COLORECTAL CANCER SCREENING

Chaired by: Heather Bryant (Canada)
Alan Barkun (Canada)

Proposed by the Canadian Partnership Against Cancer
OUTLINE OF SESSION

- The Thailand Colorectal Cancer Screening (CRC) Pilot Demonstration Project in Lampang Province
  *Christopher P Wild (IARC, France)*

- Endoscopy and imaging in colorectal cancer detection
  *Alan Barkun (PQDCCR, Canada)*

- The role of the Global Rating Scale in Colonoscopy Quality
  *Don Macintosh (NSCRCSP, Canada)*

- Quality and access issues
  *David Armstrong (CAG, Canada)*
Endoscopy and imaging in colorectal cancer detection

Alan N. Barkun
Clinical co-Lead,
Le Programme Québécois de Dépistage du Cancer Colorectal
Division of Gastroenterology, McGill University and the McGill University Health Center
CONFLICTS OF INTEREST

- Consultant and recipient of research support from
  - Olympus Canada Inc.
  - Cook Inc.
  - Boston Scientific Inc.
OUTLINE

- Background
- Flexible sigmoidoscopy
- Colonoscopy
- CT colography
- The colonic wireless videocapsule
- Conclusion
Worldwide, colorectal cancer (CRC) is the second most common cancer diagnosed in women and third most common in men. Jemal CA Cancer J Clin 2011
Most common risk factor: age
Colorectal Cancer – biology

- If diagnosed early **95% will survive**; presently only **35%** of cases diagnosed at this stage

- **60% will die** if cancer spreads to lymph nodes

- **95% will die** if cancer spreads to distant organs

Polyp-cancer sequence 8-12 yrs
Advantages of early diagnosis

• Survival rates are improved if treated in its **early stages**

![Cancer Free 5 Year Survival Chart]

- **A**: 99%
- **B**: 85%
- **C**: 67%
- **D**: 14%

_Duke's Classification_
RECOMMENDATIONS – main CRC screening technologies

- Cancer detecting technologies
  - FOBT
    - Guaiac
    - FIT
  - Stool DNA
  - Other specialized tests

- Cancer preventing technologies
  - Flexible sigmoidoscopy
  - Colonoscopy
  - CT colography
  - Colonic wireless capsule endoscopy
  - Stool DNA
FLEXIBLE SIGMOIDOSCOPY
<table>
<thead>
<tr>
<th>Study</th>
<th>Country / Year Publication type</th>
<th>Population Enrolment duration and follow-up Attendance rate</th>
<th>Female Mean age (std) N (randomized)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hoff G et al. NORCCAP</td>
<td>Norway 2009 RCT</td>
<td>population based age 55-64 years January 1999 to December 2001 Median follow-up after inclusion in the trial was seven years for incident colorectal cancer and six (range five to seven) years for mortality 64.8% attendance rate</td>
<td>50% (by randomization) 59 years old N = 55 736</td>
</tr>
<tr>
<td>Atkin et al.</td>
<td>UK 2010 RCT</td>
<td>age 55 and 64 years November 1994 to March 1999. Median follow-up of 11.2 years (IQR 10.7-11.9). 71% attendance rate</td>
<td>51% 60 years (SD 2.9) N = 170 432</td>
</tr>
<tr>
<td>Segan et al. SCORE</td>
<td>Italy 2011 RCT</td>
<td>Population based age aged 55-64 years June 14 1995 to 1999 Median follow-up: 10.5 years for incidence and 11.4 years for mortality; 58.3% attendance rate</td>
<td>52.3% Intervention: 59.7 years Control: 59.6 years N = 34 292</td>
</tr>
<tr>
<td>Schoen et al. PLCO</td>
<td>USA 2012 RCT</td>
<td>Population base age 55 to 74 years 1993 to 2001 Median follow-up time for incidence was 11.9 years and for mortality was 12.1 years.</td>
<td>50.5% N = 154 900</td>
</tr>
</tbody>
</table>
RCT Flexible sigmoidoscopy: Incidence CRC

NORCAP
134.5 v 131.9 cases per 100,000 person years

PLCO (USA): CRC reduction 21% (RR: 0.79; 95% CI: 0.72 - 0.85)

UK (Atkin trial): CRC reduction of 23% in the intervention (B) group (HR: 0.77, 95% CI: 0.70 - 0.84)

Score (Italy): CRC reduction 18% (RR: 0.82, 95% CI: 0.69 to 0.96)

A 5th Dutch RCT has just initiated f/u Hol et al.
CRC incidence

Left CC incidence

Right CC incidence

CRC mortality

Atkin, Lancet, 2010
RCT Flexible sigmoidoscopy

Incidence

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Intervention Events</th>
<th>Total Events</th>
<th>Total</th>
<th>Weight</th>
<th>Odds Ratio M-H, Random, 95% CI</th>
<th>Odds Ratio M-H, Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atkin 2010</td>
<td>706</td>
<td>57099</td>
<td>112939</td>
<td>33.3%</td>
<td>0.77 [0.70, 0.84]</td>
<td></td>
</tr>
<tr>
<td>Hoff 2009</td>
<td>123</td>
<td>13653</td>
<td>41092</td>
<td>14.0%</td>
<td>1.02 [0.83, 1.26]</td>
<td></td>
</tr>
<tr>
<td>Schoen 2012</td>
<td>1012</td>
<td>77445</td>
<td>77445</td>
<td>34.4%</td>
<td>0.78 [0.72, 0.85]</td>
<td></td>
</tr>
<tr>
<td>Segan 2011</td>
<td>251</td>
<td>17136</td>
<td>17136</td>
<td>18.3%</td>
<td>0.82 [0.69, 0.97]</td>
<td></td>
</tr>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td><strong>165333</strong></td>
<td><strong>248612</strong></td>
<td>100.0%</td>
<td></td>
<td>0.81 [0.74, 0.89]</td>
<td></td>
</tr>
<tr>
<td>Total events</td>
<td>2092</td>
<td>3773</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heterogeneity: Tau² = 0.00; Chi² = 6.74, df = 3 (P = 0.08); I² = 55%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test for overall effect: Z = 4.44 (P &lt; 0.00001)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Mortality

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Intervention Events</th>
<th>Total Events</th>
<th>Total</th>
<th>Weight</th>
<th>Odds Ratio M-H, Fixed, 95% CI</th>
<th>Odds Ratio M-H, Fixed, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atkin 2010</td>
<td>221</td>
<td>57099</td>
<td>637</td>
<td>47.5%</td>
<td>0.69 [0.59, 0.80]</td>
<td></td>
</tr>
<tr>
<td>Hoff 2009</td>
<td>24</td>
<td>13653</td>
<td>99</td>
<td>5.5%</td>
<td>0.73 [0.47, 1.14]</td>
<td></td>
</tr>
<tr>
<td>Schoen 2012</td>
<td>252</td>
<td>77445</td>
<td>341</td>
<td>37.8%</td>
<td>0.74 [0.63, 0.87]</td>
<td></td>
</tr>
<tr>
<td>Segan 2011</td>
<td>65</td>
<td>17136</td>
<td>83</td>
<td>9.2%</td>
<td>0.78 [0.57, 1.08]</td>
<td></td>
</tr>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td><strong>165333</strong></td>
<td><strong>248612</strong></td>
<td>100.0%</td>
<td></td>
<td>0.72 [0.65, 0.79]</td>
<td></td>
</tr>
<tr>
<td>Total events</td>
<td>562</td>
<td>1160</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heterogeneity: Chi² = 0.74, df = 3 (P = 0.86); I² = 0%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test for overall effect: Z = 6.36 (P &lt; 0.000001)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## RCTs of Screening Flexible Sigmoidoscopy

<table>
<thead>
<tr>
<th>Study</th>
<th>Country /Year Publication type</th>
<th>Population Enrolment duration</th>
<th>Attendance rate</th>
<th>Female Mean age (std) N (randomized)</th>
<th>Comparison (n)</th>
<th>CRC detection</th>
<th>Mortality due to CRC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hoff G et al.</td>
<td>Norway 2009 RCT NORCCAP</td>
<td>population based age 55-64 years</td>
<td>64.8% attendance rate</td>
<td>50% (by randomization) 59 years old N=55 736</td>
<td>Screening group: PP: n=13 823 ITT: n=13 653 (8846 screened, 4807 not screened)* Flexible sigmoidoscopy only (PP n=6915) Combined flexible sigmoidoscopy and faecal occult blood testing (PP n=6906)</td>
<td>123 (after 6-8 years FU)</td>
<td>24</td>
</tr>
<tr>
<td>Atkin et al.</td>
<td>UK 2010 RCT</td>
<td>age 55 and 64 years</td>
<td>71% attendance rate</td>
<td>51% 60 years (SD 2·9) N=170 432</td>
<td>Intervention: flexible sigmoidoscopy PP: 57 237 ITT: 57 099 (40 621 screened, 16 478 not screened)*</td>
<td>706</td>
<td>221</td>
</tr>
<tr>
<td>Segan et al.</td>
<td>Italy 2011 RCT SCORE</td>
<td>Population based age 55-64 years</td>
<td>58.3% attendance rate</td>
<td>52.3% Intervention: 59.7 years Control: 59.6 years N= 34 292</td>
<td>Intervention: flexible sigmoidoscopy PP: 17 148 ITT: 17 136 (9911 screened and 7225 not screened)*</td>
<td>251</td>
<td>65</td>
</tr>
<tr>
<td>Schoen et al.</td>
<td>USA 2012 RCT PLCO</td>
<td>Population base age 55 to 74 years</td>
<td>50.5% N= 154 900</td>
<td>Intervention: flexible sigmoidoscopy PP: 77 445</td>
<td></td>
<td>1012</td>
<td>252</td>
</tr>
</tbody>
</table>
Limitations of Flexible sigmoidoscopy in screening

- **Resources**
  - Equipment
  - Manpower (nurse-endoscopists)

- Patient acceptability, especially in North America (versus a full colonoscopy)
Population-level decreases (NIS) in rates of resection for distal CRC are associated with screening, in general, and that implementation of screening colonoscopy, specifically, might be an important factor that contributes to population-level decreases.
LONG-TERM IMPACT OF COLONOSCOPIC POLYPECTOMY ON CRC MORTALITY

2602 patients in the NPS with adenomas removed at colonoscopy after a median of 15.8 years follow-up compared to expected outcomes from SEER.

Table 3. Deaths from Colorectal Cancer in the Adenoma Cohort, as Compared with Incidence-Based Mortality from Colorectal Cancer in the General Population.*

<table>
<thead>
<tr>
<th>Follow-up Time</th>
<th>Adenoma Cohort</th>
<th>General Population</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>Person-Years at Risk</td>
</tr>
<tr>
<td>All</td>
<td>2602</td>
<td>37,073</td>
</tr>
<tr>
<td>&lt;10 yr</td>
<td>2602</td>
<td>22,903</td>
</tr>
<tr>
<td>≥10 yr</td>
<td>2031</td>
<td>14,170</td>
</tr>
</tbody>
</table>

* Data on the general population are from the Surveillance, Epidemiology, and End Results registries of nine areas (SEER9). The standardized mortality ratio (SMR) and percent reduction in mortality are for the adenoma cohort as compared with the general population.
Increased use of colonoscopy procedures is associated with a reduction in the incidence (*rel 48%) and mortality (*rel 81%) of CRC in the population studied. Jacob, GIE 2012
1688 cases with CRC & 1932 controls ≥50 yrs
Rhine-Neckar region of Germany; colonoscopy last 10 yrs
Colonoscopy in the preceding 10 years was associated with decreased risks of

- any CRC 0.23 (95% CI, 0.19 to 0.27),
- right-sided CRC 0.44 (CI, 0.35 to 0.55), and
- Left-sided CRC 0.16 (CI, 0.12 to 0.20)

Strong risk reduction observed for all cancer stages and all ages, except for right-sided cancer in 50-59 yrs

Risk reduction increased over the years in both the right and the left colon.
Missed cancer rates by colonoscopy

- Canadian administrative database of new diagnosis of right-sided, transverse, splenic flexure/descending, rectal or sigmoid CRC in Ontario (1997 to 2002), undergoing a colonoscopy within 3 years of diagnosis.

- Patients with new or missed cancers were those whose most recent colonoscopy was 6 to 36 months before diagnosis.

- CRC diagnosed in 3288 (right sided), 777 (transverse), 710 (splenic flexure/descending), and 7712 (rectal or sigmoid) patients.

- The rates of new or missed cancers were 5.9%, 5.5%, 2.1%, and 2.3%, respectively.

- Independent risk factors for these cancers in men and women were older age; diverticular disease; right-sided or transverse CRC; colonoscopy by an internist or family physician; and colonoscopy in an office.

Rabeneck, Gastro, 2007
THE IMPORTANCE OF COLONOSCOPY QUALITY

155 cases & 260 controls with physician-validated polyp detection in the past 10 years

<table>
<thead>
<tr>
<th>Risk Indicator</th>
<th>OR (95% CI)*</th>
<th>AF, %†</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Attributes of previous colonoscopy</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incomplete</td>
<td>1.42 (0.56–3.61)</td>
<td>1.9</td>
</tr>
<tr>
<td>Poor bowel preparation</td>
<td>1.12 (0.50–2.51)</td>
<td>0.9</td>
</tr>
<tr>
<td>Not all polyps completely removed</td>
<td>3.73 (2.11–6.60)</td>
<td>20.8</td>
</tr>
<tr>
<td>≥5 y ago</td>
<td>2.96 (1.70–5.16)</td>
<td>18.4</td>
</tr>
<tr>
<td><strong>Attributes of detected polyps</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥1 cm</td>
<td>1.39 (0.85–2.27)</td>
<td>8.1</td>
</tr>
<tr>
<td>Villous components or high-grade dysplasia</td>
<td>1.31 (0.75–2.29)</td>
<td>5.1</td>
</tr>
<tr>
<td>≥3 polyps</td>
<td>2.21 (1.07–4.54)</td>
<td>8.1</td>
</tr>
<tr>
<td>≥1 proximal polyp</td>
<td>1.13 (0.72–1.77)</td>
<td>4.5</td>
</tr>
</tbody>
</table>

AF = attributable fraction; OR = odds ratio.
* Adjusted for sex, age, and all other risk indicators.
† AF for the presence of a specific single risk indicator ("single") or at least 1 risk indicator from the respective group of risk indicators ("any").

Brenner, AIM, 2012
Alternative strategies: colonoscopy

Data collected from 186 endoscopists who were involved in a colonoscopy-based colorectal-cancer screening program involving 45,026 subjects in Poland.
Colonoscopy vs FIT screening

Higher adherence in FIT than colonoscopy (34.2% vs. 24.6%, P<0.001)

<table>
<thead>
<tr>
<th>Colorectal Lesion</th>
<th>Colonoscopy (N = 26,703)</th>
<th></th>
<th>FIT (N = 26,599)</th>
<th></th>
<th>Odds Ratio (95% CI)†</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Subjects no.</td>
<td>Rate</td>
<td>Subjects no.</td>
<td>Rate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cancer</td>
<td>30</td>
<td>0.1</td>
<td>33</td>
<td>0.1</td>
<td>0.99 (0.61–1.64)</td>
<td>0.99</td>
</tr>
<tr>
<td>Advanced adenoma†‡</td>
<td>514</td>
<td>1.9</td>
<td>231</td>
<td>0.9</td>
<td>2.30 (1.97–2.69)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Advanced neoplasia§</td>
<td>544</td>
<td>2.0</td>
<td>264</td>
<td>1.0</td>
<td>2.14 (1.85–2.49)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Nonadvanced adenoma</td>
<td>1109</td>
<td>4.2</td>
<td>119</td>
<td>0.4</td>
<td>9.80 (3.10–11.85)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Any neoplasia</td>
<td>1653</td>
<td>6.2</td>
<td>383</td>
<td>1.4</td>
<td>4.67 (4.17–5.24)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

* The diagnostic yield was calculated as the number of subjects with true positive results divided by the number of subjects who were eligible to undergo testing. Subjects were classified according to the most advanced lesion.
† Odds ratios were adjusted for age, sex, and participating center. CI denotes confidence interval.
‡ Advanced adenoma was defined as an adenoma measuring 10 mm or more in diameter, with villous architecture (>25%), high-grade dysplasia, or intramucosal carcinoma.
§ Advanced neoplasia was defined as advanced adenoma or cancer.

First of 5 RCTs of colonoscopy, 4 population-based

Quintero, NEJM, 2012
CT COLOGRAPHY (virtual colonoscopy)
Systematic review included:

- 20 studies for colonoscopy
- 12 studies for sigmoidoscopy
- 26 studies for Barium enema
- 62 studies for CT colonography

**Table 6. Average sensitivity/specificity of screening methods ± standard deviation obtained from systematic review of related articles**

<table>
<thead>
<tr>
<th>Type</th>
<th>Colonoscopy</th>
<th>Sigmoidoscopy</th>
<th>Barium enema</th>
<th>FOBT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sen(^1) for large polyps</td>
<td>92.5±6.2</td>
<td>93.6±6.9</td>
<td>57.6±20.8</td>
<td>18.5±11.8</td>
</tr>
<tr>
<td>Sen(^2) for cancer</td>
<td>94.7±4.6</td>
<td>82.0±9.3</td>
<td>82.3±8.7</td>
<td>45.7±26.3</td>
</tr>
<tr>
<td>Overall Sen(^3)</td>
<td>84.9±8.5</td>
<td>86.3±8.1</td>
<td>81.7±16.8</td>
<td>37.0±19.4</td>
</tr>
<tr>
<td>Spc(^2) for large polyps**</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Spc(^2) for cancer**</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Overall Spc(^2)</td>
<td>99.8±0.2</td>
<td>83.9(^{***})</td>
<td>92.4±14.7</td>
<td>87.6±11.4</td>
</tr>
</tbody>
</table>

1. Sen: Sensitivity
2. Spc: Specificity

\(^{*}\) Overall sensitivity does not mean the sum of other sensitivities. This term was exactly reported in some articles (refer to previous tables).

\(^{**}\) For all methods except CT colonography specificity for large polyps, cancer and overall specificity are pooled together because of inadequacy of evidences and is explained as overall specificity.

\(^{***}\) There was only one article that reported this value.
## 3 Meta-analysis:

<table>
<thead>
<tr>
<th>Study</th>
<th>Country /Year</th>
<th>Number of studies</th>
<th>Database and period searched</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allameh et al.</td>
<td>Iranian 2010</td>
<td>20 studies for colonoscopy</td>
<td>12 studies for sigmoidoscopy, 26 studies for Barium enema, 62 studies for CT colonography</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>8 studies (5 fully published, 3 abstracts) Pubmed, Cochrane and CRD database systematically until Jan 2009.</td>
</tr>
<tr>
<td>Pickhardt et al.</td>
<td>USA 2011</td>
<td>49 studies comparing CT to colonoscopy</td>
<td>PubMed search from 1994 to 2009</td>
</tr>
<tr>
<td>de Haan et al.</td>
<td>The Netherlands 2011</td>
<td>5 studies CT colonography for screening.</td>
<td>PubMed, Embase and Cochrane 4,086 participants (&lt;1% high risk).</td>
</tr>
</tbody>
</table>
CT Colonoscopy: Sensitivity/Specificity

- **Allameh et al. 2011**
  - Overall:
    - Sensitivity: 84.9% ± 8.5
    - Specificity: 99.8% ± 0.2
  - CRC Cancer:
    - Sensitivity: 94.7% ± 4.6
    - Specificity: NA

- **Pickhardt et al. 2011**
  - CRC Cancer:
    - Sensitivity: 96.1% (95% CI, 93.8%–97.7%)
    - Specificity: NA

It is important to note and understand that the specificity of CT colonography (and OC) for cancer detection could not be assessed on the basis of these published trials because the number of false-positive and true-negative results for cancer assessment is not known because of the usual definition of CT colonography (and OC) test positivity according to lesion size and not morphology or likely histologic nature.
CT Colonoscopy: Sensitivity/Specificity

- **De Haan et al. 2011**
  - polyps or adenomas $\geq 6$ mm:
    - Sensitivity: 75.9% (95%CI: 62.3–85.8)
    - Specificity: 94.6% (95%CI: 90.4–97.0)
  - Adenomatous polyps $\geq 6$ mm
    - Sensitivity: 82.9 (73.6–89.4)
    - Specificity: 91.4 (84.1–95.5)
CT colography Q5 or Q10 yrs is more cost-effective than no screening

Colonoscopy Q10 yrs dominates 2D-CT colography Q3 and Q5 years

3D-CT colography is more effective yet more expensive than colonoscopy Q10 yrs ($156,000/QALY)

Sensitive variables are: Costs, sensitivity, and adherence
PATIENT PREFERENCE: CT COLOGRAPHY VS COLONOSCOPY

- Dutch RCT

- Participation: CTC 34% vs colonoscopy 22%, P=0.001

- Significantly more advanced neoplasias identified w colonoscopy, but similar diagnostic yield

- NOT COMPLETE

- ?perceived burden

Stoop Lancet Oncol 2012
Virtual colonoscopy

Not recommended for screening:
- lack of data
- risk of irradiation
- downstream implications of incidentalomas
- unfavorable cost-effectiveness
Rokkas et al. 2010:
• Any polyp found:
  ➢ Sensitivity: 73% (95% CI, 68-77)
  ➢ Specificity: 89% (95% CI, 81-94)

Spada et al. 2010:
• Polyps of any size:
  ➢ Sensitivity: 71% (95% CI, 66%–76%)
  ➢ Specificity: 75% (95% CI, 66%–83%)
The colonic capsule

Figure 1. Forest plot of the included studies analyzing the sensitivity and specificity of CCE for polyp of any size.
Colon capsule endoscopy (1\textsuperscript{st} generation): sensitivity / specificity

- 2 Meta-analysis:

<table>
<thead>
<tr>
<th>Study</th>
<th>Country/Year</th>
<th>Publication type</th>
<th>Number of studies Database and period searched</th>
<th>Number of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spada et al.</td>
<td>Italy 2010</td>
<td>Meta-analysis</td>
<td>8 studies (5 fully published, 3 abstracts) MEDLINE, EMBASE, and SCOPUS, from 2006 to 2009, 837 patients</td>
<td></td>
</tr>
<tr>
<td>Rokkas et al.</td>
<td>Greece 2010</td>
<td>Meta-analysis</td>
<td>7 studies (4 fully published, 3 abstracts) PubMed/MEDLINE and EMBASE. No beginning date limit until the end of July 2009, 626 individuals</td>
<td></td>
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**Colon capsule endoscopy (1st generation): sensitivity / specificity**

1st Meta-analysis  
Rokkas et al. 2010  
Included 7 studies  
(4 fully published, 3 abstracts) and 626 individuals

Colon capsule endoscopy 1st generation

2nd Meta-analysis
Spada et al.
Included 8 studies (5 fully published, 3 abstracts) and 837 individuals

MEDLINE, EMBASE, and SCOPUS, from 2006 to 2009.
Colon capsule endoscopy
2nd generation

2 Prospective studies:

- **Eliakim et al. 2009 (n=104 patients)**
  - polyps larger than 6mm:
    - Sensitivity: 89% (95% CI: 70–97)
    - Specificity: 76% (95% CI: 72–78)
  - polyps larger than 10mm:
    - Sensitivity: 88% (95% CI: 56–98)
    - Specificity: 89% (95% CI: 86–90)

- **Spada et al. 2011 (n=117 patients)**
  - polyps larger than 6mm:
    - Sensitivity: 84% (95% CI: 74-95)
    - Specificity: 64% (95% CI: 52-76)
  - polyps larger than 10mm:
    - Sensitivity: 88% (95% CI: 76-99)
    - Specificity: 95% (95% CI: 90-100)
CONCLUSION

Many efficacious / promising imaging techniques as primary screening for CRC

Limitations:
- Feasibility (Flex sig, nurse endoscopists?)
- Morbidity (quality is key for efficacy and safety)
- Technology (?CT colography, colonic WCE)

Most population-based programs remain FOBT-based

Colonoscopy (and CT colography) remain very popular for opportunistic (discretionary) screening

Time will tell whether these imaging tests will become favored as primary methods of screening in population-based programs