Patient Decision Aids for Colorectal Cancer Screening:

A Systematic Review and Meta-analysis

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Abstract

Context—Decision aids (DAs) prepare patients to make decisions about healthcare options consistent with their preferences. Helping patients choose among available options for colorectal cancer (CRC) screening is important because rates are lower than screening for other cancers. This systematic review describes studies evaluating patient DAs for CRC screening in average-risk adults and their impact on knowledge, screening intentions, and uptake.

Evidence acquisition—Sources included Ovid MEDLINE, Elsevier EMBASE, EBSCO CINAHL Plus, Ovid PsycINFO through July 21, 2015, pertinent reference lists, and Cochrane review of patient DAs. Reviewers independently selected studies that quantitatively evaluated a DA compared to one or more conditions or within a pre–post evaluation. Using a standardized form, reviewers independently extracted study characteristics, interventions, comparators, and outcomes. Analysis was conducted in August 2015.

Evidence synthesis—Twenty-three articles representing 21 trials including 11,900 subjects were eligible. Patients exposed to a DA showed greater knowledge than those exposed to a control condition (mean difference [MD], 18.3 of 100; 95% CI=15.5, 21.1), were more likely to be interested in screening (pooled relative risk [RR], 1.5; 95% CI=1.2, 2.0), and more likely to be screened (pooled RR, 1.3; 95% CI=1.1, 1.4). DA patients had greater knowledge than patients

receiving general CRC screening information (pooled MD, 19.3 of 100; 95% CI=14.7, 23.8); however, there were no significant differences in screening interest or behavior.

Conclusions—DAs improve knowledge and interest in screening, and lead to increased screening over no information, but their impact on screening is similar to general CRC screening information.

Context

Colorectal cancer (CRC) is the second leading cause of cancer death among men and women in the U.S.[1] CRC incidence and mortality have been declining[2] owing to screening and improvements in treatment. Many tests, including fecal occult blood testing (both guaiac- and immunochemical-based), flexible sigmoidoscopy, and colonoscopy, are recommended to screen for CRC.[3–7] Despite these recommendations, screening rates for CRC (59.5%) are lower than other recommended cancer screening tests such as breast cancer (72.4%) and cervical cancer (82.9%).[8]

One of the underlying factors contributing to low screening rates is suboptimal decision making, including low rates of assessing patient preferences.[9] Patients have strong preferences for the different CRC screening test attributes such as accuracy, frequency of testing, and required preparation,[10–15] but health providers have difficulty correctly identifying those preferences.[9] Health providers tend to recommend colonoscopy, although many patients prefer fecal testing for a variety of reasons.[16,17] Several organizations discuss the importance of including patient preferences to increase screening rates for CRC[5] and allow individuals to make an informed decision when choosing one of the screening options.[2,18,19]

One way to promote consideration of patient preferences and informed decision making for CRC screening is through the use of patient decision aids. Patient decision aids provide information about options, and help patients to construct, clarify, and communicate the personal values they associate with the different features of the options.[20–22] The desired outcome is a preference-concordant, informed decision, resulting from a high-quality shared decision-making process.[21,22]

A high-quality shared decision-making process is a valued outcome independent of the impact of patient decision aids on actual screening uptake. Previous systematic reviews of decision aids used in RCTs indicate that, in general, compared with standard care, decision aids improve decision quality by improving knowledge, risk perceptions, match between values and choices, and patient–provider communication, and decrease decisional conflict and passive decision making.[23] The impact of decision aids on screening behaviors is inconsistent, and varies by topic. The overall purpose of this review was to describe studies that evaluated decision aids for CRC screening and to determine the impact of these aids in average-risk adults. Specifically, the aim was to determine the effect of decision aids compared to control conditions or to general CRC screening information on CRC screening knowledge, screening intention or interest, and uptake.

Evidence Acquisition

Using the Cochrane Handbook[24] and Guide,[25] a review protocol was developed to help facilitate the review and to finalize study eligibility, information sources, and data elements for abstraction. The protocol was registered online through NIH Research's international prospective register of systematic reviews (CRD42013002826, www.crd.york.ac.uk/PROSPERO).

A research librarian searched Ovid MEDLINE, Elsevier EMBASE, EBSCO CINAHL Plus, and Ovid PsycINFO from inception through July 21, 2015. The search strategy for Ovid MEDLINE is provided in Appendix A (available online). The search was not limited to English-only publications and conference proceedings were included in order to obtain a broad picture of all existing decision aids for CRC screening. Reference lists of pertinent reviews were manually searched, including the Cochrane review of decision aids for treatment and screening.[23] For the final selection of studies, English publications and only published journal articles were included although the aids were not limited to English language.

Trained raters (at least two for each search) independently reviewed each record retrieved from the search to assess for eligibility. Raters were not blinded to author, journal, or funding source. Raters checked titles and abstracts to rate each record as "included," "excluded," or "not sure." After screening titles and abstracts, raters reviewed full texts for all records marked as "included" and "not sure" to assess for final eligibility. Raters first reviewed discordant ratings, and then the research team reviewed any unresolved discrepancies and those records still marked as "not sure." Included were studies where the decision point was whether or not to be screened (i.e., one screening option compared to no screening), to choose between two or more screening options, or whether or not to continue screening for CRC. The intervention evaluated in the study had to be a decision aid, defined as information provided about the pros and cons of at least two screening options (including no screening) that allows the user to consider trade-offs between options. Trials that compared a decision aid to one or more comparators (e.g., control condition, general CRC screening information, other aid) had to have at least a post-evaluation. Uncontrolled trials or those studies that compared outcomes with a within-subjects design had to report a pre–post evaluation, that is, a comparison of outcomes measured before and after the patient viewed the decision aid.

Data Extraction and Synthesis

Two trained reviewers independently extracted data from each article using a standardized abstraction form and procedure developed by the Task Force on Community Preventive Services[26] as a guideline. Reviewers were not blinded to author, journals, or funding source. Reviewers extracted study characteristics including:

1. study purpose, taken directly from the abstract or text;

2. study design, categorized into RCT, controlled trial, or uncontrolled trial (within-subjects assessment);

3. country, the geographic location of the study;

4. setting, where the recruitment took place and where the intervention was conducted;

5. sampled population, including sample size, age requirements, and any unique characteristics; and

6. measured outcomes.

Reviewers extracted intervention and comparison characteristics including decision aid name, format, theory used in the development, presented screening options, description of the content, features, and implementation process. Reviewers described comparisons and then categorized comparisons into the following:

1. no information, usual care, or health education materials not related to CRC screening (e.g., safety belt use, health tips), or use of a pre-test, post-test design;

2. general CRC screening information, interventions that provided the basics about CRC and screening options, but lacked an opportunity to compare risks and benefits regarding the tests; and

3. another decision aid, where a version of the decision aid or another decision aid was the comparison.

Data analysis was completed in August 2015. For the quantitative analysis, eligible studies assessed knowledge, screening interest or intention, or screening uptake. All study designs and comparators to the decision aid were included. Study authors were only contacted to obtain data for the quantitative analysis if the data needed were not reported in the study.

Knowledge was analyzed in two ways. First, adequacy of knowledge was considered using the study's predefined degree of knowledge that was determined to be adequate in making an informed decision. Adequate knowledge was dichotomized as adequate or inadequate. Second, overall accuracy knowledge was considered, expressed as the percentage of correct responses to a knowledge measure assessed during the final assessment.

Screening interest or intention was included for those studies where responses could be dichotomized to intended to be screened or intended not to be screened. Screening uptake was defined as the completion of any test for CRC indicated by self-report, medical chart review, or claims review. Screening uptake was dichotomized as screened and not screened.

The two main comparisons were the decision aid versus a control condition and the decision aid versus general CRC screening information. Because some studies compared decision aids or made multiple comparisons, two additional comparisons were included: a detailed decision aid versus a simple decision aid, and a decision aid with more options versus fewer options. For some of the meta-analyses, the results from the detailed and simple decision aids were combined and compared to a control condition or general CRC screening information. Sample sizes were recalculated as reported elsewhere[27] for those studies that used a cluster design and where the intraclass correlation coefficient was provided. To avoid

unit of analysis error (over-precise results), the sample sizes and events were reduced to its effective size by calculating the average cluster size in the trial and the design effect for the trial.

Pooled occurrences and relative risks (RRs) for dichotomous outcomes (i.e., adequate knowledge, screening intention/interest) were calculated. Pooled occurrence information can be used to report absolute event rates of the outcomes for decision aid patients versus controls. For pooled occurrences, the Freeman–Tukey arcsine transformation was used to stabilize variances and conducted a meta-analysis using inverse variance weights. Then, estimates and CI boundaries were back-transformed into proportions. Mean differences (MDs) were calculated for continuous measures. The proportion of accurate knowledge responses was transformed into a percentage as suggested by O'Connor et al.[20,28] When SDs were not directly reported in the article, the study authors were contacted, or they were imputed from other measures of dispersion (95% CIs or p-values from t-tests), or the baseline measurement reported in the study was used instead.

A sensitivity analysis was performed to assess the robustness of the methods used to impute by excluding any trials with imputed SDs. Study heterogeneity was assessed using the I^2 statistic and subsequent chi-square test. Fixed-effect meta-analysis was used if the score was <40%, and random-effects if it was 40%.[29] Meta-regression was performed to investigate if study characteristics could explain the observed heterogeneity. Among the variables tested as predictors of study heterogeneity were study design, quality, follow-up, and type of comparison used (control condition or general CRC screening information). Study quality was assessed using the study quality form from the Guide to Community Preventive Services.[26] The risk of publication bias was assessed through funnel plots and an Egger regression test.[30] When the regression slope significantly deviated from the vertical slope, this was considered significant potential for bias. Statistical analyses were performed using RevMan, version 5.0.22 and Stata, version 10. All statistical tests were two-sided and defined the cut off for statistical significance as a p-value <0.05.

Evidence Synthesis

After removal of duplicate records, the search identified 762 unique records for review (Figure 1). A total of 97 full-text articles were assessed for eligibility, which resulted in 23 studies representing 21 trials included in the qualitative synthesis. For the quantitative synthesis, 20 trials were eligible: seven for accurate knowledge (percentage correct), six for adequate knowledge, 13 for screening intention or interest, and 13 for screening uptake.

Qualitative Synthesis

The 21 trials included a total of 11,900 participants (Appendix Table 1, available online).[31–53] Fourteen of the trials were RCTs including two randomized at the group level. Four of the trials were non-RCTs including one group-level design. The remaining three trials were uncontrolled using a pre–post assessment.

Sixteen of the trials took place in the U.S., two in Australia, one in Germany, one in Canada, and one in the Netherlands. Fifteen trials recruited participants from a clinical setting; five trials recruited from community settings such as telephone marketing databases, senior centers, or registries; and one trial recruited from both types of settings. For the trials that recruited participants from a clinical setting, six had the participant view the decision aid at home.

The majority of the trials focused on average-risk adults aged 50–74 years. Two of the trials focused on older adults, with one focusing on adults aged 65 years[50] and the other on adults aged 75 years.[40] Three of the trials focused on specific populations, including individuals with low education,[47] individuals with low SES,[41] and Hispanic or Latino individuals with limited English proficiency.[51]

Thirteen different decision aids for CRC screening were evaluated in the trials (Appendix Table 2, available online). Seven of the studies evaluated a version of a video called "Communicating Health Options through Interactive Computer Education," three studies evaluated the Foundation for Informed Medical Decision Making (now Informed Medical Decisions Foundation) video titled, "Colon Cancer Screening: Deciding What's Right for You," and 11 aids were developed by the study investigators. Video decision aids were in a variety of formats including VHS, DVD, computer-based, and web-based. Interactive programs were either computer- or web-based. For five studies, the main component of the decision aid was a printed booklet. There was a wide range of theories and frameworks used during development (Appendix Table 2, available online). Theory used in the development of the decision aid was not mentioned for four of the 13 aids.

Seven different screening options were presented in the decision aids. The most common option presented in the aids was fecal occult blood testing, presented as an option in all the decision aids except for a study that compared a colonoscopy decision aid and a CT-colonography decision aid.[31] The next most common screening option was colonoscopy, followed by flexible sigmoidoscopy, barium enema, a combination of flexible sigmoidoscopy and fecal occult blood test, and CT-colonography. Twelve of the studies evaluated decision aids that included no screening either explicitly as an option (e.g., no testing, wait and see) or presented it during trade-offs of test attributes, including all four non-U.S. studies.

Three of the studies used pre–post comparisons without a control group. For the controlled trials, eight of the trials compared a decision aid to a control condition that included no information about CRC screening (e.g., video about automobile or drug refill safety, handout on ways to stay healthy), and seven compared a decision aid to general CRC screening information with fewer details or less attractive presentation. Not enough information was

provided about the general CRC screening information to compare the content with the decision aid. In addition, seven trials compared it to another aid or another version of the aid. For example, one trial compared an aid with a no screening option to the aid without the option,[34] one trial compared a five-option aid to a two-option version,[35] and one trial compared a decision aid with and without a personalized risk calculator.[45,46] For the controlled trials, three of the 21 trials had more than one comparison condition.[45–47,50]

Thirteen trials assessed knowledge (Appendix Table 1, available online).[31,33–36,40,43,45–51] Seven of the trials assessed interest in screening,[34,35,37–39,47,50] and nine assessed intentions for screening.[32–34,40,45,46,48–51] Several of the studies measured a variation of interest or intention, including attitudes toward screening (four trials),[31,33,45–48] intentions to ask or discuss screening (four trials),[33,37,38,51] and stage of readiness (five trials).[36,37,41,42,44,53] Fifteen of the trials assessed screening uptake or test completion,[31,32,37–39,41–49,51–53] and seven assessed test preference.[35,37,38,41,42,44–46,53] Several of the trials measured a variation of behavior or test preference, including if screening was discussed (four trials)[33,42,45,46,51] or if a test was ordered (four trials).[37,41,42,45,46,53]

Many of the studies measured the extent to which the decision aid improved informed decision making by using a combination of measured outcomes. For example, one study defined informed choice as a combination of adequate knowledge and clear values.[49] Three other studies defined informed choice as adequate knowledge and attitude toward screening consistent with behavior.[31,47,48]

Meta-analysis Results

The pooled rates of adequate knowledge, screening interest or intention, and screening uptake are shown in Table 1. Nearly half of the patients exposed to any type of decision aid were deemed to have adequate knowledge (49%, 95% CI=36%, 62%). However, most studies considered adequate knowledge in a subjective fashion with cut offs specified by the authors. The pooled rates of screening interest or intention for patients in any type of decision aid group was 66% (95% CI=54%, 77%), but uptake was only 33% (95% CI=22%, 46%). Patients in the general CRC screening information group showed lower rates of adequate knowledge, but similar screening interest/intention and screening uptake rates. Patients in a control condition group (e.g., usual care, no CRC screening information, other health information) had lower rates for all three outcomes.

All comparisons described in this section can be found in Table 2.

Accuracy of knowledge was reported as the proportion of correct responses (percentage correct) or adequate knowledge (threshold specified a priori by the authors). Patients in the decision aid group improved their knowledge compared with either those patients in a control condition or receiving general CRC screening information (MD=18.3%, 95% CI=15.5%, 21.2% and MD=19.3%, 95% CI=14.7%, 23.8%, respectively). Patients in the decision aid group were more likely to have adequate knowledge after the intervention compared with the group receiving general CRC screening information (RR=2.6, 95% CI=1.4, 5.1). There were no differences in knowledge between different versions of decision aids (detailed versus simple or more options versus fewer options).

More patients in the decision aid group expressed interest or intention to undergo screening compared with those patients in a control condition (RR=1.5, 95% CI=1.2, 2.0). The absolute group benefit was 14% (95% CI=4%, 24%), that is, in the decision aid group, 40 of 100 people reported interest in screening versus 26 of 100 for the control group. The number needed to treat was eight (95% CI=4, 21), interpreted as eight people had to be exposed to the decision aid in order for one additional person to report interest on being screened. Similar rates of screening interest or intention were observed in the patients assigned to the decision aid group compared to the general CRC screening information group (RR=1.1, 95% CI=0.93, 1.3).

Patients in the decision aid group were 1.3 times more likely to complete screening at 16–52 weeks compared with the patients in control conditions (e.g., usual care, no CRC screening information, other health information) (95% CI=1.1, 1.4). The absolute group benefit was 8% (95% CI=6%, 11%), that is, in the decision aid group, 47 of 100 people completed their screening over 16–52 weeks, versus 40 of 100 for the control group. The number needed to treat was ten (95% CI=7, 25), interpreted as ten people had to be exposed to the decision aid in order for one additional person to get screened. No other statistically significant differences were observed.

When comparing rates of screening completion by follow-up time for patients receiving the decision aid versus those patients receiving only general CRC screening information, no differences were observed at 4, 8–12, or 24 weeks. No other associations were found between treatment effects and study design, quality, or follow-up. Publication bias was not observed.

Discussion

This review found that decision aids for CRC screening improve patients' knowledge by about 20% compared with control conditions and general CRC screening information. This increase in knowledge is higher than the 13% difference reported in a Cochrane systematic review of decision aids for various healthcare conditions.[21] Decision aids are associated with greater intentions to be screened and screening uptake compared to control conditions. However, compared to general CRC information, intentions and uptake are not statistically significant when decision aids are used.

It is important to not lose sight of the rationale for using of patient decision aids, that is, to improve the decision-making process and match between preferences and choices.[21,22] Similar to studies of decision aids in general, current evaluations of CRC screening decision aids are limited in their attention to the decision-making process. This review showed greater knowledge among patients receiving decision aids compared with standard CRC screening information, and knowledge is one key component of a high-quality decision.

The wide range of theories and frameworks used to guide development of the decision aids does not allow for a detailed examination of the impact of specific theories on patient outcomes. More research is needed to better understand how the theoretic underpinnings of decisions aids influence their effectiveness.[54] Similarly, more research is needed to

determine which patient groups are most likely to benefit from decision support compared with general information about CRC screening. For example, the development, use, and evaluation of decision aids with lower-literacy populations is recommended.[21] It is noteworthy that four of the trials in this review focused on vulnerable populations with mixed effects of the decision aid on screening uptake.[41,45–47,51] Clearly, there is a need for more research on the role of patient decision aids on CRC screening decisions for vulnerable populations where the burden of CRC may be highest.

Decision making about screening for CRC is an interesting and challenging prevention model for decision aid developers. There is a both persuasive component and a preference-sensitive component to the decision. In general, there is strong evidence from randomized trials and modeling studies supporting several different screening tests and schedules in decreasing CRC incidence and mortality.[4] Although presenting a no-screening option to patients may be ethically justifiable and advocated in standards for decision aid developers,[55] it can be argued that the net benefit of CRC screening warrants promotion of screening. This persuasive emphasis is in contrast to the question of which screening test is best for a given patient. Here, the evidence is equivocal, and a values-based decision is generally recognized as the desired outcome.

In this review, the tension between a persuasive emphasis (i.e., the decision to be tested) and preference sensitivity (i.e., which test to have) was reflected in the decision context selected by the researchers, and the choice of measured outcomes. When the focus of the decision was to choose between test options, shared decision making was encouraged in order to increase screening uptake. Primary outcomes measured included test preference, screening uptake, and concordance between preference and test completed. Of note, all of the studies where the decision was to choose between test options were conducted in the U.S., where preventive services recommendations strongly endorse CRC screening for eligible patients.[4] If the decision was whether to be screened or to continue screening, informed decision making was encouraged in order to promote informed choice. Here, the majority of the studies defined informed choice as having adequate knowledge and a match between values or attitude toward screening and screening behavior. Most of these studies were conducted outside the U.S., where CRC screening is not universally endorsed.

Limitations

There are several limitations to this systematic review. First, all study designs and study quality were included in the meta-analysis. Though this can influence findings, the sensitivity analysis indicated that the findings were robust across study design or quality. Second, a broad definition of a decision aid was used and no rating of the aids used in the trials against international standards for content, development, and evaluation of decision aids was conducted.[55,56] Third, the outcomes in the meta-analysis were measured using a variety of scales. For example, studies were included that measured screening uptake in various ways—self-report, medical chart review, and medical claims review. Fourth, owing to the nature of the study, the review was constrained to the data published or provided by the authors. Finally, adequacy of patients' knowledge was based on the authors' a priori

criteria given there is no consensus on essential facts a patient should know to make an informed screening choice.

Conclusions

When compared with general CRC screening information, decision aids appear to lead to greater patient knowledge of CRC and screening options, while having a similar impact on screening rates. As part of a high-quality shared-decision making experience, decisions aids have value independent of their impact on screening rates. Further improvements in colorectal cancer screening rates may be achieved by aligning patient and provider preferences. Focused efforts to integrate patient decision aids in routine clinical practice[57,58] appear highly justified given the potential to favorably impact both patient cognitive outcomes and screening rates.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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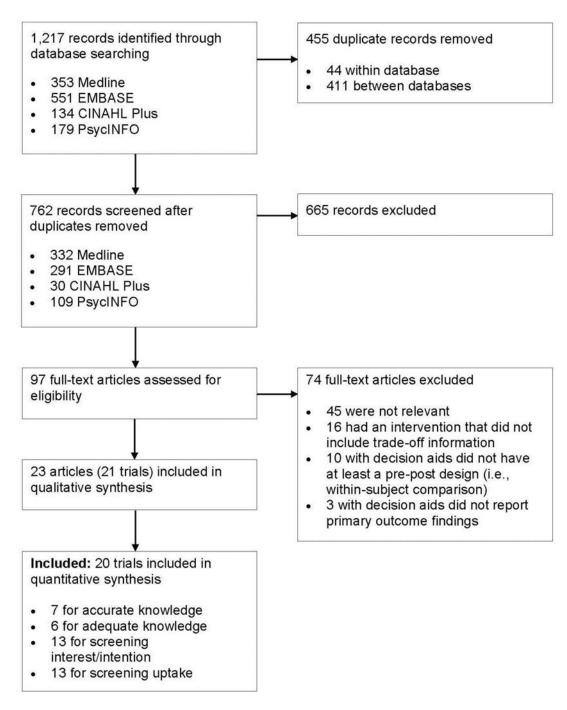
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Figure 1.
Study flow for the systematic review of colorectal cancer screening decision aid studies.

Table 1

Pooled Rates of Adequate Knowledge, Screening Interest/Intention and Uptake for Colorectal Cancer (CRC) Screening.

Study ID	Design[a]	Any decision aid			Control condition (no intervention or materials about a different topic)			General CRC screening information		
		Events	Total N	Rate (95% CI)	Events	Total N	Rate (95% CI)	Events	Total N	Rate (95% CI)
Adequate Knowledge[b]										
Griffith (2008)[35c]	RCT	21	62	0.34 (0.23, 0.46)	–	–	–	–	–	–
Lewis (2010)[40d]	UCT	24	46	0.52 (0.38, 0.66)	2	46	0.05 (0.01, 0.13)	–	–	–
Smith (2010)[47e]	RCT	200	357	0.56 (0.51, 0.61)	–	–	–	32	173	0.19 (0.13, 0.25)
Steckelberg (2011)[48]	RCT	468	785	0.60 (0.56, 0.63)	–	–	–	128	792	0.16 (0.14, 0.19)
Trevena (2008)[49]	RCT	28	134	0.21 (0.15, 0.28)	–	–	–	8	137	0.06 (0.03, 0.11)
Wolf (2000)[50f]	RCT	191	269	0.71 (0.65, 0.76)	–	–	–	72	133	0.54 (0.46, 0.62)
Pooled				0.49 (0.36, 0.62)			0.05 (0.01, 0.13)			0.22 (0.08, 0.39)
Screening Interest and/or Intention										
Dolan (2002)[32]	RCT	37	45	0.82 (0.69, 0.91)	–	–	–	27	43	0.63 (0.48, 0.76)
Frosch (2008)[33g]	CT	39	100	0.39 (0.30, 0.49)	–	–	–	53	107	0.50 (0.40, 0.59)
Griffith (2008)[34c]	RCT	59	62	0.94 (0.88, 0.99)	–	–	–	–	–	–
Leone (2013)[38]	G–CT	34	56	0.61 (0.48, 0.73)	–	–	–	–	–	–
Lewis (2008)[39h]	CT	31	35	0.88 (0.75, 0.96)	–	–	–	–	–	–
Lewis (2010)[40d]	UCT	28	46	0.61 (0.46, 0.74)	31	46	0.67 (0.53, 0.80)	–	–	–
Miller (2011)[41]	RCT	40	132	0.30 (0.23, 0.39)	28	132	0.21 (0.15, 0.29)	–	–	–
Pignone (2000)[42]	RCT	63	125	0.50 (0.42, 0.59)	33	106	0.31 (0.23, 0.40)	–	–	–
Reuland (2012)[51d]	UCT	76	80	0.94 (0.88, 0.98)	50	80	0.62 (0.52, 0.73)	–	–	–
Smith (2010)[47]	CT	121	357	0.34 (0.29, 0.39)	–	–	–	21	173	0.12 (0.08, 0.18)
Steckelberg (2011)[48]	RCT	397	785	0.51 (0.47, 0.54)	–	–	–	416	792	0.53 (0.49, 0.56)
Trevena (2008)[49]	RCT	117	134	0.87 (0.81, 0.92)	–	–	–	124	137	0.90 (0.85, 0.95)
Wolf (2000)[50f]	RCT	175	269	0.65 (0.59, 0.71)	–	–	–	79	133	0.59 (0.51, 0.67)
Pooled				0.66 (0.54, 0.77)			0.45 (0.24, 0.67)			0.55 (0.33, 0.75)

Screening Uptake

Study ID	Design[a]	Any decision aid			Control condition (no intervention or materials about a different topic)			General CRC screening information		
		Events	Total N	Rate (95% CI)	Events	Total N	Rate (95% CI)	Events	Total N	Rate (95% CI)
Dolan (2002)[32]	RCT	18	45	0.40 (0.27, 0.55)	–	–	–	14	43	0.33 (0.20, 0.47)
Kim (2005)[37]	UCT	34	80	0.43 (0.32, 0.53)	–	–	–	–	–	–
Leone (2013)[38]	G-CT	39	240	0.16 (0.12, 0.21)	18	174	0.11 (0.06, 0.16)	–	–	–
Lewis (2008)[39]	CT	20	137	0.15 (0.09, 0.21)	4	100	0.04 (0.01, 0.09)	–	–	–
Miller (2011)[41]	RCT	25	132	0.19 (0.13, 0.26)	18	132	0.14 (0.09, 0.20)	–	–	–
Pignone (2000)[42]	RCT	46	125	0.37 (0.29, 0.45)	28	124	0.23 (0.16, 0.31)	–	–	–
Pignone (2011)[43d]	G-RCT	50	129	0.37 (0.29, 0.45)	50	156	0.32 (0.25, 0.40)	–	–	–
Reuland (2012)[51b]	BA	13	68	0.20 (0.11, 0.30)						
Ruffin (2007)[44]	RCT	56	87	0.64 (0.54, 0.74)	–	–	–	33	87	0.38 (0.28, 0.48)
Schroy (2011)[45i]	RCT	220	549	0.40 (0.36, 0.44)	96	276	0.35 (0.29, 0.41)	–	–	–
Smith (2010)[47e]	RCT	211	357	0.59 (0.54, 0.64)	–	–	–	130	173	0.75 (0.68, 0.81)
Steckelberg (2011)[48]	RCT	171	785	0.22 (0.19, 0.25)	–	–	–	161	792	0.20 (0.18, 0.23)
Trevena (2008)[49]	RCT	7	134	0.06 (0.02, 0.10)				9	137	0.07 (0.03, 0.12)
Clouston (2014)[52d]	G-RCT	740	1,112	0.67 (0.64, 0.69)	609	1071	0.57 (0.54, 0.60)			
Pooled				0.33 (0.22, 0.46)			0.23 (0.09, 0.41)			0.33 (0.12, 0.59)

[a] Design: G-RCT=group RCT, G-CT=group controlled trial, UCT=uncontrolled trials with within-subjects comparisons, CT=controlled trial. Lower-case n refers to frequency of occurrence, such as adequate knowledge; upper-case N refers to total sample size.

[b] Adequate knowledge was defined as follows: Griffith (2008),[35] responding correctly to all questions. Lewis (2010),[40] defined as 67% of the questions responded correctly. Smith (2010)[47] and Steckelberg (2011),[48] if patient had 50% or above correct responses. Trevena (2008),[49] if the patient had a positive score for understanding the potential benefits and for understanding the potential harms of screening. Wolf (2000),[50] reported as patients that responded correctly or incorrectly to one question only.

[c] Griffith (2008)[35] compared 2-option decision aid to a 5-option decision aid. Here, the results are combined.

[d] Lewis (2010)[40] and Reuland (2012),[51] pre-intervention data used as the control condition group.

[e] Smith (2010)[47] compared decision aid with question prompt list to a decision aid without the list and to general CRC screening information. Here, the two decision aid group results are combined. It was noted in the trial that there were no significant differences between the two decision aid groups.

[f] Wolf (2000)[50] compared a decision aid with absolute risk information to decision aid with relative risk information and to a control. Here, the decision aid group results are combined.

[g] Frosch (2008),[33] numbers presented include patients receiving prostate or colorectal cancer information. Removal of this study did not change the magnitude of the pooled estimate (0.69%; 95% CI 0.56, 0.82).

[h] Lewis (2008)[39] control group was not asked about screening intention and therefore no data is presented.

[i] Schroy (2011)[45] compared a decision aid with a personalized risk assessment to a decision aid without the personalized risk assessment and to a control condition. Here, the two decision aid group results are combined.

Table 2

Efficacy of Colorectal Cancer (CRC) Screening Decision Aids (DA) Compared to Various Comparator Interventions

Accurate knowledge (proportion of accurate responses out of 100)

	DA			vs	Control condition			Mean difference (95% CI)
	Mean	SD	N		Mean	SD	N	
Schroy (2011)[45][a]	90.0	14.7	549		71.7	21.7	276	**18.3 (15.5, 21.2)**

	DA			vs	General CRC information screening			Mean difference (95% CI)
	Mean	SD	N		Mean	SD	N	
Frosch (2008)[33]	30.1	22.3	61		18.1	16.6	60	**12.0 (5.0, 19.0)**
Smith (2010)[47]	54.2	27.8	357		34.2	14.3	173	**20.0 (16.4, 23.6)**
Steckelberg (2011)[48]	53.8	28.8	785		31.3	15.0	792	**22.5 (20.2, 24.8)**
							Pooled	**19.3 (14.7, 23.8)**

	Detailed DA			vs	Simple DA			Mean difference (95% CI)
	Mean	SD	N		Mean	SD	N	
Jerant (2007)[36]	67.9	22.8	24		63.7	20.9	25	4.2 (−8.1, 16.5)
Schroy (2012)[46]	89.2	15.8	280		90.8	13.3	269	−1.7 (−4.1, 0.78)
							Pooled	−1.4 (−3.8, 0.96)

	DA with more options			vs	DA with fewer options			Mean difference (95% CI)
	Mean	SD	N		Mean	SD	N	
Griffith (2008)[34]	46.0	22.8	57		46.0	20.9	49	0.0 [−8.3, 8.3]
Griffith (2008)[35]	70.0	22.8	25		66.7	20.9	37	3.3 [−7.9, 14.5]
							Pooled	1.2 (−5.5, 7.9)

Adequate knowledge (proportion of patients with adequate knowledge)[b]

	DA		vs	General CRC screening information		Risk ratio (95% CI)
	n	N		n	N	
Smith (2010)[47]	200	357		32	173	**3.0 (2.2, 4.2)**
Steckelberg (2011)[48]	468	785		128	792	**3.7 (3.1, 4.4)**
Trevena (2008)[49]	28	134		8	137	**3.6 (1.7, 7.6)**
Wolf (2000)[50]	191	269		72	133	**1.3 (1.1, 1.6)**

Accurate knowledge (proportion of accurate responses out of 100)

	DA			vs	Control condition			Mean difference (95% CI)
	Mean	SD	N		Mean	SD	N	
DA with more options				vs	**DA with fewer options**		Pooled	**2.6 (1.4, 5.1)**
	n		**N**	vs	**n**		**N**	**Risk ratio (95% CI)**
DA with more options				vs	**DA with fewer options**			
Griffith (2008)[35]	9		25	vs	12		37	1.1 (0.55, 2.2)

Screening interest/intention

	DA			vs	**Control condition**			**Risk ratio (95% CI)**
	n		**N**	vs	**n**		**N**	
Miller (2011)[41]	40		132	vs	28		132	1.4 (0.94, 2.2)
Pignone (2000)[42]	63		125	vs	33		106	**1.6 (1.2, 2.3)**
							Pooled	**1.5 (1.2, 2.0)**
General CRC screening information	**DA**			vs	**Control condition**			**Risk ratio (95% CI)**
	n		**N**	vs	**n**		**N**	
Dolan (2002)[32]	37		45	vs	27		43	**1.3 (1.0, 1.7)**
Frosch (2008)[33]	39		100	vs	53		107	0.79 (0.58, 1.1)
Smith (2010)[47]	121		357	vs	21		173	**2.8 (1.8, 4.3)**
Steckelberg (2011)[48]	397		785	vs	416		792	0.96 (0.87, 1.1)
Trevena (2008)[49]	117		134	vs	124		137	0.96 (0.89, 1.1)
Wolf (2000)[50]	175		269	vs	79		133	1.1 (0.93, 1.3)
							Pooled	1.1 (0.94, 1.3)
DA with more options	**n**		**N**	vs	**DA with fewer options** n		**N**	**Risk ratio (95% CI)**
Griffith (2008)[35]	24		25	vs	35		37	1.0 (0.91, 1.1)

Screening uptake

	DA			vs	**Control condition**			**Risk ratio (95% CI)**
	n		**N**	vs	**n**		**N**	
16–24 weeks								
Clouston (2014)[52]c	740		1,112	vs	609		1,071	**1.2 (1.1, 1.3)**

Accurate knowledge (proportion of accurate responses out of 100)

	DA			vs	Control condition			Mean difference (95% CI)
	Mean	SD	N		Mean	SD	N	
Lewis (2008)[34]	20		137		4		100	**3.7 (1.3, 10.4)**
Miller (2011)[41]	25		132		18		132	1.4 (0.80, 2.4)
Pignone (2000)[42]	46		125		28		124	**1.6 (1.1, 2.4)**
							Pooled	**1.5 (1.1, 2.0)**
52 weeks								
Leone (2013)[38]	39		240		18		174	1.6 (0.93, 2.7)
Pignone (2011)[43c]	50		129		50		156	1.2 (0.88, 1.7)
Schroy (2011)[45a]	220		549		96		276	1.2 (0.95, 1.4)
							Pooled	**1.2 (1.0, 1.4)**
All subgroups							Pooled	**1.3 (1.1, 1.4)**

	DA		vs	General CRC screening information			Risk ratio (95% CI)
	n	N		n	N		
4 weeks							
Trevena (2008)[49]	7	134		9	137		0.80 (0.30, 2.1)
8–12 weeks							
Dolan (2002)[32]	18	45		14	43		1.2 (0.70, 2.2)
Smith (2010)[47]	211	357		130	173		0.79 (0.70, 0.89)
					Pooled		*0.91 (0.60, 1.4)*
24 weeks							
Ruffin (2007)[44]	56	87		33	87		**1.7 (1.2, 2.3)**
Steckelberg (2011)[48]	171	785		161	792		1.1 (0.89, 1.3)
					Pooled		*1.3 (0.84, 2.1)*
All subgroups					Pooled		*1.1 (0.78, 1.5)*

	Detailed DA		vs	Simple DA			Risk ratio (95% CI)
	n	N		n	N		
52 weeks							

Accurate knowledge (proportion of accurate responses out of 100)

	DA			vs	Control condition			Mean difference (95% CI)
	Mean	SD	N		Mean	SD	N	
Schroy (2011)[45]	104		280		116		269	0.86 (0.70, 1.1)

Notes: Boldface in the rightmost column indicates statistical significance (*p*<0.05)

Lower case n refers to frequency of occurrence, such as adequate knowledge; upper case N refers to total sample size.

[a]Schroy (2011)[45] compared DA with personalized risk assessment to a DA without personalized risk assessment and to a control condition with no information. Here, the two DA groups' results are combined.

[b]Adequate knowledge was defined by authors as follows: Smith (2010)[47] and Steckelberg (2011)[48] if patient had 50% or above correct responses. Trevena (2008)[49] if the patient had a positive score for understanding the potential benefits and for understanding the potential harms of screening. Wolf (2000)[50] reported patients that responded correctly or incorrectly to one question only. Griffith (2008)[35] defined as responding to all the questions correctly.

[c]To avoid unit of analysis error (over-precise results), the sample sizes and events were reduced to its effective size by calculating the average cluster size in the trial and the design effect for the trial as reported elsewhere.[27]