Tailored interventions to overcome identified barriers to change: effects on professional practice and health care outcomes (Review)

Baker R, Camosso-Stefinovic J, Gillies C, Shaw EJ, Cheater F, Flottorp S, Robertson N

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[Intervention Review]

Tailored interventions to overcome identified barriers to change: effects on professional practice and health care outcomes

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ABSTRACT

Background

In the previous version of this review, the effectiveness of interventions tailored to barriers to change was found to be uncertain.

Objectives

To assess the effectiveness of interventions tailored to address identified barriers to change on professional practice or patient outcomes.

Search strategy

For this update, in addition to the EPOC Register and pending files, we searched the following databases without language restrictions, from inception until August 2007: MEDLINE, EMBASE, CINAHL, BNI and HMIC. We searched the National Research Register to November 2007. We undertook further searches to October 2009 to identify potentially eligible published or ongoing trials.

Selection criteria

Randomised controlled trials (RCTs) of interventions tailored to address prospectively identified barriers to change that reported objectively measured professional practice or healthcare outcomes in which at least one group received an intervention designed to address prospectively identified barriers to change.

Data collection and analysis

Two reviewers independently assessed quality and extracted data. We undertook quantitative and qualitative analyses. The quantitative analyses had two elements.

1. We carried out a meta-regression to compare interventions tailored to address identified barriers to change with either no interventions or an intervention(s) not tailored to the barriers.

2. We carried out heterogeneity analyses to investigate sources of differences in the effectiveness of interventions. These included the effects of: risk of bias, concealment of allocation, rigour of barrier analysis, use of theory, complexity of interventions, and the reported presence of administrative constraints.

Main results

We included 26 studies comparing an intervention tailored to address identified barriers to change to no intervention or an intervention(s) not tailored to the barriers. The effect sizes of these studies varied both across and within studies.

Twelve studies provided enough data to be included in the quantitative analysis. A meta-regression model was fitted adjusting for baseline odds by fitting it as a covariate, to obtain the pooled odds ratio of 1.54 (95% CI, 1.16 to 2.01) from Bayesian analysis and 1.52 (95% CI, 1.27 to 1.82, P < 0.001) from classical analysis. The heterogeneity analyses found that no study attributes investigated were significantly associated with effectiveness of the interventions.

Authors' conclusions

Interventions tailored to prospectively identified barriers are more likely to improve professional practice than no intervention or dissemination of guidelines. However, the methods used to identify barriers and tailor interventions to address them need further development. Research is required to determine the effectiveness of tailored interventions in comparison with other interventions.

PLAIN LANGUAGE SUMMARY

Tailored interventions to overcome identified barriers to change effects on professional practice and health care outcomes

Tailored interventions to change professional practice are interventions planned following an investigation into the factors that explain current professional practice and any reasons for resisting new practice. These factors are referred to as barriers to change. The barriers may vary in different healthcare settings, groups of healthcare professionals or clinical tasks. It is widely assumed that efforts to change professional practice have a lower likelihood of success unless these barriers are identified and taken into account.

In a previous review that was able to include only 15 studies, we were unable to conclude that tailoring was effective. However, more studies of tailoring have been published and therefore we have incorporated the new studies into an update of the review.

We have included 26 studies in the new review. The findings indicate that tailored interventions can change professional practice. As yet, there is insufficient evidence on the most effective approaches to tailoring, including how barriers should be identified and how interventions should be selected to address the barriers. In addition, there is no evidence about the cost-effectiveness of tailored interventions compared to other interventions to change professional practice. Consequently, it is reasonable to employ low-cost tailored interventions in practice, but evidence on the cost-effectiveness of the alternative methods of tailoring is required before use of more costly tailored approaches can be justified.

SUMMARY OF FINDINGS FOR THE MAIN COMPARISON *[Explanation]*

Should tailored interventions be used for overcoming identified barriers to changing professional practice?

Patient or population: Health care professionals responsible for patient care
Settings: Mostly primary care in the U.S. and Europe
Intervention: Tailored interventions

Outcomes	Illustrative comparative risks* (95% CI)		Relative effect (95% CI)	No of Participants (studies)	Quality of the evidence (GRADE)	Comments
	Assumed risk	Corresponding risk				
	Control	Experimental				
Desired professional practice The outcome measures used were measures of professional performance, such as prescribing, and adherence to guideline recommendations	**Medium risk population**[1]		OR 1.52 (1.27 to 1.82)[2]	2189 (12 studies)[3]	+++O moderate[4]	
	60 per 100	69.5 per 100 (65.6 to 73.2)				
	High risk population[1]					
	20 per 100	27.5 per 1000 (24.1 to 31.3)				

*The basis for the **assumed risk** (e.g. the median control group risk across studies) is provided in footnotes. The **corresponding risk** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

CI: Confidence interval; OR: Odds Ratio

GRADE Working Group grades of evidence
High quality: Further research is very unlikely to change our confidence in the estimate of effect.
Moderate quality: Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.
Low quality: Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.
Very low quality: We are very uncertain about the estimate.

[1] The assumed risks without a tailored intervention were selected to help interpret the overall odds ratios in situations in which there are is a high risk of undesirable professional practice or bad healthcare outcomes without intervening (20% desired practice or outcomes) and a medium risk (60% desired practice or outcomes).

[2] The OR and confidence intervals are from the meta-regression using a classical analysis. The results using a Bayesian analysis are also reported in the results section of the review.

[3]The number of participants shown here is the approximate number of health professionals in the 12 studies. The results of 14 studies not included in the meta regression also suggest that on average tailored interventions improve professional practice, but the effects are heterogeneous.

[4] We have downgraded the quality of evidence to moderate because study limitations (risk of bias) in some of the included studies and heterogeneity of results.

BACKGROUND

This review updates a previous Cochrane review (Shaw 2005) of the effects of tailored strategies, which we define as 'strategies to improve professional practice that are planned taking account of prospectively identified barriers to change'. Barriers to change are factors that could potentially impair the effectiveness of an intervention to improve professional practice, and have been classified by the Cochrane Effective Practice and Organisation of Care Group into nine categories (information management, clinical uncertainty, sense of competence, perceptions of liability, patient expectations, standards of practice, financial disincentives, administrative constraints and other) (EPOC 2002).

Whether considered in the context of models for quality and safety improvement or guideline implementation initiatives (Ashford 1999; Grol 2005; Lomas 1994; Robertson 1996), systematic reviews of improvement interventions (Chaillet 2006; Grimshaw 2004) or guideline adoption (Cabana 1999), barriers are believed to influence the success of improvement strategies. If the barriers to improved performance are identified and strategies then chosen and implemented to overcome them, it would appear reasonable to expect performance to improve. Despite the attractiveness of this argument, however, the effects of attempts to translate research evidence into practice and improve performance remain inconsistent (Grimshaw 2004; McGlynn 2003).

Although there are a number of reviews in specific clinical fields (Chaillet 2006; Kroenke 2000) which have discussed the possibility that tailored strategies might be more effective than strategies selected without taking account of barriers, these reviews did not address the effect or costs of tailored interventions specifically. Bosch and colleagues (Bosch 2007) undertook a qualitative analysis of 20 quality improvement studies reporting investigation of barriers. Individual and group interviews of professionals were the most commonly used method of identifying barriers, but in many studies the reasons for believing a particular strategy would overcome a particular barrier were not explained. Again, the effectiveness of tailored strategies was not evaluated.

Why it is important to do this review

We have not identified any reviews evaluating the effects of tailored strategies on professional performance other than our earlier version of this review, which concluded that the effectiveness of tailored interventions was uncertain. Since the publication of that review (2005), several new studies of tailored intervention strategies have been published, and as tailoring is frequently regarded as an important step in improvement interventions, we have updated the review.

OBJECTIVES

We addressed the question: are tailored strategies effective in improving professional practice and healthcare outcomes?

To answer this question, we considered the same comparisons as in the earlier review.

1. A comparison of interventions tailored to address identified barriers to change with no intervention or an intervention(s) not tailored to the barriers. We repeated this analysis for two subsets of the studies, one in which the control group received no intervention and the other in which the control was a non-tailored intervention. We also undertook an investigation of heterogeneity on the effectiveness of tailored interventions to identify factors important to consider when designing and implementing a tailored intervention.

2. An intervention targeted at both individual and social or organisational barriers compared with interventions that are targeted at only individual barriers.

METHODS

Criteria for considering studies for this review

Types of studies

Randomised controlled trials (RCTs).

Types of participants

Healthcare professionals responsible for patient care. We excluded studies that included only students.

Types of interventions

We defined tailored strategies as strategies to improve professional practice that are planned taking account of prospectively identified barriers to change. Barriers may be identified by various methods, including observation, focus group discussions, interviews or surveys of the involved healthcare professionals, and/or through an analysis of the organisation or system in which care is provided. We excluded studies that used gap analysis only (i.e. audits identifying a gap between actual and desired performance), as well as studies of educational interventions based on an identified lack of knowledge and designed to improve knowledge only. The identification of barriers must have been undertaken before the design and delivery of the intervention. If the timing of the identification of barriers was not clear, we contacted the study authors for clarification.

Studies had to involve a comparison group that did not receive a tailored intervention (including either no intervention or an

intervention not tailored to identified barriers), or a comparison between an intervention that was targeted at both individual and social or organisational barriers, compared with an intervention targeted at only individual barriers.

Types of outcome measures

Objectively measured professional performance in a healthcare setting. We excluded studies that measured knowledge or performance in a test situation only.

Search methods for identification of studies

Electronic searches

See: Cochrane Effective Practice and Organisation of Care Group (EPOC) Guide for review Authors: Developing a Protocol (EPOC 2007a).

We undertook searches for studies reported by August 2007, and have included relevant studies identified in this review. We undertook further searches to October 2009 to identify any potentially relevant or ongoing studies to be considered in the next update of this review.

The Cochrane Effective Practice and Organisation of Care (EPOC) Group Specialised Register and pending files were searched by the EPOC Trials Search Co-ordinator, using the following strategy initially: ((tailored or tailoring) and (program* or intervention* or strategy or strategies or system* or treatment* or education*)). The later strategy (including the pending citations until October 2009) was: tailor/tailors/tailored/tailoring. The Specialised Register aims to contain all RCTs and other relevant trial reports within the scope of a Cochrane Review Group. Therefore, we did not undertake a search of the Cochrane Central Register of Controlled Trials (CENTRAL) (Cochrane TSC User Guide 2008). We also searched the following databases, without language restrictions: MEDLINE (Ovid) from 1950 to August 2007; EMBASE (Ovid) from 1980 to August 2007; Cumulative Index to Nursing and Allied Health Literature (CINAHL) from 1982 to August 2007; PsycINFO and the Allied and Complementary Medicine Database (AMED) from inception to August 2007; British Nursing Index (BNI) from 1994 to August 2007; Health Management Information Consortium (HMIC) from 1983 to August 2007. We repeated the searches with modified strategies for the period September 2007 to October 2009, with the exception of PsycINFO and the Allied and Complementary Medicine Database (AMED), as there was a very low yield of potentially eligible articles when these databases were initially searched.

We developed two separate but related strategies and applied these in both MEDLINE and EMBASE (the two most productive databases in terms of reports of trials identified for inclusion in the review). We took this approach in an effort to maximise search strategy sensitivity, while maintaining precision (see Appendix 1). Using both strategies together was more sensitive in detecting studies already known to be eligible for inclusion. We then adapted one of these two strategies (MEDLINE strategy I, see Appendix 1) for use in the other databases consulted.

Search terms utilised in the EMBASE methodology filter (used to identify reports of controlled trials) followed current EPOC methodology (EPOC 2007b).

We reviewed the reference lists of related systematic reviews and of all articles obtained in full text so as to identify any additional, potentially relevant reports of trials. We handsearched titles and abstracts in the online electronic version of the *Journal of Evaluation in Clinical Practice*, from February 2003 to October 2009. Most other relevant journals have been included in the EPOC register (EPOC 2009).

Searching other resources

We identified one relevant published review article and examined it for any additional, useful (free text or indexing) terms to complement our existing search strategy (Bosch 2007). We also contacted the article authors, in June 2007, for further information regarding their search strategy, which they provided.

We undertook citation searches in November 2007 (on ISI WoK) for articles citing any of the papers newly identified and included in our review.

We contacted the corresponding authors of the included papers in December 2007, for information regarding any potentially relevant studies that they were aware of (both published and unpublished), to add to those we had already identified.

We last searched the National Research Register on 4 September 2007 (using the terms 'tailor or tailored' and 'barrier or barriers'), for details of ongoing trials. We searched all active registers in the *meta*Register of controlled trials (http://www.controlled-trials.com/mrct/), in October 2009, using six different combinations of search terms (Strategies A.-F., Appendix 3), for reports of relevant ongoing and completed trials. We contacted authors of identified trials listed on the *meta*Register as completed in October 2009, to ask for details of publications.

We have listed papers identified by the searches conducted in 2009, considered likely to be eligible for inclusion but awaiting further assessment, below, under Studies awaiting classification.

Data collection and analysis

Selection of studies

Two review authors independently assessed studies for inclusion; a third author resolved any discrepancies.

Data extraction and management

Two reviewers independently extracted the data from included studies by using the EPOC Data Collection Checklist (EPOC 2002). We contacted study investigators if data were missing from a study or further clarification was needed.

We summarised the methods that were used to identify barriers to change and qualitatively assessed the processes that were used to identify barriers and tailor interventions to address them. Two reviewers independently classified the complexity of the methods used to identify barriers using the following categories: low - a questionnaire survey of health professionals or informal discussion with, for example, a guideline group; moderate - interviews and/or focus groups with samples of health professionals specifically seeking information about barriers, or a survey supplemented by performance data; high - interviews and/or focus groups of health professionals supplemented by additional methods, for example observation.

We classified barriers using the EPOC categories (EPOC 2002): a) information management; b) clinical uncertainty; c) sense of competence; d) perceptions of liability; e) patient expectations; f) standards of practice; g) financial disincentives; h) administrative constraints; i) other.

Two independent reviewers classified the extent to which the tailored intervention was adjusted to local barriers using the following categories: low - the intervention was limited to feedback and education tailored to the general barriers affecting all or most professionals, and not tailored to the particular barriers at individual or team level; moderate - educational outreach or other interventions beyond feedback or education, tailored to general barriers and not to barriers at the individual or team level; high - any intervention or interventions tailored to the particular barriers facing individual health professionals or individual healthcare teams.

Assessment of risk of bias in included studies

Two reviewers assessed the risk of bias of included studies using the criteria described by EPOC for RCTs (EPOC 2002). We also used the EPOC Data Collection Checklist to assess risk of bias and extract data. Given the potential heterogeneity of the targeted behaviours, skills and organisational factors relevant to the review, we did not base study inclusion on a minimum cut-off for methodological quality. We have presented the risk of bias of each of the included studies in the Results section. Since many of the trials were cluster randomised, we assessed whether analyses had taken the unit of analysis into account.

For all of the studies included in the review, we assigned an overall risk of bias rating (high, moderate, low risk of bias) based on the following criteria: concealment of allocation, blinded or objective assessment of primary outcome(s), completeness of follow up of professionals, and no important concerns in relation to baseline measures, reliable primary outcomes, or protection against contamination. We assigned a rating of low risk of bias if the first three criteria were scored as done, and there were no important concerns related to the last three criteria, moderate if one or two criteria were scored as not clear or not done, and high if more than two criteria were scored as not clear or not done (adapted from Jamtvedt 2003).

Measures of treatment effect

We assessed all the included studies for inclusion in a meta-regression analysis, with the aim of providing an overall assessment of the effectiveness of tailored interventions. Where possible, we used the primary binary outcome of each study as an estimate of the effectiveness of the tailored intervention, expressed as odds ratios. Where more than one primary outcome was listed, or a secondary outcome had to be utilised because none of the primary outcomes were binary in format, two authors made the decision on which outcome to use through discussion, based on which was the most clinically relevant measure for the study objectives. We excluded five studies from the analyses as they did not report a suitable binary outcome. There was insufficient information to calculate odds ratios for a further nine studies, despite contacting the authors for further information where possible.

Unit of analysis issues

We included 12 trials in the meta-regression analysis. As all the trials were cluster randomised, either results reported for each cluster, or an estimate of the intra-class correlation coefficient (ICC) were needed to enable the clustering effect to be accounted for in the overall effect size estimate from each study. Seven of the 12 studies reported either an estimate of the ICC or reported data for each cluster, allowing the ICC to be estimated. We calculated a mean ICC value from the studies where it was reported using Fisher's transformation approach (Ukoumunne 2002). We used this mean ICC value to adjust the effect size for clustering in studies where only the summary results were reported across all clusters. We calculated the design effect, induced by the cluster design of the trials, for each study using the estimated or average ICC value. We then used the design effect to adjust the estimated effect sizes for clustering, whereby the variances of the odds ratios were increased by multiplying them by the design effect (Rao 1992). The method of using an average ICC for studies where results were not reported by cluster is not ideal due to heterogeneity between studies. However, it is a better approach than ignoring the clustering effect altogether, which is often how this problem is dealt with.

Dealing with missing data

The trials included in the analysis were randomised at the cluster level, for example, at the level of the clinic or general practice. None of the studies described problems of drop outs at this level during the trial period. As the data collected were on different

patients before and after interventions, drop out at the patient level was not an issue. For the five studies that did not report sufficient information to enable calculation of an ICC value, we used the average ICC value from the seven studies where it could be calculated.

Assessment of heterogeneity

We tested for heterogeneity between the odds ratios at follow up using the Cochrane Q test. To investigate possible causes of heterogeneity on the effectiveness of tailored interventions between studies, we assessed attributes that might have an impact on findings of intervention effectiveness: risk of bias, concealment of allocation, level of tailoring, rigour of barriers analysis, complexity of interventions, use of a theory when developing the intervention, and the reported presence or absence of administrative constraints. We have reported classifications for each study by attribute in the table Characteristics of included studies. We investigated heterogeneity by fitting the meta-regression analysis separately for each category of the study attribute of interest and comparing odds ratios and additionally by fitting the study attributes as continuous variables into the meta-regression models.

Assessment of reporting biases

We applied no language restrictions in the searches or inclusion of studies. To check for possible publication bias, we undertook a search in 2009 of the *meta*Register of Controlled Trials (mRCT, available at: http://www.controlled-trials.com/mrct/). As mRCT includes randomised trials records held on the National Institutes of Health (NIH) ClinicalTrials.gov website (available at: http://clinicaltrials.gov/), we did not search the latter registry. Furthermore, as the studies included in the review spanned a number of years and were not all recent publications, time-lag bias is unlikely to be a major problem.

Data synthesis

We combined the estimated odds ratios for each study using meta-regression techniques, whereby the baseline odds ratios were included as a covariate to adjust for any baseline differences between the intervention and control groups (Sutton 2000). The same model was fitted in both Stata (classical approach, see Appendix 4 for Stata code) and WinBUGS (Bayesian approach), with the Bayesian approach having the added advantage of modelling the ICC with an error term, thus accounting for some of the heterogeneity between studies.

Sensitivity analysis

The main analysis assumed the control groups were equivalent in all 12 studies. To test the robustness of this assumption we carried out two separate analyses, one in which the control groups had no intervention, and another in which the control groups were a non-tailored intervention.

RESULTS

Description of studies

See: Characteristics of included studies; Characteristics of excluded studies; Characteristics of ongoing studies.

Results of the search

Searches of the electronic databases to August 2007 yielded a total of 3250 potentially relevant articles. Following review of titles and abstracts, we obtained 57 for assessment in full text. Searches of the EPOC Register and Pending Files identified a further 23 and four potentially relevant papers respectively. These were either records that had already been identified by the database searches (25) or reports of studies which were not eligible for inclusion (two).
Online handsearching of titles and abstracts in the *Journal of Evaluation in Clinical Practice* identified eight potentially relevant articles; we found none of these to be eligible for inclusion in the review. Citation searches of the new papers identified did not retrieve any additional papers for consideration in full text.
We received replies to our letters to corresponding authors of newly included papers from five of the contacted authors, and investigated their suggestions for possible additional relevant papers. However, this did not result in the identification of any additional papers meeting our inclusion criteria.
The National Research Register search carried out in September 2007 yielded 27 reports of ongoing or completed studies for consideration, but none of these identified a study for inclusion. Of the 93 studies obtained in full text, 11 met the criteria for inclusion in the review. The searches 2007 to 2009 found seven studies recently identified as eligible for inclusion and awaiting assessment, while seven other records were identified describing study protocols, ongoing, or recently completed studies meeting our inclusion criteria. We have listed these below under Studies awaiting classification and Ongoing studies, respectively.

Included studies

We included 26 trials in the review, 15 of which had been included in the original review. Of the 11 additional studies, nine had been published since the previous review and two (Callahan 1994; Karuza 1995) had not been identified in the previous review. There were two four-arm trials, four three-arm trials, and 20 two-arm trials. The unit of allocation was the health professional in five, the practice in eight, and a larger grouping (hospital, geographical

cluster) in 13 trials. The characteristics of the included studies are shown in the Characteristics of included studies table.

Healthcare setting and characteristics of health care professionals

Eleven studies had been undertaken in healthcare settings in the US, four in the UK, two each in Belgium, Canada, Indonesia, Norway and the Netherlands, and one in Portugal. In 16 trials, the professionals were physicians only, in two nurses, in six multi-professional staff teams, and community pharmacists (Ross-Degnan 1996) and prescribers (Santoso 1996) in one each. Fifteen trials were based in primary or community care, seven in hospital or specialist care, three in both, and one in a nursing home (Avorn 1992).

Targeted behaviours

In nine trials, prescribing was the targeted aspect of care, in three preventive care, in one intrapartum monitoring (Davies 2002), in one reporting of adverse drug reactions (Figueiras 2006), and in 12 aspects of clinical management of a variety of conditions, including depression, back pain, incontinence, hypertension, and abortion care.

Prospective identification of barriers to change

In 13 studies, more than one method was used to identify barriers. Interviews with health professionals and occasionally patients were used in 11 studies, focus group interviews in 10 studies, questionnaire surveys in six, review of the literature in four, review of performance data in two, a meeting or workshop in two, and other methods in four (including observation and consultation with an expert group). Some studies employed a complex mix of methods. For example, in one (Flottorp 2002), a literature search, discussion with the guideline development group, brainstorming, focus group interviews with patients and health professionals, discussion groups and informal interviews were all used. The depth of investigation of barriers was categorised as low in six studies, moderate in 13, and high in seven.

Barriers identified

The amount of information about the barriers varied among the studies. In three (Avorn 1992; Goodwin 2001; Hux 1999), the details were insufficient to enable the barriers to be classified. Seven studies reported barriers in only one of the EPOC domains: two in the clinical uncertainty domain only (Leviton 1999; Soumerai 1998), two in the patient demand domain only (Avorn 1983; Engers 2005), and three in the other domain only (Karuza 1995; Sehgal 2002; Simon 2005). The other 16 studies reported barriers in between two and four domains.

The numbers of studies reporting barriers in each domain were: administrative constraints 13, clinical uncertainty nine, patient expectations five, information management three, sense of competence two, financial disincentives two, and 'other' 15. Barriers in the 'other' category included negative staff attitudes, anxiety about changing practice, a perception that the clinical issue was not a priority, and advocacy of certain drugs by pharmaceutical companies. Administrative barriers included lack of time, staff or facilities.

Influence of prospective identification of barriers on intervention design

Six studies reported drawing on behavioural theory to guide the choice of strategies in response to the identified barriers (Avorn 1983; Avorn 1992; Baker 2001; Cheater 2006; Davies 2002; Evans 1997). The remaining 20 studies made no reference to any theoretical underpinning when developing interventions.

Characteristics of the intervention

Details of all interventions can be found in Characteristics of included studies. We identified no new studies that had not been included in the first version of this review that had addressed organisational barriers.

Excluded studies

The characteristics of the excluded studies are shown in Characteristics of excluded studies. Reasons for excluding studies included the absence of a prospective identification of barriers to change, and non-randomised study design.

Risk of bias in included studies

We assessed nine studies as having low risk of bias (see Characteristics of included studies table). We assessed 15 trials as having moderate and two as high risk of bias. We assessed 12 studies as having adequate allocation concealment. The performance of health professionals was the focus of all the studies, and in all but one study follow up of professionals was adequate, the proportion followed up being unclear in one study. Adequate follow up of patients was not achieved in two studies, unclear in one study, and achieved in 17, but not appropriate in six studies. Blinded assessment of study outcomes was completed in 17 studies, and a power calculation was reported in 15 studies.

Unit of analysis errors

We accounted for unit of analysis errors in the analysis by adjusting the odds ratios for clustering prior to their inclusion in the meta-regression models. Of the 14 studies not included in the meta-regression, 11 were cluster trials, of which six had accounted for clustering, and five had not.

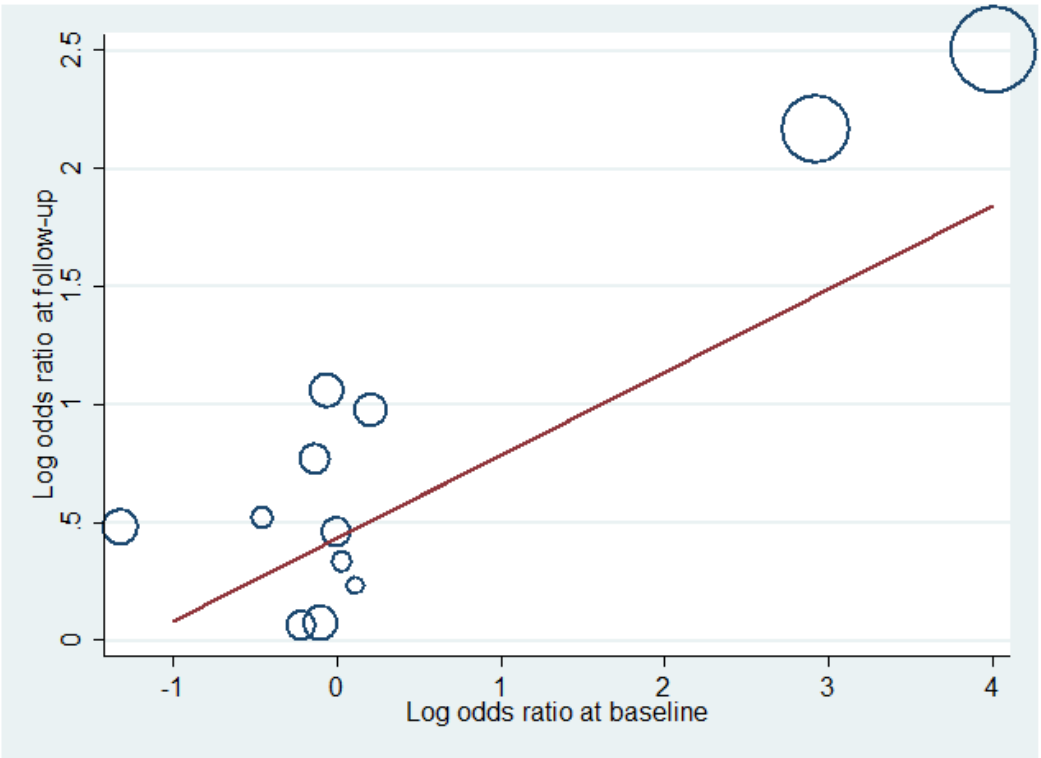
Effects of interventions

See: **Summary of findings for the main comparison** Tailored interventions for overcoming identified barriers to changing professional practice

The results of the included studies were mixed both across and within studies (Table 1). Some studies showed a statistically significant improvement in all relevant outcomes. Fourteen studies met the criteria for inclusion in the review, but did not report the necessary data for inclusion in the meta-regression. The main results and conclusions of these studies are reported in Table 1. Overall eight of the 14 studies reported benefit of tailored interventions, two reported benefit for some outcomes but not others, and four studies reported that interventions showed no improvement over control arms in terms of the study's primary outcomes. The positive studies included three with unit of analysis errors, and the mixed and negative studies included three with unit of analysis errors. As the excluded studies did not differ from those included in the meta-regression in terms of level of risk of bias, the results of the meta-regression should not be biased in this respect by their unavoidable omission.

In Table 2, for the twelve studies where a suitable binary outcome was available for analysis, we report the effect sizes used for meta-regression analysis. The effect sizes have been adjusted for the clustering effect induced by the study designs. The specific outcomes were chosen because of clinical relevance and suitability for the statistical analysis. The odds ratios at follow up, adjusted for clustering, ranged from 1.07 to 12.25, but not all of the results were statistically significant. When combined using meta-regression techniques and adjusting for baseline odds ratios, the pooled odds ratio for all 12 studies was 1.54 (95% CI, 1.16 to 2.01) from the Bayesian analysis and 1.52 (95% CI, 1.27 to 1.82) $P < 0.001$ from the classical analysis. The use of Bayesian methods enabled all parameter uncertainty, especially that regarding the between-study variation, to be fully accounted for in the final pooled effect estimate. Both approaches show benefit with tailored interventions. Figure 1 shows a meta-regression plot with the log odds ratio at follow up plotted against the log odds ratio at baseline. Each circle shows the result of one study and circle size relates to the standard error of the log odds ratio. The red line shows the pooled estimated log odds ratio for each value of the baseline log odds ratio. The plot shows that imbalances between the intervention and control groups at baseline influenced the follow-up log odds ratio, therefore the adjustment for baseline values was an important step in the analysis. The results of the classical analysis can be obtained from the plot, as when the baseline log odds ratio is zero, i.e. when there is no estimated difference between the intervention and control groups at baseline, the estimated log odds ratio at follow up is 0.42, which when exponentiated equals the 1.52 pooled value obtained for the classical analysis. The control group in four of the 12 studies involved no intervention (Avorn 1992; Callahan 1994; Flottorp 2002; Schouten 2007), and in eight studies the control group (Baker 2001; Cheater 2006; Coenen 2004; Davies 2002; Evans 1997; Fretheim 2006; Leviton 1999; Simon 2005) received a non-tailored intervention. There was little difference in the pooled effect size associated with the nature of the control group, although it should be noted that only a small number of studies had a no intervention control (no intervention control OR 1.58 (95% CI, 0.96 to 2.59]; non-tailored control OR 1.56 (95% CI, 1.27 to 1.90)). In the eight trials using a control group receiving a non-tailored intervention, all but one study compared a tailored strategy to dissemination of educational materials or guidelines.

Figure 1. Meta-regression plot **The log odds ratio at follow-up is plotted against the log odds ratio at baseline, with each circle representing one study in the analysis, and the red line indicating the pooled estimated follow-up log odds ratio for each value of the baseline log odds ratio. Circle size is relative to the standard error of the log odds ratio. The result from the classical analysis can be read from the graph in that when the intervention and control groups are equal at baseline (i.e. when the baseline odds ratio=0) then the estimated log odds ratio from the plot is 0.42. When exponentiated this gives the pooled effect size of 1.52.**



Significant heterogeneity was found between the odds ratios at follow up (P < 0.001). Some of this heterogeneity was due to differences between the comparison groups at baseline, which was adjusted for in the main meta-regression analyses. We carried out further analyses out to investigate other possible sources of heterogeneity between trial results. Although we assessed several study attributes including risk of bias, level of tailoring, rigour of barrier analysis, complexity of interventions, concealment of allocation, explicit utilisation of a theory when developing the intervention, and the reported presence or absence of administrative constraints, we found none to be significantly associated with the reported effectiveness of the tailored interventions. When we performed subgroup analyses for level of tailoring, a high level of tailoring of the intervention had a pooled odds ratio of 1.63 (95% CI, 0.64 to 4.18) and moderate tailoring a pooled odds ratio of 1.44 (95% CI, 1.26 to 1.66). Only one study was classified as having an intervention of low tailoring, hence we could not estimate a pooled odds ratio for low level. Although a high level of tailoring showed a greater effect size than moderate, this was not a significant difference.

The original version of this review included a comparison of an intervention targeted at both individual and social or organisational barriers compared with interventions that are targeted at only individual barriers. We did not identify any further studies relevant to this comparison. In the earlier review only three studies

had been identified (Evans 1997; Langham 2002; Matchar 2002), and no conclusions had been possible due to the limited number of studies.

DISCUSSION

Summary of main results

Interventions tailored to prospectively identified barriers are more likely to improve professional practice than no intervention or to dissemination of guidelines or educational materials. The overall effectiveness as indicated by the meta-regression is modest. There is, however, wide variation in effectiveness between studies and between the targeted behaviours within single studies, from lack of effect to relatively large effect. Part of the variation may be explained by the variety of barriers identified and addressed in the studies, the variety of clinical settings and targeted behaviours, and the lack of consistency in the methods used within the tailored strategy. The methods used to identify barriers, to select interventions likely to overcome the barriers, and to deliver the chosen interventions varied widely between studies. Although some adaptation of the methods can be expected in order to account for differences between settings or the mix of prevailing barriers, the extent of variation was such as to suggest that the tailored strategies approach has not yet been developed to the point at which there is broad agreement about the design and role of the constituent elements. For example, although tailored interventions appear to be effective, we do not yet know the most effective ways to identify barriers, to pick out from amongst all the barriers those that are most important to address, or how to select interventions likely to overcome them.

Overall completeness and applicability of evidence

Barriers may be classified in different ways (Légaré 2009). We used the EPOC classification, which employs descriptive categories not related to a conceptual model. Revision of the EPOC classification, including the elaboration of an appropriate conceptual model, would be advisable prior to the next update of this review. The studies did not investigate whether identified barriers had been overcome by the chosen interventions other than through assessment of professional behaviour or health outcomes. In future, researchers should consider investigating whether barriers have indeed been overcome, perhaps using some of the methods initially used to identify the barriers, with investigation taking place in both the intervention and control arms of trials. Studies to compare different ways of selecting interventions are also required, for example studies that compare the use of different theories, or the use of theory with no explicit theory.

Furthermore, it is not clear which element of the tailored strategy approach explained effectiveness. The studies employed various interventions to improve professional practice and it is possible that use of such interventions (for example, audit with feedback, educational outreach) would have improved professional practice whether or not tailoring had been undertaken. Eight of the trials in the meta-regression included a control group that received a non-tailored intervention, but in all but one study the control intervention was limited to the relatively ineffective strategy of dissemination of educational materials or guidelines. Therefore, our review shows that tailored strategies can be effective, but is unable to determine whether this approach is more effective than selecting other interventions already shown to have effect but not involving a barriers analysis followed by tailoring to overcome the identified barriers.

It should also be pointed out that the studies included in this review do not enable any assessment of the costs of tailored strategies. Since the identification of barriers and tailoring of strategies involve additional steps beyond the application of a particular strategy such as education alone, the economic costs of tailoring are likely to be higher than several other interventions. Consequently, evidence of the cost-effectiveness of tailoring in comparison with other implementation methods is required from well designed evaluation studies. There are, therefore, several important questions to be addressed in future research of the effectiveness of tailored strategies.

Quality of the evidence

It was possible to include 26 trials in this update, whereas only 15 could be included in the previous version (Shaw 2005). Only six studies could be included in the meta-regression analysis in the original review, but 12 were included in this update. Therefore, the amount of evidence has improved. There was no convincing trend over time towards improvement in the quality of studies, three of the eleven additional studies being rated as having low risk of bias, seven as moderate, and one high risk of bias. Applying the Grades of Recommendation, Assessment, Development and Evaluation (GRADE) system (GRADE Working Group 2004), we have downgraded the level of evidence to moderate (Summary of findings table 1). The reasons for this are the variable risk of bias of the included studies and the heterogeneity of results.

A number of questions remain about the design of tailored strategies and their impact on identified barriers, as described above. It is possible to have reasonable confidence that tailored implementation strategies are more likely to lead to improved performance than the use of no strategy, or of dissemination of guidelines alone, but further well-planned studies are required to determine how the tailored strategies approach should be designed to maximise effectiveness, and how the approach compares to other implementation strategies.

Potential biases in the review process

The review was limited to RCTs, and whilst the randomised trial design is considered to be less susceptible to bias in comparison with other study designs, it is possible that good quality interrupted time series or controlled before and after studies could provide further insight into the effectiveness of tailored implementation strategies.

Of the 26 trials reviewed, we could include only 12 in the meta-regression. Nevertheless, both classical and Bayesian methods produced the same conclusion. In the meta-regression analysis, the outcomes included were either those reported as the primary outcome or, when this was not possible, we selected the most clinically relevant measure and therefore the introduction of bias is unlikely. We pooled a relatively wide variety of outcomes in the meta-regression, although in all studies the study outcomes related to processes of care and the studies all addressed the same question about the effectiveness of tailored interventions. The small number of studies, however, is likely to have contributed to the finding that no study attributes were associated with reported intervention effectiveness. Another consequence of the relatively small number of studies is that it is not possible to confirm effectiveness of tailored strategies in improving health outcomes, as most studies reported only changes in professional behaviour, not clinical outcomes.

It should also be acknowledged that the classification of reported barriers and assessment of level of tailoring were limited by the limited information reported in the included studies.

A potential limitation of electronic handsearching is that this approach, in contrast to handsearching print journals, risks overlooking otherwise unpublished studies reported in (non-indexed) conference abstracts and journal supplements (Hopewell 2002). However, this is more likely to be a source of bias for reviews in which interrupted time series and controlled before and after studies are included, since in comparison with these types of studies, randomised trials are more likely to be identified through electronic database searches. Using a complex search, including a sensitive RCT filter, in the key electronic databases should have identified the majority of relevant, published trials.

AUTHORS' CONCLUSIONS

Implications for practice

The selection of interventions tailored to prospectively identified barriers is more likely to improve professional practice than no intervention or to dissemination of guidelines or educational materials alone.

At present, there is no single, standard method for tailoring strategies to identified barriers. It is not possible to decide the most effective approach based on available evidence, and the cost of the approach in comparison with other approaches is not known. Therefore, use of low cost approaches in practice would be reasonable; complex and more costly tailored strategies projects should not be undertaken outside carefully designed evaluation studies.

Implications for research

Research is needed to: (a) better develop the intervention, including methods of identifying the salient barriers and of tailoring interventions to address them; (b) develop and apply methods of investigating whether barriers actually have been overcome, showing how the interventions and barriers interact, for example through use of process evaluations; and (c) determine whether tailored interventions are more cost-effective than non-tailored interventions.

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* *Indicates the major publication for the study*

CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

Avorn 1983

Methods	RCT (three study groups, randomised block design)
Participants	435 office-based physicians Country: USA Targeted activity: use of 3 selected drugs (cerebral and peripheral vasodilators, oral cephalosporin, propoxyphene)
Interventions	Barriers analysis: face-to-face interviews with professionals Complexity: moderate Barriers: patient expectations Theory: communications theory and behaviour change research Interventions: 1. printed materials only 2. printed materials plus academic detailing 3. no intervention Tailoring: moderate
Outcomes	Professional practice: number of units of drugs prescribed Health outcome: none
Notes	

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Unclear	Quote: "Control and experimental interventions were then allocated randomly within each block..."
Blinding? All outcomes	Unclear	Insufficient information reported to permit judgement
Follow-up of professionals?	Yes	Quote: "Of the original 435 members of the sample, 9 had moved out of the state, 6 had died, and 5 had retired by the start of 1981."
Protection against contamination?	Yes	Quote: "If a small town contained more than one physician from our sample, all physicians in that town were randomized as a cluster to prevent cross-contamination..."
Follow-up of patients?	Unclear	No patients or patient level data included

Avorn 1983 (*Continued*)

Power calculation?	No	A power calculation is not reported
Reliable outcomes?	Yes	Quote: "We used Medicaid prescribing records to document changes in the prescribing of target drugs."
Baseline data?	Yes	Quote: "The physicians in each of the study groups were comparable before the intervention in terms of the amount of the target drugs they prescribed..."

Avorn 1992

Methods	RCT
Participants	Staff in nursing homes Country: USA Targeted activity: use of psychoactive drugs
Interventions	Barriers analysis: interviews of nurses, nursing assistants and physicians in nursing homes not included in the study, and reviews of the literature Complexity: moderate Barriers: unclear Theory: principles of academic detailing Interventions: 1. educational outreach to high prescribing physicians, and training sessions for nurses 2. no intervention. Tailoring: moderate
Outcomes	Professional practice: psychoactive drug use Health outcome: mental status
Notes	

Risk of bias

Item	**Authors' judgement**	**Description**
Allocation concealment?	Unclear	One institution in each pair was then randomly assigned to receive the experimental program
Blinding? All outcomes	Unclear	Quote: "After measuring base-line drug use and performing clinical assessments, we initiated a comprehensive educational-outreach program..."
Follow-up of professionals?	Unclear	No data about professionals were reported.

Avorn 1992 (*Continued*)

Protection against contamination?	Yes	Quote: "We sought to ensure that the facilities in each pair were similar in terms of baseline drug use but were geographically distant enough to minimize the spread of information by staff members affiliated with both an experimental and a control nursing home."
Follow-up of patients?	Yes	Quote: "The proportions of residents remaining in the two groups of homes after the intervention were also quite similar: 349 of 431 (81%) in the experimental nursing homes and 329 of 392 (84%) in the control facilities."
Power calculation?	No	A power calculation is not reported.
Reliable outcomes?	Unclear	Quote: "Software was written for a laptop computer and used to record all medications received ..."
Baseline data?	Yes	Quote: "At base line, the use of psychoactive medication was comparable in the experimental and control nursing homes."

Baker 2001

Methods	RCT
Participants	60 general practices Country: UK Targeted activity: management of patients with depression
Interventions	Barriers analysis: interviews of general practitioners, plus performance data Complexity: high Barriers: varied according to the individual practitioner, including sense of competence, administrative constraints and other Theory: psychological theories of behaviour change Interventions: 1. guideline plus strategies selected from outreach, feedback, scripts, group session 2. guideline only Tailoring: high
Outcomes	Professional practice: adherence to guideline recommendations Health outcome: depression score
Notes	

Risk of bias

Item	**Authors' judgement**	**Description**
Allocation concealment?	Yes	Quote: "The practices of those GPs who agreed to take part were randomised using a table of random numbers to control and intervention groups."

Baker 2001 (*Continued*)

Blinding? All outcomes	Yes	Quote: "Data collection was undertaken by two trained data collectors blind to practitioners' study groups."
Follow-up of professionals?	Yes	Quote: "64 randomised (three of the original volunteers did not enrol any patients and were excluded, one moved away, one withdrew)."
Protection against contamination?	Yes	Quote: "No practice included a doctor in both study groups."
Follow-up of patients?	Unclear	Quote: "Data collected from patient records; details of missing records not given. Beck depression inventory completed by more than 80% of patients at baseline."
Power calculation?	Yes	Power calculation reported.
Reliable outcomes?	Yes	Quote: "Inter-rater reliability of the data collection for the variables to check adherence to the guidelines were all satisfactory (k = 0.68-0.95)."
Baseline data?	Yes	Quote: "There were no significant differences in the age of patients in each study group, but there were fewer males in the intervention group in the first data collection (P < 0.05). There were no significant differences between groups in adherence to the guideline recommendations at baseline."

Callahan 1994

Methods	RCT
Participants	103 primary care physicians Country: USA Targeted activity: diagnosis and management of depression in late life
Interventions	Barriers analysis: survey of 153 primary care physicians, plus performance data Complexity: moderate Barriers: clinical uncertainty, administrative constraints, other Theory: none Interventions: 1. guidelines, additional appointments for patients, feedback on depression score, letter to the physician about each patient 2. no intervention Tailoring: moderate
Outcomes	Professional practice: adherence to guidance on depression management Health outcome: depression score
Notes	
Risk of bias	

Callahan 1994 (*Continued*)

Item	Authors' judgement	Description
Allocation concealment?	Unclear	Quote: "29 practice sessions were randomized to control or intervention status."
Blinding? All outcomes	Unclear	No information is given about blinding.
Follow-up of professionals?	Yes	Quote: "Among the 103 (43%) physicians with a patient enrolled in the clinical trial, 3 (61%) had 1 patient enrolled, 18 (17%) had 2, and 22 (21%) had 3 or more patients enrolled."
Protection against contamination?	Unclear	The study took place in a single ambulatory care clinic, giving rise to a risk of contamination, although 'No physician had both control and intervention patients.'
Follow-up of patients?	Yes	Process data are reported on all 175 patients enrolled in the trial
Power calculation?	Yes	Power calculation reported.
Reliable outcomes?	Unclear	Hamilton depression rating scale used, but source of data on recording diagnoses of depression and prescribing not described
Baseline data?	Yes	'There were no significant differences between these 2 groups in any baseline characteristics.'

Cheater 2006

Methods	RCT
Participants	194 community nurses Country: UK Targeted activity: nurse urinary incontinence care
Interventions	Barriers analysis: questionnaire survey of nurses in the intervention group Complexity: low Barriers: information management, administrative constraints, other Theory: communication and behaviour change theory Interventions: 1. educational outreach tailored to barriers 2. audit with feedback 3. audit with feedback, plus educational outreach 4. educational materials alone Tailoring: high
Outcomes	Professional practice: adherence to guideline recommendations Health outcomes: symptoms, and well-being

Cheater 2006 (*Continued*)

Notes	

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	Concealed randomisation was conducted by the project administrator and SR, other researchers and data collectors being blind to allocation.'
Blinding? All outcomes	Yes	Quote: "Researchers and data collectors were blind to allocation."
Follow-up of professionals?	Yes	Quote: "176 nurses recruit 1078 patients." Comment: Follow up indicated in flow chart
Protection against contamination?	Yes	Quote: "Family practices to which nurses were attached were randomized to reduce the risk of intrapractice contamination."
Follow-up of patients?	Yes	Quote: "Data on compliance with review criteria at baseline were available for 1017 (94.7%) patients and follow-up data for 877 (81.3%)."
Power calculation?	Yes	Power calculation reported.
Reliable outcomes?	Yes	Quote: "Four trained data collectors, blind to allocations, extracted information from records (mean inter-rater percentage agreement for all items 86.7%)."
Baseline data?	Yes	Compliance with recommendations lower in one study group at baseline. 'Baseline differences were adjusted for in analysis of aggregate compliance scores by fitting the baseline score as a covariate in the model.'

Coenen 2004

Methods	RCT
Participants	85 general practitioners Country: Belgium Targeted activity: antibiotic prescribing for acute cough
Interventions	Barriers analysis: interviews of 24 general practitioners, and survey of 316 general practitioners Complexity: high Barriers: sense of competence, patient expectations, other Theory: none Interventions: 1. guideline, educational outreach visit. 2. educational materials Tailoring: high

Coenen 2004 (*Continued*)

Outcomes	Professional practice: antibiotic prescribing rate Health outcome: time to symptom resolution
Notes	

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	Quote: "Afterwards, P.V.R., who was blinded for the composition of the groups, determined whether group 1 became the intervention or the control by tossing a coin."
Blinding? All outcomes	Unclear	Quote: "They (the GPs) collected the data themselves on pre-printed forms."
Follow-up of professionals?	Yes	Quote: "This left 27 of 42 GPs in the intervention arm and 32 of 43 GPs in the control arm for the post-test."
Protection against contamination?	Yes	Quote: "We randomized GPs rather than practices since more than half of the GPs worked single-handed and not all GPs from group practices participated. SC made sure that GPs from the same practice ended up in the same group."
Follow-up of patients?	Yes	Quote: "They included 1800 patients in the study of which 1503 patients were eligible for analysis of the primary outcome."
Power calculation?	Yes	A power calculation is reported.
Reliable outcomes?	Unclear	The reliability of the GP collected data and of patient diaries is not reported
Baseline data?	Yes	Quote: "No significant differences were found between the intervention and control GPs."

Davies 2002

Methods	RCT
Participants	135 nurses in two obstetric hospitals Country: USA Targeted activity: intrapartum foetal monitoring
Interventions	Barriers analysis: interactive workshops of nurses. Complexity: low Barriers: self-efficacy, other Theory: self-efficacy Interventions:

Davies 2002 (*Continued*)

	1. 8-hour interactive workshops; use of existing channels (rounds, departmental meetings, posters) 2. newsletter publications and presentation Tailoring: low
Outcomes	Professional practice: use of electronic foetal monitoring, time spent providing labour support Health outcome: none
Notes	

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Unclear	Quote: "Central random allocation was done so that 1 hospital of either type was designated to receive the tailored intervention."
Blinding? All outcomes	Yes	Quote: "All research assistants (observers and chart reviewers) were blind to the study design and had not worked at any of the study hospitals."
Follow-up of professionals?	Unclear	Information about professionals not reported.
Protection against contamination?	Yes	Randomisation was at the level of the hospital.
Follow-up of patients?	Yes	Quote: "We reviewed 2864 randomly selected charts of women who had given birth in the fall of 1995 or the fall of 1996."
Power calculation?	Yes	Power calculation reported.
Reliable outcomes?	Yes	Quote: "To determine the proportion of women who received EFM, we randomly selected charts for all women who gave birth in an 8-week period."
Baseline data?	Yes	Quote: "The EFM rates from the regional database at the 4 hospitals before the intervention 91993-95) ranged from 84.4% to 99.3%)."

Engers 2005

Methods	RCT
Participants	67 general practitioners Country: The Netherlands Targeted activity: management of low back pain
Interventions	Barriers analysis: interviews of 20 patients and their general practitioners Complexity: moderate Barriers: patient expectations Theory: none

Engers 2005 (*Continued*)

	Interventions: 1. workshop, patient education card, scientific articles, tool to facilitate collaboration with patients, and guideline 2. guideline only Tailoring: moderate
Outcomes	Professional practice: prescribing, referral, advice Health outcomes: none
Notes	

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	Quote: "Blind treatment allocation was conducted by an independent researcher with no information on the GPs, using a computer-generated random list of numbers."
Blinding? All outcomes	No	Comment: GPs participating in the study collected the data. Quote: "The GPs were asked to prospectively complete self-registration forms shortly after the first consultations..."
Follow-up of professionals?	Yes	Quote: "Of the 67 GPs included in the study, a total of 42 returned one or more postconsultation forms (response rate 61%)."
Protection against contamination?	Unclear	Randomisation at the level of the GP; it is not reported whether some GPs were in the same practice
Follow-up of patients?	Yes	Quote: "A total of 616 consultations for 531 patients with nonspecific low back pain were reported on."
Power calculation?	Yes	Power calculation reported.
Reliable outcomes?	Unclear	Outcomes recorded by GP participants.
Baseline data?	Yes	Quote: "There were no differences in baseline characteristics among GPs in the intervention and control groups."

Evans 1997

Methods	RCT
Participants	134 staff in child health clinics Country: USA Target activity: diagnosis and management of childhood asthma

Evans 1997 (*Continued*)

Interventions	Barriers analysis: focus groups Complexity: moderate Barriers: clinical uncertainty, administrative constraints Theory: planned organisational change, learner centred teaching Interventions: 1. teaching sessions, discussions of patients, tutorial for physicians, monthly educator visits 2. guideline Tailoring: moderate
Outcomes	Professional practice: identification of patients with asthma, continuity of care, use of medication, patient education Health outcomes: none
Notes	

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	Quote: We randomly allocated one panel to intervention status by asking a volunteer to toss a coin during a meeting of BH supervisors and administrators."
Blinding? All outcomes	No	No blinding reported.
Follow-up of professionals?	Yes	Quote: "Nevertheless, each clinic had at least one paediatrician, public health nurse, public health assistant, laboratory technician, and clerical worker."
Protection against contamination?	Yes	Quote: "Randomisation took place at the level of the clinic."
Follow-up of patients?	Yes	Quote: "We conducted telephone interviews with the caregivers of 460 patients identified through the BCH database who had receive treatment for asthma in the 22 clinics."
Power calculation?	No	No power calculation reported.
Reliable outcomes?	Yes	Quote: "We examined data from the BCH computer database of patient visits."
Baseline data?	Yes	Quote: "There were no significant differences between the intervention and control clinics."

Figueiras 2006

Methods	RCT
Participants	6451 physicians Country: Portugal Targeted activity: reporting of adverse drug reaction
Interventions	Barriers analysis: survey of staff who had and had not reported an adverse drug reaction Complexity: low Barriers: administrative constraints, other. Theory: none Interventions: 1. educational outreach, reminder card and report form 2. no intervention control Tailoring: moderate
Outcomes	Professional practice: reporting of adverse drug reactions Health outcomes: none
Notes	

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	Quote: "Using a computer-generated procedure, 4 clusters were assigned to the intervention and 11 to the control group."
Blinding? All outcomes	Yes	Quote: "The Pharmacosurveillance Unit expert responsible for codifying adverse reactions (J.P.) was blinded to the physician study group assignment."
Follow-up of professionals?	Yes	All included physicians followed up through reporting of adverse drug reactions
Protection against contamination?	Yes	Quote: "To prevent cross-contamination between the intervention and control groups, 15 spatial clusters were used as units of assignment."
Follow-up of patients?	Unclear	No patient level data collected
Power calculation?	Yes	Power calculation reported.
Reliable outcomes?	Yes	Quote: "All data came from the Northern Pharmacosurveillance Unit (under the Portuguese Health Authority) and were certified in accordance with World Health Organization guidelines."
Baseline data?	Yes	Quote: "Models were adjusted for age, speciality and work setting' (there were baseline differences for these variables)."

Flottorp 2002

Methods	RCT
Participants	142 general practices Country: Norway Targeted activity: management of urinary tract infection in women and sore throat
Interventions	Barriers analysis: literature search, discussion with the guideline development group, brainstorming, focus group interviews with patients and GP assistants, a pilot study, discussion groups at a course, and informal interviews Complexity: high Barriers: patient expectations, financial disincentives, administrative constraints, other Theory: none Interventions: 1. summary of guideline recommendations, patient educational material, computer based support and reminders, increased fees for telephone consultations, printed material to facilitate discussions, interactive courses for GPs and practice assistants, CME point for participants 2. no intervention Tailoring: moderate
Outcomes	Professional practice: rates of use of antibiotics, laboratory tests and telephone consultations Health outcomes: none
Notes	

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	Quote: "142 practices were randomised by computer."
Blinding? All outcomes	Unclear	Quote: "Because of the nature of the interventions, participating practices knew the group to which they were assigned."
Follow-up of professionals?	Yes	Quote: "Thirteen practices in the urinary tract infection arm and nine practices in the sore throat arm dropped out after randomisation."
Protection against contamination?	Yes	Randomisation at practice level.
Follow-up of patients?	Yes	Data were collected from electronic records using bespoke software for all relevant consultations
Power calculation?	Yes	Power calculation reported.
Reliable outcomes?	Yes	Data on antibiotic prescribing, laboratory tests and telephone consultations collected with standard software
Baseline data?	Yes	Quote: "The arms were similar for patient characteristics and baseline measurements."

Foy 2004

Methods	RCT
Participants	Medical and nursing staff of 26 hospital gynaecology units Country: UK Targeted activity: adherence to induced abortion guideline
Interventions	Barriers analysis: interviews of lead gynaecologists in each unit plus a survey of medical, nursing and midwifery staff Complexity: high Barriers: administrative constraints, other Theory: none Interventions: 1. feedback, a presentation and discussion of barriers, patient booklet, local action plans, structured case records 2. guidelines only Tailoring: high
Outcomes	Professional practice: adherence to 15 guideline recommendations Health outcomes: patient satisfaction
Notes	

Risk of bias

Item	Authors' judgement	Description
Allocation concealment?	Yes	Quote: "The units in each matched pair ere randomised to either intervention or control by an independent statistician."
Blinding? All outcomes	No	Blinding not reported.
Follow-up of professionals?	Yes	Comment: Details of professionals in participating units not reported Quote: "Post-intervention, 1474 case notes from 25 gynaecology units were reviewed. No relevant cases were identified in one small rural gynaecology unit."
Protection against contamination?	Yes	Quote: "Measures were taken to avoid contamination (e.g. avoidance of any joint educational meetings between units)."
Follow-up of patients?	Yes	Quote: "Post-intervention data were abstracted from up to 75 cases per unit."
Power calculation?	Yes	Power calculation reported.
Reliable outcomes?	Yes	Quote: "Prior to the intervention, women undergoing induced abortion over a three month period were identified from ward admission books. Fifty case records per unit were randomly selected and compliance with guideline recommendations audited."

Foy 2004 (*Continued*)

Baseline data?	Yes	Quote: "Overall, intervention and control units were balanced with respect to patient and unit characteristics, except for a higher proportion of medical abortions in the intervention arm."

Fretheim 2006

Methods	RCT
Participants	501 physicians in 139 general practices Country: Norway Targeted activity: management of cardiovascular risk factor
Interventions	Barriers analysis: literature search, structured reflection, physician questionnaire, focus group Complexity: high Barriers: clinical uncertainty, administrative constraints, other Theory: none Interventions: 1. guidelines plus educational outreach, software package with reminders, audit and feedback 2. guidelines only Tailoring: moderate
Outcomes	Professional practice: adherence to guideline recommendations Health outcomes: BP and cholesterol control
Notes	

Risk of bias

Item	**Authors' judgement**	**Description**
Allocation concealment?	Yes	Quote: "A colleague not directly involved in our research project generated the allocation list using software..."
Blinding? All outcomes	Yes	Data extracted from electronic health records.
Follow-up of professionals?	Yes	Quote: "For seven of the 146 participating practices, we were unable to collect medical record data for various reasons."
Protection against contamination?	Yes	Randomisation was at the level of the practice.
Follow-up of patients?	Yes	Details given in patient flow chart.
Power calculation?	Yes	Power calculation reported.
Reliable outcomes?	Yes	Data collected from electronic records using software for this purpose

Fretheim 2006 (*Continued*)

Baseline data?	Yes	Quote: "The practices and patients in the intervention and control groups were similar with regards to baseline characteristics."

Goodwin 2001

Methods	RCT
Participants	154 family physicians Country: USA Targeted activity: preventive care
Interventions	Barriers analysis: observation of practice, staff interviews Complexity: high Barriers: not clear Theory: none Interventions: 1. facilitation, practice meetings, feedback, menu of tools and approaches 2. no intervention Tailoring: high
Outcomes	Professional practice: delivery of preventive care Health outcomes: none
Notes	

Risk of bias

Item	**Authors' judgement**	**Description**
Allocation concealment?	Yes	Quote: "Practices were randomized in blocks of four as they enrolled..."
Blinding? All outcomes	Unclear	Information on blinding not reported.
Follow-up of professionals?	Yes	Quote: "During the course of the clinical trial, one practice in the intervention group declined continued participation and two practices in the control group moved."
Protection against contamination?	Unclear	Randomisation at practice level, but risk of interaction between practices not discussed
Follow-up of patients?	Yes	Data collection at baseline and at 6 and 12 months involved a total of 10,172 patient visits
Power calculation?	Yes	Power calculation reported.
Reliable outcomes?	Yes	Data from unannounced medial record review.

Goodwin 2001 (*Continued*)

Baseline data?	Yes	Quote: "The lack of statistically significant differences between intervention and control practices indicates that randomization of practices at baseline successfully produced balanced study groups."

Hux 1999

Methods	RCT
Participants	251 primary care physicians Country: Canada Targeted activity: antibiotic prescribing
Interventions	Barriers analysis: focus groups of physicians Complexity: moderate Barriers: unclear Theory: none Interventions: 1. feedback with educational bulletins 2. no intervention Tailoring: low
Outcomes	Professional practice: cost of antibiotic prescribing and choice of antibiotics Health outcomes: none
Notes	

Risk of bias

Item	**Authors' judgement**	**Description**
Allocation concealment?	Unclear	Quote: "400 were randomly assigned to the intervention arm and 400 to the control arm."
Blinding? All outcomes	No	Prescribing profiles obtained from claims data.
Follow-up of professionals?	Yes	Quote: "All included physicians followed up except for 1 intervention physician had fewer than 10 prescriptions in the study period, and the data for this doctor were not included."
Protection against contamination?	Yes	Quote: "To reduce the chance of contamination between study arms or reinforcement of the intervention through participant interaction, physicians with the same address as another participant were not selected."
Follow-up of patients?	Unclear	Physician level prescribing data only.
Power calculation?	Unclear	Power calculation not given.

Hux 1999 (*Continued*)

Reliable outcomes?	Yes	Data from a claims database.
Baseline data?	Yes	Quote: "Physicians in the intervention and control arms of the study were similar with regard to age, sex, number of years since graduation from medical school and certification by the College of Family Physicians."

Karuza 1995

Methods	RCT
Participants	51 primary care physicians Country: USA Targeted activity: influenza vaccination
Interventions	Barriers analysis: literature and facilitated discussion groups Complexity: moderate Barriers: other Theory: none Interventions: 1. lecture, development of an action plan 2. discussion on an unrelated preventive healthcare topic Tailoring: high
Outcomes	Professional practice: vaccination rates Health outcomes: none
Notes	

Risk of bias

Item	**Authors' judgement**	**Description**
Allocation concealment?	Unclear	Randomisation process not described.
Blinding? All outcomes	Unclear	It is not stated whether data extraction was blind to study group
Follow-up of professionals?	Yes	Quote: "...51 met the inclusionary criteria for analysis. Eight physicians dropped out...."
Protection against contamination?	Yes	Quote: "Because the physicians practiced in group settings, the practice groups were assigned to the two study arms randomly..."
Follow-up of patients?	Yes	Quote: "Physician compliance with the influenza vaccination guideline was defined by the percentage of patients older than 65 years in his or her practice who received influenza vaccine..."

Karuza 1995 (*Continued*)

Power calculation?	Unclear	No power calculation reported.
Reliable outcomes?	Yes	Qquote: "For the key measures, the inter-judge reliability of the chart review was better than 98% agreement."
Baseline data?	No	Quote: "No systematic differences in the patients' demographic profile or health status were noted between study arms."

Langham 2002

Methods	RCT
Participants	17 general practices Country: UK Targeted activity: prescribing for, and recording and control of cardiovascular risk factors
Interventions	Barriers analysis: meetings with each practice, and with all practices together Complexity: moderate Barriers: information management, clinical uncertainty Theory: none Interventions: 1. training in organisation of patient information 2. training in assessing evidence of effectiveness 3. training in both information and evidence 4. training on an unrelated topic Tailoring: high
Outcomes	Professional practice: recording of risk factors and relevant prescribing Health outcomes: control of blood pressure and cholesterol
Notes	

Risk of bias

Item	**Authors' judgement**	**Description**
Allocation concealment?	Unclear	Quote: "Practices were randomly allocated to one of the four intervention groups..."
Blinding? All outcomes	Unclear	It is not reported whether case note abstraction was blind to study group
Follow-up of professionals?	Yes	All practices randomised were followed up.
Protection against contamination?	Yes	Practice teams were the unit of randomisation.

Langham 2002 (*Continued*)

Follow-up of patients?	Yes	Quote: "Baseline and follow-up data were collected on 974 patients (85.2% of those alive at follow-up)."
Power calculation?	Yes	Power calculation reported.
Reliable outcomes?	Unclear	The reliability of chart review not reported.
Baseline data?	Yes	Quote: "Baseline patient characteristics were broadly comparable across intervention groups..."

Leviton 1999

Methods	RCT
Participants	Obstetricians and fetal-maternal specialists in 27 hospitals Country: USA Targeted activity: use of antenatal corticosteroids
Interventions	Barriers analysis: interviews and focus groups Depth: moderate Barriers: clinical uncertainty Theory: none Interventions: 1. educational outreach, opinion leader grand rounds, chart reminders, group discussion, feedback 2. written educational materials Tailoring: moderate
Outcomes	Professional practice: use of corticosteroids Health outcomes: none
Notes	

Risk of bias

Item	**Authors' judgement**	**Description**
Allocation concealment?	Yes	Quote: "The NPIC and AECOM conducted randomization separately for their member hospitals."
Blinding? All outcomes	No	Quote: "The study was not blinded because physicians in the active dissemination condition were aware of the study, and the leadership of all hospitals ... were aware of the condition assignment."
Follow-up of professionals?	Yes	All included institutions followed up.

Leviton 1999 (*Continued*)

Protection against contamination?	Yes	Quote: "...cross-hospital diffusion of the intervention was unlikely because almost no practitioners overlapped across institutions..."
Follow-up of patients?	Yes	Quote: "The charts of 6798 eligible women were abstracted from the 27 institutions..."
Power calculation?	Unclear	Quote: "For statistical power, our goal was to abstract an average of 162 charts per hospital per study year."
Reliable outcomes?	Yes	Quote: "We trained medical data collectors to identify cases in a 2-stage process."
Baseline data?	Yes	Quote: "There were no baseline differences between intervention and control hospitals for..."

Matchar 2002

Methods	RCT
Participants	Physicians in 6 managed care organisations Country: USA Targeted activity: anticoagulation in atrial fibrillation
Interventions	Barriers analysis: literature review, survey of physicians, interviews Complexity: high Barriers: clinical uncertainty, financial disincentives, administrative constraints, other Theory: none Interventions: 1. introduction of an anticoagulation service 2. no intervention Tailoring: moderate
Outcomes	Professional practice: time in target anticoagulation range, time to follow up Health outcomes: thrombo-embolic events
Notes	

Risk of bias

Item	**Authors' judgement**	**Description**
Allocation concealment?	Yes	Quote: "Using a computer random number function ... we assigned one practice cluster to the intervention ... and the other to the control..."
Blinding? All outcomes	Unclear	Blinding is not described.

Matchar 2002 (*Continued*)

Follow-up of professionals?	Yes	Comment: One site was dropped. Quote: "The remaining five sites enrolled eligible patients throughout the trial..."
Protection against contamination?	Yes	Randomisation at the level of the organisation.
Follow-up of patients?	Yes	Study flow chart set out progress of 1165 patients observed.
Power calculation?	Yes	Power calculation reported.
Reliable outcomes?	Yes	Data abstracted from records.
Baseline data?	Yes	Quote: "There were no statistically significant differences in the characteristics of the patients in the intervention and control clusters."

Ross-Degnan 1996

Methods	RCT
Participants	Staff in 87 community pharmacies Country: Indonesia Targeted activity: treatment for diarrhoea
Interventions	Barriers analysis: interviews and focus group discussions Complexity: moderate Barriers: patient expectations, financial disincentives, other Theory: none Interventions: 1. educational outreach, patient education materials 2. no intervention Tailoring: moderate
Outcomes	Professional practice: use of rehydration salts and antidiarrhoeals Health outcomes: none
Notes	

Risk of bias

Item	**Authors' judgement**	**Description**
Allocation concealment?	Yes	Quote: "Pharmacies were randomly assigned to intervention (n = 43) and control groups (n = 44) ..." Comment: Details of method not given.
Blinding? All outcomes	Yes	Quote: "These surrogate patients were blind to the purpose of the study."

Ross-Degnan 1996 (*Continued*)

Follow-up of professionals?	Yes	Quote: "All pharmacies visited with one visit per pharmacy per period."
Protection against contamination?	Yes	Randomisation at level of the pharmacy unit.
Power calculation?	Unclear	No power calculation reported.
Reliable outcomes?	Yes	Data collected by surrogate patients.
Baseline data?	Unclear	Baseline characteristics not described.

Santoso 1996

Methods	RCT
Participants	Primary care prescribers Country: Indonesia Targeted activity: use of drugs for diarrhoea
Interventions	Barriers analysis: focus groups with prescribers and patients Complexity: moderate Barriers: clinical uncertainty, patient expectations Theory: none Interventions: 1. small group discussions, group work, written information 2. formal seminars and written material 3. no intervention Tailoring: low
Outcomes	Professional practice: prescribing Health outcomes: none
Notes	

Risk of bias

Item	**Authors' judgement**	**Description**
Allocation concealment?	Unclear	The method of randomisation was not described.
Blinding? All outcomes	Unclear	No information is given on blinding.
Follow-up of professionals?	Unclear	Details of numbers of professionals and their follow up not given
Protection against contamination?	Yes	Quote: "The districts were randomly divided into three groups."
Follow-up of patients?	Yes	Quote: "Ten cases were randomly selected from all acute diarrhoea cases seen in each month from a health center."

Power calculation?	No	No power calculation reported.
Reliable outcomes?	Unclear	Details of data collection limited.
Baseline data?	Unclear	Information about baseline characteristics not given.

Schouten 2007

Methods	RCT
Participants	Hospital staff caring for patients with community acquired pneumonia Country: The Netherlands Targeted activity: antibiotic use in pneumonia
Interventions	Barriers analysis: individual and group interviews Complexity: moderate Barriers: clinical uncertainty, administrative constraints, other Theory: none Interventions: 1. lecture, feedback, critical care pathway, plus facilitated modules specific to each intervention site 2. no intervention Tailoring: high
Outcomes	Professional practice: adherence to 15 guideline recommendations Health outcomes: length of stay, mortality, intensive care unit admission
Notes	

Risk of bias

Item	**Authors' judgement**	**Description**
Allocation concealment?	Yes	Quote: "R.P.A., who was blinded to the composition of the groups, flipped a coin to determine which hospitals would be in the intervention and control groups."
Blinding? All outcomes	Unclear	Blinding is not described.
Follow-up of professionals?	Yes	All included hospitals completed the study.
Protection against contamination?	Yes	Randomisation took place at the level of the hospital.
Follow-up of patients?	Yes	Quote: "Exclusion rates varied from 10.4% to 17.8%, and exclusions were mainly attributable to the recent discharge (within 30 days) of patients with LRTI."

Schouten 2007 (*Continued*)

Power calculation?	No	No power calculation reported.
Reliable outcomes?	Yes	Quote: "2 independent researchers performed double-chart reviews to 10% of the patients." Comment: Kappa 0.7-1.
Baseline data?	Yes	Quote: "No clinically relevant differences were detected for characteristics of hospitals and professionals..."

Sehgal 2002

Methods	RCT
Participants	53 nephrologists Country: USA Targeted activity: haemodialysis treatment
Interventions	Barriers analysis: review of care of 749 patients Complexity: low Barriers: other Theory: none Interventions: 1. recommendations, feedback, patient education 2. no intervention Tailoring: high
Outcomes	Professional practice: changes in dialysis dose, catheter use and treatment time Health outcomes: quality of life
Notes	

Risk of bias

Item	**Authors' judgement**	**Description**
Allocation concealment?	Yes	Quote: "We used a random number generator to assign these nephrologists to an intervention or control group."
Blinding? All outcomes	Unclear	Blinding not described
Follow-up of professionals?	Yes	1 nephrologist declined participation. 44 of 53 nephrologists included in the analysis
Protection against contamination?	Yes	Quote: "...assigning nephrologists rather than patients to prevent the possibility that a given nephrologist may care for both intervention and control patients."

Sehgal 2002 (*Continued*)

Follow-up of patients?	Yes	Quote: "A total of 169 patients completed the trial."
Power calculation?	Yes	Power calculation reported.
Reliable outcomes?	Yes	Data collected from patient records.
Baseline data?	Yes	Quote: "Intervention and control patients had similar demographic and medical characteristics..."

Simon 2005

Methods	RCT
Participants	781 prescribers at practice sites in a large health maintenance organisation Country: USA Targeted activity: use of antihypertensives
Interventions	Barriers analysis: focus group discussion Complexity: moderate Barriers: clinical uncertainty, patient expectations Theory: none Interventions: 1. individual academic detailing 2. group academic detailing 3. printed educational materials Tailoring: moderate
Outcomes	Professional practice: antihypertension medication prescribing Health outcomes: last blood pressure reading
Notes	

Risk of bias

Item	**Authors' judgement**	**Description**
Allocation concealment?	Unclear	The randomisation process was not described.
Blinding? All outcomes	No	Quote: "Blinding with respect to the experimental condition was not feasible."
Follow-up of professionals?	Yes	The three practices completed the study.
Protection against contamination?	Yes	Quote: "We recruited 3 geographically separated practices of similar size and demographic composition from each division."
Follow-up of patients?	Yes	Data collected on all 3692 included patients.

Simon 2005 (*Continued*)

Power calculation?	No	No power calculation reported.
Reliable outcomes?	Yes	Data from electronic medical records and prescribing data were used
Baseline data?	Yes	Quote: "The rates of use of diuretics or ?-blockers across the 3 arms were almost identical..."

Soumerai 1998

Methods	RCT
Participants	Doctors and nurses in 36 hospitals Country: USA Targeted activity: use of medication in acute myocardial infarction
Interventions	Barriers analysis: 1-day meeting of opinion leaders and guideline panel Complexity: low Barriers: clinical uncertainty Theory: none Interventions: 1. opinion leader led programmes in each hospital, including educational sessions and materials, administrative support and system changes, feedback 2. feedback Tailoring: high
Outcomes	Professional practice: use of specific drugs Health outcomes: none
Notes	

Risk of bias

Item	**Authors' judgement**	**Description**
Allocation concealment?	Unclear	The randomisation process not described in detail.
Blinding? All outcomes	Unclear	Information on blinding not given.
Follow-up of professionals?	Yes	The recruited hospitals completed the study.
Protection against contamination?	Yes	Quote: "To minimize contamination of control hospitals, large cities ... were randomized as clusters..."
Follow-up of patients?	Yes	Data were collected on all eligible patients.
Power calculation?	Unclear	Details of power calculation not given.

Soumerai 1998 (*Continued*)

Reliable outcomes?	Yes	Quote: "Abstractors were required to demonstrate ongoing interrater agreement with the criterion reviewer of 95% of higher."
Baseline data?	Yes	Quote: "Both groups were comparable overall with respect to several characteristics..."

Verhoeven 2005

Methods	RCT
Participants	36 general practitioners Country: Belgium Targeted activity: screening for Chlamydia infection
Interventions	Barriers analysis: survey of primary care clinicians Complexity: low Barriers: patient expectations, administrative constraints, other Theory: none Interventions: 1. training in interview techniques, plus practice visit to discuss procedures 2. practice visit to discuss procedures Tailoring: low
Outcomes	Professional practice: numbers of patients assessed and tested Health outcomes: none
Notes	

Risk of bias

Item	**Authors' judgement**	**Description**
Allocation concealment?	Unclear	Details of randomisation process not described.
Blinding? All outcomes	No	Quote: "The GPs knew they were participating in a pilot implementation program..."
Follow-up of professionals?	Yes	Quote: "Fourteen GPs dropped out after they received full information..."
Protection against contamination?	Yes	Quote: "GPs working together in a practice were grouped for randomisation."
Follow-up of patients?	Yes	Data were collected on all 317 patients who underwent rapid risk assessment
Power calculation?	No	No power calculation reported.

Verhoeven 2005 (*Continued*)

Reliable outcomes?	Unclear	The data were collected by the participating GPs.
Baseline data?	Yes	Quote: "Non-participants did not differ significantly from participants with respect to age, sex, or type of practice."

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Allison 2005	Intervention not explicitly tailored to barriers
Altiner 2007	No systematic, prospective identification of barriers
Azocar 2003	No systematic, prospective identification of barriers
Baer 2001	No systematic, prospective identification of barriers; no clinical outcome measures
Benrimoj 2003	No systematic, prospective identification of barriers
Bosworth 2007	Targeted patient behaviour, not professionals' behaviour
Bravo 2005	Not an RCT - pre/post-test design
Brinkman 2009	No systematic, prospective identification of barriers or tailoring
Buckmaster 2006	Not an RCT
Byrne 2006	Not an RCT
Cabrera 2001	Not an RCT
Casebeer 2003	No systematic, prospective identification of barriers; only outcome measured: knowledge
Cranney 1999	No objective performance outcomes
Cranney 2001	Not an RCT
de Velasco 2004	Not an RCT
Downs 2006	No systematic, prospective identification of barriers
Edwards 2002	Not an RCT
Edwards 2007	Not an RCT

(*Continued*)

Figueiras 2001	No systematic, prospective identification of barriers
Fretheim 2004	Not an RCT
Garcia 2004	No systematic, prospective identification of barriers; not an RCT
Gask 2005	Not an RCT
Gonano 2003	No systematic, prospective identification of barriers or tailoring
Green 2002	Not an RCT
Gregory 1999	Lack of objectively measured outcomes; no statistical tests reported
Griffiths 2007	No systematic, prospective identification of barriers or tailoring
Gülmezoglu 2007	No systematic, prospective identification of barriers
Hanbury 2009	Not an RCT
Hardeman 2005	Not an RCT
Hendryx 1998	Intervention targeted at patients, not health professionals
Hennessy 2006	No systematic, prospective identification of barriers
Herdeiro 2005	Not an RCT
Holzemer 2007	Intervention targeted at patients, not health professionals
Inouye 2000	Not an RCT
Jones 2004	Not an RCT
Kinmonth 1996	Not an RCT
LaPointe 2006	No systematic, prospective identification of barriers
Laprise 2009	No systematic, prospective identification of barriers or tailoring
Leong 2006	Not an RCT
Leveille 1998	Intervention targeted at patients, not health professionals
Levine 2005	RCT with pre- and post-intervention survey. Outcome measured: physician satisfaction
Lundborg 1999	No systematic, prospective identification of barriers

(*Continued*)

Markey 2001	Only outcomes measured: knowledge and attitudes
Murphy 2005	Not an RCT
Nansel 2007	RCT. Some tailoring, but outcomes not measured objectively (parent self-report)
Naughton 2007	No systematic, prospective identification of barriers or tailoring
New 2003	No systematic, prospective identification of barriers
Otero-Sabogal 2006	Intervention targeted at patients, not health professionals
Peters-Klimm 2008	No systematic, prospective identification of barriers or tailoring
Ploeg 2007	Not an RCT
Romero 2005	Focused on content of guidelines, rather than barriers to implementation
Saini 2006	Not an RCT
Sehgal 1998	Not an RCT
Seltzer 1997	Not an RCT
Shirazi 2008	Educational intervention tailored, but lack of objectively measured outcomes
Silverman 2004	Not an RCT
Socolar 1998	Feedback tailored to identified deficiencies, not to barriers
Solomon 2001	No systematic, prospective identification of barriers
Solomon 2007	No systematic, prospective identification of barriers. Some tailoring of education for patients, but not reported at professional level
Spunt 1996	Not an RCT
Straand 2006	No systematic, prospective identification of barriers
Stéphan 2006	No systematic, prospective identification of barriers
Taylor 1996	Interventions carefully planned, but not tailored to barriers
Taylor 2000	Not an RCT
Turnbull 2006	No systematic, prospective identification of barriers

(*Continued*)

Unrod 2007	Targeted at patients rather than professional performance
Vallerand 2004	Only outcomes measured: knowledge and attitudes
van Driel 2007	No systematic, prospective identification of barriers
van Eijk 2001	No systematic, prospective identification of barriers
Ward 2009	Intervention targeted at patients, not health professionals
Welschen 2004	No systematic, prospective identification of barriers
Witt 2004	No systematic, prospective identification of barriers
Wright 2003	Not an RCT
Wright 2006	Not an RCT - before and after design
Zimmerman 2003	Not an RCT
Zimmerman 2006	Not an RCT

Characteristics of ongoing studies *[ordered by study ID]*

Barkun 2009

Trial name or title	The dissemination of consensus recommendations on upper gastrointestinal bleeding (REASON-II)
Methods	
Participants	Hospital healthcare teams and patients with non-variceal upper gastrointestinal bleeding
Interventions	Multi-faceted educational intervention
Outcomes	Application of guidelines on upper gastrointestinal bleeding
Starting date	September 2008
Contact information	A. Barkun, McGill University alan.barkun@muhc.mcgill.ca
Notes	Estimated Primary Completion Date: December 2009 (Final data collection date for primary outcome measure)

Dykes 2009

Trial name or title	
Methods	
Participants	
Interventions	
Outcomes	
Starting date	
Contact information	
Notes	

Engelman 2007

Trial name or title	
Methods	
Participants	
Interventions	
Outcomes	
Starting date	
Contact information	
Notes	

Gjelstad 2006

Trial name or title	Can antibiotic prescriptions in respiratory tract infections be improved? A cluster-randomized educational intervention in general practice - the Prescription Peer Academic Detailing (Rx-PAD) Study
Methods	
Participants	
Interventions	A tailored, multifaceted intervention. Study design: multifaceted intervention, educational outreach
Outcomes	Identifying determinants and patterns of antibiotic prescribing and improving antibiotic prescribing

Gjelstad 2006 (*Continued*)

Starting date	Janary 2006
Contact information	S. Gjelstad (svein.gjelstad@medisin.uio.no)
Notes	study protocol. ClinicalTrials.gov Identifier:[NCT00272155].

Jansen 2007

Trial name or title	Tailoring intervention procedures to routine primary health care practice; an ethnographic process evaluation
Methods	Ethnographic process evaluation
Participants	General practices
Interventions	Multi-faceted tailored intervention strategy
Outcomes	Adherence to recommendations for cardiovascular disease prevention
Starting date	April 2003
Contact information	YJFM Jansen; y.jansen@bmg.eur.nl
Notes	

Laurant 2007

Trial name or title	
Methods	
Participants	
Interventions	
Outcomes	
Starting date	
Contact information	
Notes	

van Gaal 2009

Trial name or title	The design of the SAFE or SORRY? study: a cluster randomised trial on the development and testing of an evidence based inpatient safety program for the prevention of adverse events
Methods	Cluster randomised trial
Participants	Nurses and patients admitted to hospitals and nursing homes
Interventions	Multifaceted tailored implementation strategy
Outcomes	Incidence of adverse events in hospitals and nursing homes
Starting date	September 2006
Contact information	Van Gaal B.vangaal@iq.umcn.nl
Notes	Study protocol

DATA AND ANALYSES

This review has no analyses.

ADDITIONAL TABLES

Table 1. Tailored interventions: effects on professional practice & health care outcomes

Risk of Bias	Study ID	Primary outcome(s)	Effect size	Authors' Conclusions
Studies included in the meta-analysis				
Moderate	Avorn 1992	1. Residents not on psychoactive drugs	1. Decrease of 27% in intervention arm and 8% in control arm (P = 0.02)	An educational program targeted to physicians, nurses, and aides can reduce the use of psychoactive drugs in nursing homes without adversely affecting the overall behaviour and level of functioning of the patient
Low	Baker 2001	1. Suicide risk assessed at diagnosis 2. Beck depression Inventory score < 11 at 16 weeks	1. OR 5.6 (95% CI, 2.8 to 11.3) 2. OR 2.5 (95% CI, 1.2 to 5.2)* (both ORs adjusted for baseline)	The findings suggest that this approach to implementation may be effective and should be further investigated
High	Callahan 1994	1. Frequency of recording a depression diagnosis 2. Stopping medications associated with depression 3. Initiating anti-depressant medication 4. Psychiatry referral	1. 12% control and 32% intervention arm (P < 0.01) 2. 22% control and 23% intervention arm 3. 8% control and 26% intervention arm (P < 0.01) 4. 14% control and 12% intervention arm	Intensive screening and feedback of patient-specific treatment recommendations increased the recognition and treatment of late life depression by GPs
Low	Cheater 2006	1. Nurse performance assessed by examining patients' nursing records against a list of review criteria	Mean improvement in aggregate compliance scores in percentage points: 1. -2.3 (95% CI, -1.63 to 1.7) for audit and feedback compared to control 2. 0.9 (95% CI, -3.3 to 5.1) for educational outreach compared to control	In comparison with educational materials alone, the implementation methods did not improve care at 6 months follow up
Moderate	Coenen 2004	1. Anti-biotic prescribing rate by GPs for adult patients with acute cough	1. OR 0.56 (95% CI, 0.36 to 0.87) Risk of prescribing antibiotics	Implementing a guideline for acute cough is successful in optimizing antibiotic pre-

Table 1. Tailored interventions: effects on professional practice & health care outcomes (*Continued*)

			for intervention group versus controls, adjusted for relevant clinical symptoms	scribing
Moderate	Davies 2002	1. Rate of electronic foetal monitoring 2. Time spent practising labour support	1. Reduced significantly in intervention secondary hospital (P < 0.001) and control tertiary hospital (P < 0.001)* 2. Increased in intervention tertiary hospital (P < 0.001) and decreased in control secondary hospital (P < 0.001)	The results are mixed and the tailored intervention thus appeared to have limited effects
Low	Evans 1997	1. Rate of diagnosis of asthma 2. Continuity of care (patients returning) 3. Use of recommended treatments (inhaled ß agonists) 4. Received patient education	1. 40/1000 vs. 16/1000, P < 0.01 2. 42% vs. 12%, P < 0.001* 3. 52% vs. 15%, P < 0.001 4. 71% vs 58%, P < 0.01	The intervention substantially increased child health staff's ability to identify children with asthma, involve them in continuing care, and provide them with state-of-the-art care for asthma
Low	Flottorp 2002	1. Rate of antibiotic use 2. Rate of laboratory test use 3. Rate of telephone consultations	1. 3% less likely to receive antibiotics after intervention in sore throat arm (P = 0.032), no change in UTI arm. 2. Women in UTI arm 5.1% (P = 0.046) less likely to have lab test after intervention. No change in sore throat arm. 3. No change	Passively delivered, complex interventions targeted at identified barriers to change had little effect in changing practice
Low	Fretheim 2006	1. Proportion of patients prescribed a thiazide among patients prescribed an antihypertensive for the first time 2. Proportion of those started on antihypertensive or cholesterol lowering treatment having a cardiovascular risk assessment 3. Proportion satisfying treatment goals for BP or cholesterol	1. Prescribing thiazides relative risk intervention vs control 1.94 (1.49 to 2.49) 2. Risk assessment done relative risk intervention vs control 1.04 (0.60 to 1.71) 3. Treatment goal achieved, intervention vs control relative risk 0.98 (0.93 to 1.02)	The intervention had an impact on prescribing patterns, but not on other outcomes
Moderate	Leviton 1999	1. Use of corticosteroids	1. Use increased by 108% in active dissemination hospitals and by 75% in usual dissemination hospitals (P < 0.01)	An active, focused dissemination effort increased the effectiveness of usual dissemination methods when combined with key principles to change

Table 1. Tailored interventions: effects on professional practice & health care outcomes (*Continued*)

				physician practices
Moderate	Schouten 2007	1. guideline adherent antibiotic prescription 2. adjustment of antibiotic to renal function 3. switches in therapy 4. streamlining of therapy 5. gram staining and culture of sputum samples	1. Difference between intervention and control hospitals OR 2.63 (95% CI, 1.57 to 4.42) 2. OR 12.9 (95% CI, 3.64 to 45.8) 3. OR 1.20 (95% CI, 0.02 to 76.51) 4. OR 1.94 (95% CI, 0.34 to 11.03) 5. OR 1.13 (95% CI, 0.64 to 2.00)	For some indicators, the intervention led to improvements. Secular trends may have had an effect on indicators that did not improve to a greater extent in the intervention group
Moderate	Simon 2005	1. Proportion of patients with hypertension receiving a diuretic or beta-blocker	Difference between control and group detailing OR 1.40 (95% CI, 1.11 to 1.76) Difference between control and individual detailing OR 1.30 (95% CI, 0.95 to 1.79) Difference between group and individual detailing OR 1.10 (95% CI, 0.86 to 1.42)	Both detailing interventions resulted in approximately 13% absolute increase in guideline recommended drugs
Studies not in the meta-analysis				
Moderate	Avorn 1983	1. Prescribing of targeted drugs (amount and costs) No suitable dichotomous outcome reported	Costs reduced in intervention arm v control by 14% (P = 0.0001)	Academic based 'detailing' was a useful and cost effective way to improve the quality of drug therapy decisions and reduce unnecessary expenditures
Moderate	Engers 2005	1. Referrals to a therapist. 2. Prescription of pain medication on a time-contingent basis 3. Prescription of paracetamol versus NSAIDs. No baseline data reported	Intervention compared to control: 1. OR 0.8 (95% CI, 0.5 to 1.4) 2. OR 1.0 (95% CI, 0.3 to 3.0) 3. OR 2.0 (95% CI, 0.8 to 5.5)	The intervention modestly improved implementation of the Dutch low back pain guideline by GPs
Low	Figueiras 2006	1.Number of reported adverse drugs reactions (ADRs) 2. Number of serious ADRs 3. Number of high causality ADRs 4. Number of unexpected	1. RR 10.23 (95% CI, 3.81 to 27.51) 2. RR 6.32 (95% CI, 2.09 to 19.16) 3. RR 8.75 (95% CI, 3.05 to 25.07)	The intervention increased reporting of ADRs, with effect maximal at 4 months, and no longer significant from 13 months after intervention

Table 1. Tailored interventions: effects on professional practice & health care outcomes (*Continued*)

		ADRs 5. Number of new-drug related ADRs Results not in a suitable format	4. RR 30.21 (95% CI, 4.54 to 200.84) 5. RR 8.04 (95% CI, 2.10 to 30.83)	
Moderate	Foy 2004	1. assessment appointment within 5 days 2. ascertainment of cervical cytology history 3. screening or antibiotic prophylaxis for genital tract infection 4. misoprostol used for cervical priming and early and mid-trimester abortion 5. supply of contraception at discharge Results reported as percentages,	Difference between intervention and control groups 1. OR 0.89 (95% CI, 0.50 to 1.58) 2. OR 0.93 (95% CI, 0.36 to 2.40) 3. OR 1.70 (95% CI, 0.71 to 5.99) 4. OR 1.00 (95% CI, 0.27 to 1.77) 5. OR 1.11 (95% CI, 0.48 to 2.53)	The intervention was ineffective, possibly because of high pre-intervention compliance and limited impact of the intervention on barriers outside the control of clinical staff
Moderate	Goodwin 2001	1. Rate of up-to-date preventative services Results reported as percentages, numbers of patients not given	1. Intervention: 31% to 42 %, control: 35% to 37% (P = 0.015)	An approach to increasing preventive service delivery that is individualised to meet particular practice needs can increase global preventive service delivery rates
Moderate	Hux 1999	1. Median antibiotic cost 2. Antibiotic choice - first line Results reported as percentages, numbers of patients not given	1. Change of $0.05 intervention v. $3.37 control, P < 0.002 2. Change of 2.6% v. -1.7%, P < 0.01	A simple program of confidential feedback and educational materials blunted cost increases, increased the use of first-line antibiotics, and was highly acceptable to Ontario primary care physicians
Moderate	Karuza 1995	1. Physician vaccination rates for influenza Results reported as percentages, numbers of patients not given	1. The intervention arm had a significantly higher adjusted vaccination rate (62.39%) compared to controls (46.46%), P < 0.001	Interventions using small groups can be useful in facilitating adoption of guidelines by physicians

Table 1. Tailored interventions: effects on professional practice & health care outcomes (*Continued*)

Moderate	Langham 2002	1. Adequate recording of three risk factors. n/N not reported	1. Difference of 10.5% (95% CI, -3.9 to 24.9) between information and no information and 6.6% (95% CI, -8.9 to 22.0) between evidence and no evidence	Adequate risk factor recording did not differ between the information (versus not information) or the evidence (versus not evidence) intervention groups
Low	Matchar 2002	1. % time in target range 2. Rate of thromboembolic events No suitable dichotomous outcome reported.	1. Difference (intervention minus control) adjusted for minor baseline differences was 5% (95% CI, -5% to 14%), P = 0.32 2. No significant difference	A properly administered anticoagulation service can successfully manage the anticoagulation of most patients with atrial fibrillation; however, these services did not improve antiocoagulation compared to usual care
Moderate	Ross-Degnan 1996	1. Sales of oral rehydration salts Results reported as percentages, numbers of patients not given	1. Increased by 21% in intervention arms compared to controls (P < 0.05)	Face to face training of pharmacy attendants which targets deficits in knowledge and specific problem behaviours can result in significant short-term improvements in product sales and communication with customers
High	Santoso 1996	1. Prescribing of oral rehydration solution 2. Prescribing of anti-microbials 3. Prescribing of anti-diarrhoeals Results reported as percentages, numbers of patients not given	1. Increase after intervention, but not significantly after both interventions 2. Significant reduction in antimicrobial usage for both face-to-face and seminar interventions. 3. Significantly reduced after both interventions.	The small group face-to-face intervention did not appear to offer greater impacts over large seminars in improving the appropriate use of drugs in acute diarrhoea
Low	Sehgal 2002	1. Increase in Kt/V at 6 months 2. Change in level of dialysis prescribing 3. Change in from catheter use to fistulas/grafts No suitable dichotomous outcome reported	1. +0.2 intervention vs. +0.1 control, P < 0.001 2. +0.16 intervention vs. +0.06 control, P < 0.001 3. 28% intervention vs 7% control, P = 0.04	An intervention tailored to patient-specific barriers resulted in increased haemodialysis dose
Moderate	Soumerai 1998	1. Appropriateness of the prescribing of selected drugs (aspirin in eligible elderly pa-	1. Median change +0.13 in intervention and -0.03 in con-	Working with opinion leaders and providing performance

Table 1. Tailored interventions: effects on professional practice & health care outcomes (*Continued*)

		tients) Data reported as percentages, numbers not given.	trols P = 0.04	feedback can accelerate adoption of some beneficial acute myocardial infarction therapies
Moderate	Verhoeven 2005	1. Patients undergoing risk assessment and testing 2. Proportion appropriately tested No baseline data reported.	1. Difference between intervention and control 2.28 (95% CI, -0.51 to 5.07), P = 0.106 2. Difference between intervention and control 25.4% (95% CI, 4.5 to 46.3), P = 0.019	GPs who had received the intervention performed consistently more appropriate testing

Table 2. Effect sizes used in the meta-regression (adjusted for clustering)

Study ID	Outcome	Baseline odds ratios (95% CI)	Follow-up odds ratios (95% CI)
Avorn (1992)	Residents not on antipsychotic drugs	0.90 (0.51, 1.61)	1.08 (0.76, 1.51)
Baker (2001)	Beck depression inventory < 11	0.89 (0.40, 2.00)	5.50 (3.53, 8.57)
Callahan (1994)	Depression diagnosis	1.23 (0.52, 2.91)	2.65 (1.42, 4.98)
Cheater (2006)	Recording of management criteria	18.54 (3.53, 97.34)	8.75 (1.07, 71.85)
Coenen (2004)	Antibiotics not prescribed	0.80 (0.49, 1.32)	1.07 (0.76, 1.49)
Davies (2002)	No electronic fetal monitoring	54.90 (10.53, 286.35)	12.25 (7.22, 20.77)
Evans (1997)	Returning asthma patients from previous year	0.94 (0.45, 1.95)	2.88 (2.18, 3.81)
Flottorp (2002)	Antibiotics not prescribed	1.12 (0.96, 1.30)	1.26 (1.15, 1.38)
Fretheim (2006)	Thiazides prescribed for hypertension	0.63 (0.42, 0.94)	1.68 (1.40, 2.01)
Leviton (1999)	Use of antenatal corticosteroids	1.00 (0.66, 1.50)	1.59 (1.41, 1.78)
Schouten (2007)	Guideline adherent antibiotic prescription	0.87 (0.52, 1.45)	2.16 (1.62, 2.87)
Simon (2005)	Beta-blockers or diuretics prescribed for hypertension	1.03 (0.83, 1.27)	1.40 (1.22, 1.61)

WHAT'S NEW

Last assessed as up-to-date: 14 October 2009.

Date	Event	Description
15 February 2010	New citation required and conclusions have changed	Eleven new studies identified, providing more evidence regarding the effectiveness of the intervention
15 February 2010	New search has been performed	Search conducted up to October 2009. Eleven new studies added. Risk of bias tables and summary of findings tables also added to review

HISTORY

Protocol first published: Issue 2, 1999

Review first published: Issue 3, 2005

Date	Event	Description
27 May 2008	Amended	Converted to new review format.
25 May 2005	New citation required and conclusions have changed	Substantive amendment

CONTRIBUTIONS OF AUTHORS

Richard Baker, Francine Cheater and Elizabeth Shaw were responsible for the planning of the review.

Janette Camosso-Stefinovic was responsible for developing, editing and running search strategies for the review, in collaboration with three successive EPOC Trials Search Coordinators: Jessie McGowan, Doug Salzwedel and Michelle Fiander.

Janette Camosso-Stefinovic was responsible for obtaining full text articles.

All reviewers assessed whether studies were relevant and extracted study data.

Clare Gillies was responsible for the statistical analysis.

Richard Baker prepared the first draft of the review.

DECLARATIONS OF INTEREST

Richard Baker, Francine Cheater and Signe Flottorp are authors of three of the included studies. Noelle Robertson is an author on two of the included studies. Other review authors completed data extractions for these studies.

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Internal sources

- Norwegian Knowledge Centre for the Health Services, Norway.
- Department of Health Sciences, University of Leicester, UK.

External sources

- Richard Baker receives a National Institute of Health Research (NIHR) senior investigator award. Janette Camosso-Stefinovic and Noelle Robertson are partly supported by the NIHR Collaboration for leadership in Applied Health Research and Care (CLAHRC) for Leicestershire, Northamptonshire and Rutland (LNR). Professor Baker is Director of the CLAHRC. The opinions expressed in this review do not necessarily reflect those of the NIHR., UK.

INDEX TERMS

Medical Subject Headings (MeSH)

Outcome and Process Assessment (Health Care) [*standards]; Professional Practice [*standards]; Randomized Controlled Trials as Topic

MeSH check words

Humans