S. \( (107 \text{ (K)} - 2 \text{ (R)} = 105 \text{ (S)}) \): non-advanced adenoma or normal results

T. 1 person with non-advanced adenoma or normal results.

U. 2 people with non-advanced adenoma or normal results.

V. 2 people with non-advanced adenoma or normal results.

Assuming total compliance with the new guidelines by physicians and patients a total of 246,145 surveillance colonoscopies would be performed over 20 years for patients with adenoma detected at baseline colonoscopy. This includes:

- 16,275 colonoscopies that detect advanced adenomas (combined results from Part 1 and Part 2)
  - At 3 year surveillance – 3,996 colonoscopies
  - At 5 year surveillance – 66 colonoscopies
  - At 6 year surveillance – 727 colonoscopies
  - At 8 year surveillance – 1,426 colonoscopies
  - At 9 year surveillance – 132 colonoscopies
  - At 11 year surveillance – 144 colonoscopies
  - At 12 year surveillance – 24 colonoscopies
  - At 13 year surveillance – 107 colonoscopies
  - At 14 year surveillance – 24 colonoscopies
  - At 15 year surveillance – 4,264 colonoscopies
  - At 16 year surveillance – 51 colonoscopies
  - At 17 year surveillance – 4 colonoscopies
  - At 18 year surveillance – 2,234 colonoscopies
  - At 19 year surveillance – 28 colonoscopies
  - At 20 year surveillance – 0 colonoscopies

- 229,870 colonoscopies that detect non-advanced adenomas or no neoplasia (combined results from Part 1 and Part 2)
Clinical Practice Guidelines for Surveillance Colonoscopy – in adenoma follow-up, following curative resection of colorectal cancer, and for cancer surveillance in inflammatory bowel disease

2. Proposed New Guidelines – Option B

It was assumed that the total cohort of 100,000 patients with adenomas detected at baseline colonoscopy would undergo surveillance colonoscopy according to the following intervals:

- At 3 year surveillance – 32,004 colonoscopies
- At 5 year surveillance – 60,864 colonoscopies
- At 6 year surveillance – 3,269 colonoscopies
- At 8 year surveillance – 33,714 colonoscopies
- At 9 year surveillance – 595 colonoscopies
- At 11 year surveillance – 4,551 colonoscopies
- At 12 year surveillance – 108 colonoscopies
- At 13 year surveillance – 2963 colonoscopies
- At 14 year surveillance – 715 colonoscopies
- At 15 year surveillance – 56,624 colonoscopies
- At 16 year surveillance – 1452 colonoscopies
- At 17 year surveillance – 128 colonoscopies
- At 18 year surveillance – 32,674 colonoscopies
- At 19 year surveillance – 185 colonoscopies
- At 20 year surveillance – 0 colonoscopies

It was assumed that 30.2% of colonoscopies were performed in the public sector and 69.8% in the private sector and the costs for a same day procedure were $865.32 in the public sector and $1,367 in the private sector for a patient with a non-advanced adenoma(s) or normal colonoscopy. For patients with advanced adenoma the cost in the public sector was $1,140.22 for a same day admission and $1,685 in the private sector. A further $10 was added to the cost of each procedure to account for the cost of the bowel preparation.

- Of the 16,275 colonoscopies that detected advanced adenomas, 4,915 were performed in the public sector at a cost of $1,150.22 per procedure and 11,360 were performed in the private sector at a cost of $1,695 per procedure. The total cost of colonoscopies that detected advanced adenoma(s) was $24,908,531
- Of the 229,870 colonoscopies that detected non-advanced adenomas or no neoplasia, 69,421 were performed in the public sector at a cost of $875.32 per procedure and 160,449 were performed in the private sector at a cost of $1,377 per procedure. The total cost for these colonoscopies was $281,703,863.
- For this patient cohort of 100,000 patients with adenoma detected at the baseline colonoscopy, the total cost of surveillance over 20 years of follow-up would be $306,612,394 if all patients had a same day procedure and no complications.
- Therefore 246,145 colonoscopies performed in 100,000 patients at a cost of $306,612,394 would detect advanced adenoma(s) in 16,275 patients

Using a complication rate of 0.1%, in this cohort of patients over 20 years there would be 208 colonoscopies that may result in perforation or other major complications. The cost of a complication varies from $1700 for a same day discharge to $14,911.55 for where there is a multi-stay hospitalisation. Therefore the additional costs for complications from colonoscopies could range from $418,447 to $3,670,403.
• Patients with advanced adenoma – surveillance colonoscopy at three year intervals.

• Patients with non-advanced adenoma or no neoplasia – surveillance colonoscopy at 10 yearly intervals.

Figures 2.3a and 2.3b show the distribution of patients in each category:

Figure 2.3a represents the sub-group of patients with advanced adenoma at baseline colonoscopy; the Figures 2.3a and 2.3b show the distribution of patients in each category:

- Patients with non-advanced adenoma or no neoplasia – surveillance colonoscopy at 10 yearly intervals.
- Patients with advanced adenoma – surveillance colonoscopy at three year intervals.
Figure 2.3a: Distribution of adenomas over 20 years amongst patients with advanced adenoma(s) at baseline according to proposed Guidelines- Option B

A. Total adenomas at baseline =100000

B. T=0. AA= 36,000

C. T=3. AA =3,996

D. T=3 N/N =32,004

E. T=6 AA =727

F. T=6 N/N= 3269

G. T=13 AA =2480

H. T=13 N/N =29524

I. T=9 AA =132

J. T=9 N/N =595

K. T=16 AA =228

L. T=16 N/N =3041

M. T=16 AA =52

N. T=16 N/N =2428

O. T=12 AA =24

P. T=12 N/N =108

Q. T=19 AA =42

R. T=19 N/N =553

S. T=19 AA =5

T. T=19 N/N =223

U. T=19 AA =1

V. T=19 N/N =51

W. T=15 AA =4

X. T=15 N/N =20

Y. T=18 AA =1

Z. T=18 N/N =3

AA = number of patients with advanced adenoma
NAA/NN = number of patients with non-advanced adenoma or no neoplasia
T=surveillance period (years)

Draft Clinical Practice Guidelines for Surveillance Colonoscopy - in adenoma follow-up, following curative resection of colorectal cancer, and for cancer surveillance in inflammatory bowel disease
For Figure 2.3b, which represents the sub-group of patients with non-advanced adenoma at baseline colonoscopy, the distribution of patients in each category of adenoma patients was based on the following:

A. Total number of people with adenomas at baseline colonoscopy estimated from a full national roll-out of the Bowel Cancer Screening Program for people aged 55-74 years (100,000)
B. Total number of people with non-advanced adenomas at baseline colonoscopy (64,000)
C. (64,000 (B) x 10.0% = 6400): The number of people with advanced adenomas at 10 year surveillance was based on an annual incidence rates of 1.45% (up to 4 years post baseline colonoscopy) and 0.7% (for follow-up beyond 4 years)\(^{27}\): Advanced adenoma incidence at 10 y = (4x1.45) + (6x0.7) = 10.0%.
D. (64,000(B) – 6400(C) = 57600(D)):
E. (6400(C) x 2.1% = 134): The number of people with advanced adenomas at 13 year surveillance was based on an annual incidence rates of 0.7%\(^{27}\): Advanced adenoma incidence at 13 y = (3x0.7) = 2.1%.
F. (6400(C) – 134(H) = 6266(F)):
G. (57,600 (D) x 7.0% = 4032(G)): The number of people with advanced adenomas at 20 year surveillance was based on an annual incidence rates of 0.7%\(^{27}\): Advanced adenoma incidence at 20 y = (10x0.7) = 7.0%.
H. (57,600 (D) – 4032 (G) = 53,568(H)):
I. (134(E) x 2.1% = 3): The number of people with advanced adenomas at 16 year surveillance was based on an annual incidence rates of 0.7%\(^{27}\): Advanced adenoma incidence at 20 y = (3x0.7) = 2.1%.
J. (134 (E) – 3 (I) = 131 (J)):
K. (3 (J) x 2.1% = 0.06 (0 people): The number of people with advanced adenomas at 19 year surveillance was based on an annual incidence rates of 0.7%\(^{27}\): Advanced adenoma incidence at 19 y = (3x0.7) = 2.1%.

Figure 2.2a: Distribution of adenomas over 20 years amongst patients with non-advanced adenoma(s) at baseline according to proposed Guidelines- Option B

**Diagram:**

- A. Total adenoma at baseline
- B. T=0 NAA=64,000
- C. T=10 AA =6400
- D. T=10 N/N = 57600
- E. T=13 AA = 134
- F. T=13 N/N = 6266
- G. T=20 AA=4032
- H. T=20 N/N=53568
- I. T=16 AA =3
- J. T=16 N/N =131
- K. T=19 N/N =3

AA = number of patients with advanced adenoma
NAA/NN = number of patients with non-advanced adenoma or no neoplasia
T=surveillance period (years)
Assuming total compliance with the new guidelines a total of 207,648 surveillance colonoscopies would be performed over 20 years for patients with adenoma detected at baseline colonoscopy. This includes:

- 18,261 colonoscopies that detect advanced adenomas (combined results from Part 1 and Part 2)
  - At 3 year surveillance -3,996 colonoscopies
  - At 6 year surveillance – 727 colonoscopies
  - At 9 year surveillance – 132 colonoscopies
  - At 10 year surveillance – 6,400 colonoscopies
  - At 12 year surveillance – 24 colonoscopies
  - At 13 year surveillance – (2,480 + 134) = 2,614 colonoscopies
  - At 15 year surveillance – 4 colonoscopies
  - At 16 year surveillance – (280 + 3) = 283 colonoscopies
  - At 18 year surveillance – 48 colonoscopies
  - At 20 year surveillance – 4,032 colonoscopies

- 189,387 colonoscopies that detect non-advanced adenomas or no neoplasia (combined results from Part 1 and Part 2)
  - At 3 year surveillance – 32,004 colonoscopies
  - At 6 year surveillance – 3,269 colonoscopies
  - At 9 year surveillance – 595 colonoscopies
  - At 10 year surveillance – 57,600 colonoscopies
  - At 12 year surveillance – 108 colonoscopies
  - At 13 year surveillance – (29, 524 + 6266) = 35,790 colonoscopies
  - At 15 year surveillance – 20 colonoscopies
  - At 16 year surveillance – (5,469 + 131) = 5600 colonoscopies
  - At 18 year surveillance – 3 colonoscopies
  - At 19 year surveillance – (827 + 3) = 830 colonoscopies
  - At 20 year surveillance – 53,568 colonoscopies

It was assumed that 30.2% of colonoscopies were performed in the public sector and 69.8% in the private sector. Costs for the procedure were based on $865.32 in the public sector and $1,367 in the private sector for a same day admission and non-advanced adenoma(s) or normal colonoscopy. For patients with advanced adenoma the cost in the public sector was $1,140.22 for a same day admission and $1,685 in the private sector. A further $10 was added to the cost of each procedure to account for the cost of the bowel preparation.

- Of the 18,261 colonoscopies that detected advanced adenomas, 5,515 were performed in the public sector at a cost of $1150.22 per procedure and 12,746 were performed in the private sector at a cost of $1695 per procedure. The total cost of colonoscopies that detected advanced adenomas was $27,947,933.

- Of the 189,387 colonoscopies that detected non-advanced adenomas or no neoplasia, 57,195 were performed in the public sector at a cost of $875.32 per procedure and 132,192 were
• For this patient cohort of 100,000 patients with adenoma detected at the baseline colonoscopy, the total cost of surveillance over 20 years of follow-up would be $260,040,245 if all patients had a same day procedure and no complications.

• A total of 207,648 colonoscopies were performed in 100,000 patients for $260,040,245 and detected advanced adenoma in 18,261 patients.

Using a complication rate of 0.1%, in this cohort of patients over 20 years there would be 208 colonoscopies that resulted in perforation or other major complications. The cost of a complication varies from $1700 for a same day discharge to $14,911.55 for a multi stay hospitalisation. Therefore the additional costs for complications could range from $353,600 to $3,101,602.

2005 Guidelines vs Proposed New Guidelines option A

• Over a 20 year period, a higher proportion of patients (7% of those patients tested in Option A vs. 5% of those patients tested under the 2005 Guidelines) with advanced adenoma would be detected by surveillance colonoscopies performed as per the new guidelines (option A) than would be detected from surveillance performed as per the 2005 guidelines (see Table 7.5).

• The cost per advanced adenoma detected over 20 years would be $18,840 with the new guidelines Option A compared to $26,907 with the 2005 guidelines.

• If Option A were adopted the cost of surveillance colonoscopies performed would be less expensive than the current 2005 Guidelines. Although Option A is less expensive it also is less effective in capturing less severe disease therefore, imposing a greater health burden on patients.

2005 Guidelines vs Proposed New Guidelines option B

• Over a 20 year period, a higher proportion of patients (9% of those patients tested in Option B vs. 5% of those patients tested under the 2005 Guidelines) with advanced adenoma would be detected by surveillance colonoscopies performed as per the new guidelines (option B) than would be detected from surveillance performed as per the 2005 guidelines (see Table 7.5).

• The cost per advanced adenoma detected over 20 years would be $14,240 with the new guidelines Option B compared to $26,907 with the 2005 guidelines.

• If Option B were adopted the cost of surveillance colonoscopies performed would be less expensive than the current 2005 Guidelines. Again although Option B is less expensive it also is less effective in capturing less severe disease therefore, imposing a greater health burden on patients.
Table 7.5. Summary of Colonoscopies and Costs for 100,000 pts with adenomas over 20 years

<table>
<thead>
<tr>
<th>Guideline version</th>
<th>Guideline Changes</th>
<th>Costs of Guideline Changes</th>
<th>Calculations of Outcomes</th>
<th>Calculations of Incremental Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Guideline version</td>
<td>Advanced adenoma strategy</td>
<td>Non-advanced adenoma / normal strategy</td>
<td>Total 20 year cost of program</td>
</tr>
<tr>
<td></td>
<td>2005</td>
<td>3 yearly</td>
<td>5 yearly</td>
<td>497,276,106</td>
</tr>
<tr>
<td>New option A</td>
<td>3 yearly</td>
<td>Initial at 5 years, then 10 yearly</td>
<td></td>
<td>306,612,394</td>
</tr>
<tr>
<td>New option B</td>
<td>3 yearly</td>
<td>10 yearly</td>
<td></td>
<td>260,040,245</td>
</tr>
</tbody>
</table>
3. ULCERATIVE COLITIS

Costs
There are no previous Australian guidelines for surveillance in patients with ulcerative colitis (UC) therefore the economic evaluation is presented as the costs of surveillance for a cohort of UC patients over a period of 20 years as recommended in Chapter 4.

Colonoscopy Costs

Public Patients
The estimated reimbursement for a same day colonoscopy procedure in patients with a past history UC and no recurrence is $865.32
- DRG: G48C Colonoscopy Same day
- ACHI Principle Procedure: 32090 fibreoptic colonoscopy to caecum (ACHI Principle Procedure)
- ICD-10-AM Principle Diagnosis: K519 Ulcerative colitis

The estimated reimbursement for a same day colonoscopy procedure in patients with a past history UC and recurrence is $1,140.22
- DRG: G48C Colonoscopy Same day
- ACHI Principle Procedure: 32090 fibreoptic colonoscopy to caecum (ACHI Principle Procedure)
- ICD-10-AM Principle Diagnosis: K519 Ulcerative colitis

Private Sector
The average total costs for same day patients with UC was $1,472 and $1,552 for all patients (i.e. same day, overnight or multi-stay)

Incidence and Distribution of Patients with Ulcerative Colitis
The incidence of ulcerative colitis (UC) in Australia was based on the recently reported incidence rate of 11.2 per 100,000. The total Australian population in March 2010 was 22,473,489 (Australian Bureau of Statistics) and therefore the estimated number of new cases of UC used in the evaluation was 2,517.

The distribution of patients in each category (Figure 3) was based on the following:
- An estimated 53.8% of ulcerative colitis patients will have extensive disease and the rest would have limited disease. Therefore from a population of 2517 patients with UC (A) a total of 1,354 patients (B) will have extensive UC at diagnosis and 1,163 limited UC (C).
- The mean time from onset of inflammatory bowel disease to PSC is 9 years (range 1.3 to 23 years). Approximately 3% of patients with extensive UC will have PSC i.e. 41 patients (D1). These patients will require yearly surveillance initiated when PSC is diagnosed. It was assumed that all patients with PSC were diagnosed at 8 years.
- A further 3% of UC patients with extensive disease will have a positive family history of CRC i.e. 41 patients (D2). These patients will also require yearly surveillance starting earlier than 8 years.
- The remaining 1,273 patients (E1) with extensive disease will start surveillance at 8 years.
- An estimated 20% of UC patients with limited disease or 233 patients (E2) will progress to extensive UC or inflammatory polyps or stricture and will also require surveillance from 8 years after diagnosis.
• The remaining 930 patients with limited disease (F) will follow the general population guidelines for colorectal cancer and are not considered further.

• A total of UC 1,505 patients with extensive disease will start surveillance at 8 years (i.e. E1 + E2 or 1272 + 233).

• During the 20 year period it was assumed that 20% of patients with extensive UC starting surveillance or 301 patients (G) will have surgery for cancer, dysplasia or active disease. 36 39 The remaining 1,204 UC patients (H) will continue to have surveillance colonoscopy for the next 20 years.

• A further 34% of patients with extensive disease (n=410) (I) are considered high risk (i.e. inflammatory polyps, past localised dysplasia 40-42 and will require yearly surveillance. It was assumed that they were diagnosed and commenced surveillance 8 years from UC diagnosis.

• It was assumed that the remaining 794 patients (J) with inactive disease would have surveillance colonoscopy every three years over the next 20 years even though a proportion of patients may go to five yearly surveillance if they have had 2 normal colonoscopies (proposed guidelines). These 794 patients would each have an average of 6.7 colonoscopies over 20 years.

As the cohort of patients with UC ages some patients develop low-grade dysplasia, high-grade dysplasia, or cancer these have been considered in Figure 6. As there is a wide variability in rates of colorectal cancer mortality in UC patients with five year survival reported between 36% to 100% 43 44 the evaluation did not adjust for mortality.

The economic evaluation was based on 20 years of follow-up and assumed

• All 794 patients with low risk (inactive disease) would continue to have three yearly surveillance colonoscopy during this period (see table 3.1).

• All 491 high risk patients (PSC, positive family history, inflammatory polyps, strictures, past localised dysplasia) would have yearly surveillance that commenced from 8 years following UC diagnosis.

• Patients who had surgery for cancer, dysplasia or active disease during the 20 year period were excluded.

• 30.2% of colonoscopies were performed in the public sector and 69.8% colonoscopies were performed in the private sector.

### Table 3.1 Surveillance Colonoscopies in UC Patient Cohort with Extensive UC

<table>
<thead>
<tr>
<th>Time (years)</th>
<th>Patient Cohort</th>
<th>Total Colonoscopies</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Inactive UC</td>
<td>High Risk UC</td>
</tr>
<tr>
<td>1</td>
<td>491</td>
<td>491</td>
</tr>
<tr>
<td>2</td>
<td>491</td>
<td>491</td>
</tr>
<tr>
<td>3</td>
<td>794</td>
<td>491</td>
</tr>
<tr>
<td>4</td>
<td>491</td>
<td>491</td>
</tr>
<tr>
<td>5</td>
<td>491</td>
<td>491</td>
</tr>
<tr>
<td>6</td>
<td>794</td>
<td>491</td>
</tr>
<tr>
<td>7</td>
<td>491</td>
<td>491</td>
</tr>
<tr>
<td>8</td>
<td>491</td>
<td>491</td>
</tr>
<tr>
<td>9</td>
<td>794</td>
<td>491</td>
</tr>
<tr>
<td>10</td>
<td>491</td>
<td>491</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>11</td>
<td>491</td>
<td>491</td>
</tr>
<tr>
<td>12</td>
<td>794</td>
<td>491</td>
</tr>
<tr>
<td>13</td>
<td>491</td>
<td>491</td>
</tr>
<tr>
<td>14</td>
<td>491</td>
<td>491</td>
</tr>
<tr>
<td>15</td>
<td>794</td>
<td>491</td>
</tr>
<tr>
<td>16</td>
<td>491</td>
<td>491</td>
</tr>
<tr>
<td>17</td>
<td>491</td>
<td>491</td>
</tr>
<tr>
<td>18</td>
<td>794</td>
<td>491</td>
</tr>
<tr>
<td>19</td>
<td>491</td>
<td>491</td>
</tr>
<tr>
<td>20</td>
<td>491</td>
<td>491</td>
</tr>
<tr>
<td>TOTAL</td>
<td>4764</td>
<td>9820</td>
</tr>
</tbody>
</table>

T=0 baseline colonoscopy at 8 years from diagnosis of ulcerative colitis

Costs for procedure were based on $865.32 for a same day procedure in public sector and $1,472 in the private sector with a further $10 added for the cost of the bowel preparation and cleansing.

- If all procedures were same day in patients with inactive UC there would be 1,439 colonoscopies performed in the public sector at a rate of $875.32 and total cost of $1,259,585 and 3,325 colonoscopies in the private sector at a rate of $1,482 with a total cost of $4,927,650. Therefore assuming all 794 patients had three yearly surveillance the cost for this cohort would be $6,187,235 over the 20 years.

- If all procedures were same day in the high risk UC patients there would be 2,966 colonoscopies performed in the public sector at a rate of $875.32 and total cost of $2,596,199 and 6,854 colonoscopies in the private sector at a rate of $1,482 with a total cost of $10,157,628. Therefore assuming all 491 high risk patients had yearly surveillance over 20 years the cost for this cohort would be $12,753,827.

- The total cost for 20 years of surveillance colonoscopy for a cohort of 2,517 patients diagnosed with ulcerative colitis 8 years earlier would be $18,941,062.
Figure 3. Summary of Ulcerative Colitis Groups Requiring Surveillance Colonoscopy

- A. 2517 pts diagnosed with UC
- B. Pts with Extensive UC (N=1354 pts)
  - D. 40 PSC pts (3%), 41 pts positive family history (3%) - yearly surveillance
  - E. 1505 pts no other risk factors - surveillance at 8 years
  - G. Surgery N=301 pts by 20 years
- C. Pts with Limited UC (N=1163 pts)
  - E2. 233 pts progress to extensive UC, inflamm polyps or stricture
  - F. 930 pts limited UC
- H. Intact Colon N=1204 pts at 20 years
- I. 401 other high risk pts* yearly surveillance
- J. 794 pts inactive disease -3 yearly surveillance

* other high risk patients includes those with inflammatory polyps, stricture or past localised dysplasia

Draft Clinical Practice Guidelines for Surveillance Colonoscopy - in adenoma follow-up, following curative resection of colorectal cancer, and for cancer surveillance in inflammatory bowel disease
References

6. Australian Institute of Health and Welfare. AIIHW Data Cubes


# APPENDIX 5 ABBREVIATIONS

**Abbreviations**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADRs</td>
<td>Adenoma detection rates</td>
</tr>
<tr>
<td>AJCC</td>
<td>American Joint Committee on Cancer</td>
</tr>
<tr>
<td>APC</td>
<td>Adenomatous polyposis coli</td>
</tr>
<tr>
<td>BMI</td>
<td>Body mass index</td>
</tr>
<tr>
<td>C</td>
<td>Chromoendoscopy</td>
</tr>
<tr>
<td>CAM</td>
<td>Complementary and alternative therapies</td>
</tr>
<tr>
<td>CCD</td>
<td>Charge-coupled device</td>
</tr>
<tr>
<td>CD</td>
<td>Crohn’s disease</td>
</tr>
<tr>
<td>CCFA</td>
<td>Crohn’s and Colitis Foundation of America</td>
</tr>
<tr>
<td>CEA</td>
<td>Carcinoembryonic antigen</td>
</tr>
<tr>
<td>CI</td>
<td>Confidence interval</td>
</tr>
<tr>
<td>CLE</td>
<td>Confocal laser endomicroscopy</td>
</tr>
<tr>
<td>CRC</td>
<td>Colorectal Cancer</td>
</tr>
<tr>
<td>CT</td>
<td>Computed tomography</td>
</tr>
<tr>
<td>CTC</td>
<td>Computerised tomographic colonography</td>
</tr>
<tr>
<td>DALM</td>
<td>Dysplasia associated lesion or mass</td>
</tr>
<tr>
<td>DCBE</td>
<td>Double contrast barium enema</td>
</tr>
<tr>
<td>EMR</td>
<td>Endoscopic mucosal resection</td>
</tr>
<tr>
<td>EPAGE</td>
<td>European Panel on Appropriateness of Gastrointestinal Endoscopy</td>
</tr>
<tr>
<td>ESD</td>
<td>Endoscopic submucosal dissection</td>
</tr>
<tr>
<td>FAP</td>
<td>Familial adenomatous polyposis</td>
</tr>
<tr>
<td>FGID</td>
<td>Functional gastrointestinal disease</td>
</tr>
<tr>
<td>FOBT</td>
<td>Faecal occult blood test</td>
</tr>
<tr>
<td>FS</td>
<td>Flexible sigmoidoscopy</td>
</tr>
<tr>
<td>GI</td>
<td>Gastrointestinal</td>
</tr>
<tr>
<td>HD</td>
<td>High definition</td>
</tr>
<tr>
<td>HGD</td>
<td>High grade disease</td>
</tr>
<tr>
<td>HNPCC</td>
<td>Hereditary non-polyposis colorectal cancer</td>
</tr>
<tr>
<td>IBD</td>
<td>Inflammatory bowel disease</td>
</tr>
<tr>
<td>ID</td>
<td>Indefinite dysplasia</td>
</tr>
<tr>
<td>LGD</td>
<td>Low grade dysplasia</td>
</tr>
<tr>
<td>MRI</td>
<td>Magnetic resonance imaging</td>
</tr>
</tbody>
</table>

155 Draft Clinical Practice Guidelines for Surveillance Colonoscopy - in adenoma follow-up, following curative resection of colorectal cancer, and for cancer surveillance in inflammatory bowel disease
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MUTYH</td>
<td>mutY Homolog (E. coli)</td>
</tr>
<tr>
<td>MYH</td>
<td>See MUTYH</td>
</tr>
<tr>
<td>NBCSP</td>
<td>National Bowel Screening Program</td>
</tr>
<tr>
<td>NBI</td>
<td>Narrow band imaging</td>
</tr>
<tr>
<td>OR</td>
<td>Odds ratio</td>
</tr>
<tr>
<td>PSC</td>
<td>Primary sclerosing cholangitis</td>
</tr>
<tr>
<td>RCT</td>
<td>Randomised controlled trial</td>
</tr>
<tr>
<td>SA</td>
<td>Serrated adenomas</td>
</tr>
<tr>
<td>SES</td>
<td>Socioeconomic status</td>
</tr>
<tr>
<td>SSAs</td>
<td>Sessile serrated adenomas</td>
</tr>
<tr>
<td>STAI</td>
<td>State-Trait Anxiety Inventory</td>
</tr>
<tr>
<td>TSAs</td>
<td>Traditional serrated adenomas</td>
</tr>
<tr>
<td>UC</td>
<td>Ulcerative colitis</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organisation</td>
</tr>
</tbody>
</table>