# Audit and feedback: effects on professional practice and health care outcomes (Review)

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## ABSTRACT

**Background**
Audit and feedback continues to be widely used as a strategy to improve professional practice. It appears logical that healthcare professionals would be prompted to modify their practice if given feedback that their clinical practice was inconsistent with that of their peers or accepted guidelines. Yet, audit and feedback has not consistently been found to be effective.

**Objectives**
To assess the effects of audit and feedback on the practice of healthcare professionals and patient outcomes.

**Search strategy**
We searched the Cochrane Effective Practice and Organisation of Care Group's register and pending file up to January 2004.

**Selection criteria**
Randomised trials of audit and feedback (defined as any summary of clinical performance over a specified period of time) that reported objectively measured professional practice in a healthcare setting or healthcare outcomes.

**Data collection and analysis**
Two reviewers independently extracted data and assessed study quality. Quantitative (meta-regression), visual and qualitative analyses were undertaken. For each comparison we calculated the risk difference (RD) and risk ratio (RR), adjusted for baseline compliance when possible, for dichotomous outcomes and the percentage and the percent change relative to the control group average after the intervention, adjusted for baseline performance when possible, for continuous outcomes. We investigated the following factors as possible explanations for the variation in the effectiveness of interventions across comparisons: the type of intervention (audit and feedback alone, audit and feedback with educational meetings, or multifaceted interventions that included audit and feedback), the intensity of the audit and feedback, the complexity of the targeted behaviour, the seriousness of the outcome, baseline compliance and study quality.

**Main results**
Thirty new studies were added to this update, and a total of 118 studies are included. In the primary analysis 88 comparisons from 72 studies were included that compared any intervention in which audit and feedback is a component compared to no intervention. For dichotomous outcomes the adjusted risk difference of compliance with desired practice varied from - 0.16 (a 16 % absolute decrease in compliance) to 0.70 (a 70% increase in compliance) (median = 0.05, inter-quartile range = 0.03 to 0.11) and the adjusted risk ratio varied from 0.71 to 18.3 (median = 1.08, inter-quartile range = 0.99 to 1.30). For continuous outcomes the adjusted percent change relative to control varied from -0.10 (a 10 % absolute decrease in compliance) to 0.68 (a 68% increase in compliance) (median = 0.16, inter-quartile range = 0.05 to 0.37). Low baseline compliance with recommended practice and higher intensity of audit and feedback were associated with larger adjusted risk ratios (greater effectiveness) across studies.

**Authors' conclusions**
Audit and feedback can be effective in improving professional practice. When it is effective, the effects are generally small to moderate. The relative effectiveness of audit and feedback is likely to be greater when baseline adherence to recommended practice is low and when feedback is delivered more intensively.

## PLAIN LANGUAGE SUMMARY

Providing healthcare professionals with data about their performance (audit and feedback) may help improve their practice.
Audit and feedback can improve professional practice, but the effects are variable. When it is effective, the effects are generally small to moderate. The results of this review do not support mandatory or unevaluated use of audit and feedback as an intervention to change practice.

## BACKGROUND

This review updates a previous Cochrane review of the effects of audit and feedback (Jamtvedt 2003), where we have defined audit and feedback as "any summary of clinical performance of health care over a specified period of time", given in a written, electronic or verbal format. Audit and feedback continues to be widely used as a strategy to improve professional practice. It appears logical that healthcare professionals would be prompted to modify their practice if given feedback that their clinical practice was inconsistent with that of their peers or accepted guidelines. Yet, audit and feedback has not consistently been found to be effective (Grimshaw 2001).

Previous reviews have looked at factors associated with the effectiveness of audit and feedback. Mugford and colleagues (Mugford 1991) identified 36 published studies of information feedback which they defined as the use of comparative information from statistical systems. These authors distinguished passive from active feedback where passive feedback was the provision of unsolicited information and active feedback engaged the interest of the clinician. They also assessed the impact of the recipient of the information, the format of the information and the timing of the feedback. Studies were included if their design used either a historical or a concurrent control group for comparison. The authors concluded that information feedback was most likely to influence clinical practice if the information was presented close to the time of decision-making and the clinicians had previously agreed to review their practice.

Axt-Adam and colleagues (Axt-Adam 1993) reviewed 67 published papers of interventions (26 studies of feedback) designed to influence the ordering of diagnostic laboratory tests. They reported factors could be important included the message, the provider of the feedback, the addressee, the timeliness and the vehicle. They concluded that there was considerable variation among different studies and that this variation could be explained in part by the extent, the timing, the frequency, and the availability of comparative information related to peers. They also felt that the practice setting was an important factor.

Buntinx and colleagues (Buntinx 1993) conducted a systematic review of 26 studies of feedback and reminders to improve diagnostic and preventive care practices in primary care. They categorised the information provision that occurred after or during the target performance as feedback whereas information provision that occurred before the target performance was called reminders. Ten of the 26 studies used randomised designs but the quality of the included trials was not reported. The authors concluded that both feedback and reminders might reduce the use of diagnostic tests and improve the delivery of preventive care services. However, they also reported that it was not clear how feedback or reminders work, especially the use of peer group comparisons.

Balas and colleagues (Balas 1996) reviewed the effectiveness of peer-comparison feedback profiles in changing practice patterns. They located twelve eligible trials and concluded that profiling had a statistically significant but minimally important effect.

In earlier versions of this review we found that the effects of audit and feedback varied and that it was not possible to determine what features or contextual factors determine the effectiveness of audit and feedback (Jamtvedt 2003;Thomson OBrien 1997a;Thomson OBrien 1997b).

More recently, Stone and colleagues (Stone 2002) reviewed 108 studies to assess the relative effectiveness of various interventions, including audit and feedback, to improve adult immunisation and cancer screening. Thirteen of the included studies involved provision of feedback. Feedback was not found to improve immunisation or screening for cervical or colorectal cancer and only moderately improved mammographic screening.

Most recently Grimshaw et al (Grimshaw 2004) undertook a comprehensive review of guidelines implementation strategies, finding that audit and feedback alone may result in modest improvements in guidelines implementation when compared to no intervention. In contrast however, studies in which audit and feedback was com-

bined with educational meetings and educational materials found only a small effect on professional practice.

These reviews suggested that the provision of information alone results in little, if any change in practice. Kanouse and Jacoby (Kanouse 1988) suggest that, typically, the transfer of information relies on a diffusion model that assumes that practitioners are active consumers of information and are willing to make changes in the way they provide healthcare when they encounter information that suggests alternative practices. These authors propose that factors such as the characteristics of the information provided, practitioner motivation and characteristics of the clinical context need to be considered when a change in behaviour is desired. Similarly, Oxman and Flottorp (Oxman 2001) have outlined twelve categories of factors that should be considered when trying to improve professional practice, including characteristics of the practice environment, prevailing opinion, knowledge and attitudes. Both logical arguments and previous reviews have suggested that multifaceted interventions, particularly if they are targeted at different barriers to change, may be more effective than single interventions (Grimshaw 2001), but it is still uncertain whether tailored interventions are more effective ( Shaw 2005). In this review, we examine factors that could influence the effectiveness of the intervention such as the source of the feedback and whether audit and feedback is more effective when combined with other interventions.

## OBJECTIVES

We addressed two questions:

A. Is audit and feedback effective in improving professional practice and health care outcomes?
B. How does the effectiveness of audit and feedback compare with that of other interventions, and can audit and feedback be made more effective by modifying how it is done?

To answer the first question we considered the following five comparisons. These have been modified from the first version of this review to reflect subsequent evidence that interactive educational meetings are effective at changing professional practice (Thomson O'Brien 2001), whereas printed educational materials appear to have little or no effect (Freemantle 1997; Grimshaw 2001).

1. Any intervention in which audit and feedback is a component compared to no intervention. This an overall comparison which include the studies in comparison 2, 3 and 4.

2. Audit and feedback compared to no intervention.

3. Audit and feedback with educational meetings compared to no intervention.

4. Audit and feedback as part of a multifaceted intervention (i.e., combined with reminders, opinion leaders, outreach visits, patient mediated interventions, local consensus processes or tailoring strategies) compared to no intervention.

5. Short term effects of audit and feedback compared to longer-term effects after feedback stops.

The following comparisons are considered in addressing the second question.

6. Audit and feedback with educational meetings or audit and feedback as part of a multifaceted intervention combined compared to audit and feedback alone.

7. Audit and feedback compared to other interventions (reminders, opinion leaders, educational outreach visits, patient mediated interventions, local consensus processes or tailoring strategies)

8. All comparisons of different ways audit and feedback is done

In addition we have reported all direct comparisons of different ways of providing audit and feedback that we have identified in this update and we have considered the intensity of audit and feedback across studies in analysing the results, as described in the methods section.

## CRITERIA FOR CONSIDERING STUDIES FOR THIS REVIEW

### Types of studies

Randomised controlled trials (RCTs).

### Types of participants

Healthcare professionals responsible for patient care. Studies that included only students were excluded.

### Types of intervention

Audit and feedback: defined as any summary of clinical performance of health care over a specified period of time. The summary may also include recommendations for clinical action. The information may be given in a written, electronic or verbal format.

### Types of outcome measures

Objectively measured provider performance in a health care setting or health care outcomes. Studies that measured knowledge or performance in a test situation only were excluded.

## SEARCH METHODS FOR IDENTIFICATION OF STUDIES

See: methods used in reviews.

The review has been updated primarily by using the EPOC register and pending file. We identified all articles in the Cochrane Effective Practice and Organisation of Care (EPOC)

register in January 2004 that had been coded as an RCT or clinical controlled trial (CCT) and as 'audit and feedback'. The EPOC pending file (studies selected from the EPOC search strategy results and awaiting assessment) was also searched in January 2004 using the terms 'audit' or 'feedback'. In addition the previous MEDLINE strategy was used to search MEDLINE from January 1997 to April 2000 and any articles already identified by the EPOC strategy were excluded. This search did not generate any relevant additional articles and therefore was not repeated. The reference lists of new articles that were obtained were reviewed.

Previous searches built upon earlier reviews (Thomson 1995; Davis 1995; Oxman 1995; Davis 1992). We searched MEDLINE from January 1966 to June 1997 without language restrictions. These search terms were used: explode education, professional (non sh), explode quality of health care, chart review: or quality assurance (tw), feedback (sh), audit (tw,sh) combined with these methodolological terms: clinical trial (pt), random allocation (sh), randomised controlled trials (sh), double-blind method (sh), single-blind method (sh), placebos (sh), all random: (tw). The Research and Development Resource Base in Continuing Medical Education(RDRB/CME) (Davis 1991) was also searched. The reference lists of related systematic reviews and all articles obtained were reviewed.

An updated search was done in February 2006. Potentially relevant studies are included under References to studies awaiting assessment.

## METHODS OF THE REVIEW

The following methods were used in updating this review:

Two reviewers (GJ and JY) independently applied inclusion criteria, assessed the quality of each study, and extracted data for newly identified studies using a revised data-collection form from the EPOC Group. The same data were also collected from the studies included in the original version of this review by these two reviewers. The quality of all eligible studies was assessed using criteria described in the EPOC module (see Group Details) and discrepancies were resolved by discussion.

In light of the results of a recent review of the effects of continuing education meetings (Thomson O'Brien 2001), which suggests that interactive educational meetings frequently have moderate effects on professional practice, in updating this review we considered interactive, small group meetings separately from written educational materials and didactic meetings, which have been found to have little or no effect on professional practice (Thomson O'Brien 2001;Freemantle 1997; Grimshaw 2001). A revised definition for educational meetings was applied to all of the studies included in the review: participation of health care providers in meetings that included interaction among the participants, whether or not the meetings were outside of the participants' practice settings.

We have defined multifaceted interventions as including two or more interventions. For multifaceted interventions that included audit and feedback two of us (GJ and JY) independently categorised the contribution of audit and feedback to the intervention in a subjective manner as a major, moderate or minor component.

For all of the studies included in the review an overall quality rating (high, moderate, low protection against bias) was assigned based on the following criteria: concealment of allocation, blinded or objective assessment of primary outcome(s), and completeness of follow-up (mainly related to 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 high protection against 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 low if more than two criteria were scored as not clear or not done. For cluster randomisation trials, we rated protection against contamination as done. Further, for these study designs, we rated concealment of allocation as done if all clusters were randomised at one time.

We also categorised the intensity of the audit and feedback, the complexity of the targeted behaviour, the seriousness of the outcome and the level of baseline compliance. The intensity of the audit and feedback was categorised based on the following characteristics listed in the order that we hypothesised would be most important in explaining differences in the effectiveness of the audit and feedback (with the categories listed from 'more intensive' to 'less intensive' for each characteristic):

- the recipient (individual or group)
- the format (both verbal and written, or verbal or written)
- the source (a supervisor or senior colleague, or a 'professionals standards review organisation' or representative of the employer or purchaser, or the investigators)
- the frequency of the feedback, categorised as frequent (up to weekly), moderate (up to monthly) and infrequent (less than monthly)
- the duration of feedback, categorised as prolonged (one year or more), moderate (between one month and one year) and brief (less than one month)
- the content of the feedback (patient information, such as blood pressure or test results, compliance with a standard or guideline, or peer comparison, or information about costs or numbers of tests ordered or prescriptions)

We categorised the overall intensity of the audit and feedback by combining the above characteristics as:

- "Intensive" (individual recipients) AND ((verbal format) OR (a supervisor or senior colleague as the source)) AND (moderate or prolonged feedback)
- "Non-intensive" ((group feedback) NOT (from a supervisor or senior colleague)) OR ((individual feedback) AND (written format) AND (containing information about costs or numbers of tests without personal incentives))
- "Moderately intensive"(any other combination of characteristics than described in Intensive or Non-intensive group).

The complexity of the targeted behaviour was categorised in a subjective manner independently by two of us (GJ and JY) as high, moderate or low. The categories depending upon the number of behaviours required, the extent to which complex judgements or skills were necessary, and whether other factors such as organisational change were required for the behaviour to be improved, and also depending on whether there was need for change only by the individual/professional (one person) or communication change or change in systems. If an intervention was targeted at relatively simple behaviours, but there were a number of different behaviours, (e.g., compliance with multiple recommendations for prevention), the complexity was assessed as moderate.

The seriousness of outcome was also categorised in a subjective manner independently by two of us (GJ and JY, or GJ and AO) as high, moderate or low. Acute problems with serious consequences were considered high. Primary prevention was considered moderate. Numbers of unspecified tests or prescriptions were considered low.

Baseline compliance with the targeted behaviours for dichotomous outcomes was treated as a continuous variable ranging from zero to 100%, based on the mean value of pre-intervention level of compliance in the audit and feedback group and control group.

Analysis

We only included studies of moderate or high quality in the primary analyses, and studies that reported baseline data. All outcomes were expressed as compliance with desired practice. Professional and patients outcomes were analysed separately.

When several outcomes were reported in one trial we only extracted results for the primary outcome. If the primary outcome was not specified, we calculated effect sizes for each outcome and extracted the median value across the outcomes.

Three main analyses were conducted for comparison 1 (audit and feedback alone, audit and feedback with educational meetings or audit and feedback as part of a multifaceted intervention compared to no intervention): one using the adjusted risk ratio as the measure of effect, one using the adjusted risk difference as the measure of effect and the third using the adjusted percent change relative to the control mean after the intervention.

We considered the following potential sources of heterogeneity to explain variation in the results of the included studies:

- the type of intervention (audit and feedback alone, audit and feedback with educational meetings, or multifaceted interventions that included audit and feedback)
- the intensity of the audit and feedback
- complexity of the targeted behaviour
- seriousness of the outcome
- baseline compliance
- study quality (high or moderate protection against bias)

We visually explored heterogeneity by preparing tables, bubble plots and box plots (displaying medians, interquartile ranges, and ranges) to explore the size of the observed effects in relationship to each of these variables. The size of the bubble for each comparison corresponded to the number of healthcare professionals who participated. We also plotted the lines from the weighted regression to aid the visual analysis of the bubble plots.

Each comparison was characterised relative to the other variables in the tables, looking at one potential explanatory variable at a time. We looked for patterns in the distribution of the comparisons, hypothesising that larger effects would be associated with multifaceted interventions, more intensive audit and feedback, less complexity of the targeted behaviour, more serious outcome, higher baseline compliance, and lower study quality.

The visual analyses were supplemented with meta-regression to examine how the size of the effect (adjusted RR and adjusted RD) was related to the six potential explanatory variables listed above, weighted according to the number of health care professionals. The main analysis comprised a multiple linear regression using main effects only; baseline compliance treated as a continuous explanatory variable and the others as categorical. Then studies of audit and feedback alone were pooled with audit and feedback with educational meetings and used in a multiple linear regression that also included the interaction between type of intervention and intensity of audit and feedback for adjusted RR, and the interaction between type of intervention and seriousness of the outcome for adjusted RD. The analyses were conducted using generalized linear modelling in SAS (Version 9.1.3. SAS Institute Inc., Cary, NC, USA).

Because there were frequently important baseline differences between intervention and control groups in trials, our primary analyses were based on adjusted estimates of effect, where we adjusted for baseline differences. For dichotomous outcomes we calculated the adjusted risk difference and relative risk as follows: "Adjusted risk difference" (RD) = the difference in adherence after the intervention minus the difference before the intervention. A positive risk difference indicates that adherence improved more in

the audit and feedback group than in the control group, e.g. an adjusted risk difference of 0.09 indicates an absolute improvement in care (improvement in adherence) of 9 %.
"Adjusted risk ratio" (RR) = the ratio of the relative probability of adherence after the intervention over the relative probability before the intervention. A risk ratio greater than one indicates that adherence improved more in the audit and feedback group than in the control group, e.g. an adjusted risk ratio of 1.8 indicates a relative improvement in care (improvement in adherence) of 80%.

For continuous outcomes we calculated the post mean difference, adjusted mean difference and the adjusted percent change relative to the control mean after the intervention.

## DESCRIPTION OF STUDIES

Thirty studies are added to this review since the previous update and the total number of studies included is 118. The unit of allocation was the patient in three studies, health professional in 44, practice in 36, institution in 22 and in 12 studies the unit of allocation was "other", for example health units, departments or pharmacies. In one study the unit of allocation was not clear. Twelve studies had four arms, 20 studies had three and the remaining 86 had two arms.

Characteristics of setting and professionals

Sixty-seven trials were based in North America (58 in the USA, nine in Canada), 30 in Europe (18 in United Kingdom, five in The Netherlands, four in Denmark and one each in Finland, Sweden and Belgium) nine in Australia, two in Thailand and one in Uganda and Lao.) In most trials the health professionals were physicians. One study involved dentists (Brown 1994), in three studies the providers were nurses (Jones 1996; Moongtui 2000; Rantz 2001), in two studies, pharmacists (De Almeida Neto 2000; Mayer 1998) and 14 studies involved mixed providers.

Targeted behaviours

There were 21 trials of preventive care, for example screening, vaccinations or skin cancer prevention; 14 trials of test ordering, for example laboratory tests or x-rays; 20 of prescribing and one of reduction in hospital length of stay. The remaining studies were trials of general management of a variety of problems, for example burn care, hypertension, hand washing or compliance with guidelines for different conditions. For the most part, the complexity of the targeted behaviours was homogeneous and rated as moderate (n= 79), for example ordering of laboratory tests, child immunization, compliance with guidelines of various complexity and screening. In 22 studies the complexity of the targeted behaviour was assessed as low, for example inappropriate prescribing of antibiotics and influenza vaccination. In 14 studies the complexity of the targeted behaviour was rated as high, for example provision of caesarean section deliveries and communication skills.

Characteristics of interventions

In 20 studies the overall intensity of feedback was rated as non-intensive, in eight studies as intensive. In six studies audit and feedback was performed with different intensity in different arms. In the remaining studies the intensity was rated as moderate. (Table presenting the intensity of feedback for included studies available online http://www.epoc.uottawa.ca/auditandfeedbacktables.htm). The interventions used were highly heterogeneous with respect to their content, format, timing and source.

In 11 studies audit and feedback was provided in combination with educational meetings.

There were 50 studies in which one or more groups received a multifaceted intervention that included audit and feedback as one component.

Outcome measures

There was large variation in outcome measures, and many studies reported multiple outcomes, for example studies on compliance with guidelines. Most trials measured professional practice, such as prescribing or use of laboratory tests. Some trials reported both practice and patient outcomes such as smoking status or blood pressure. There was a mixture of dichotomous outcomes (for example the proportion compliance with guidelines, the proportion of tests done and the proportion vaccinated) and continuous outcome measures (for example costs, number of laboratory tests, number of prescriptions, length of stay). Almost 2/3 of the outcome measures were dichotomous.

## METHODOLOGICAL QUALITY

See Table 01. Of the 118 trials twenty-four had low risk of bias (high quality), fourteen trials had high risk of bias (low quality) and the remaining studies were of moderate quality. Randomisation was clearly concealed or there was cluster randomisation in 71 trials, and in the rest of the studies the randomisation procedure was not clear. There was adequate follow-up of health professionals in 78 trials, inadequate follow-up in eight trials and the remaining trials this was not clear. Outcomes were assessed blindly in 66 trials, not blindly or not clear in 52 studies.

## RESULTS

For this update we identified 45 new studies as potentially relevant. We located studies mainly using the EPOC register and pending file. Fifteen of the new studies that were retrieved were excluded (see excluded studies table). Thirty new studies were included and added to this version and the total number of included studies is 118. The updated search identified seven additional studies that are awaiting assessment (see table of studies awaiting assessment).

**Comparison 1. Any intervention in which audit and feedback is a component compared to no intervention**

A total of 88 comparisons from 72 studies with more than 13 500 health professionals were included in the primary analysis (studies with low or moderate risk of bias and with baseline data) which included sixty-four comparisons of dichotomous outcomes from 49 trials, and 24 comparisons of continuous outcomes from 23 trials. Sixteen of these 72 studies had low risk of bias. There was important heterogeneity among the results across studies.

Dichotomous outcomes (Data for the studies included in this comparison are available online http://www.epoc.uottawa.ca/auditandfeedbacktables.htm.)

The 64 comparisons that reported dichotomous outcomes included over 7000 professionals. One study (Mayer 1998) was excluded from the primary analyses. This study, which reported an improvement from 0% to 70% in the provision of skin cancer preventive advice among pharmacists, differed from the other studies included in the primary analyses clinically and reported an effect that was well outside the range of effects reported in the other 63 comparisons included in the primary analyses.

For dichotomous outcomes the adjusted RR of compliance with desired practice varied from 0.71 to 18.3 (median = 1.08, inter-quartile range = 0.99 to 1.30). Baseline compliance and intensity of audit and feedback were identified as significant in the multiple linear regression of the adjusted RR (main effects model). The estimated coefficient for baseline was -0.005 (p=0.05) indicating smaller effects as baseline compliance increased (Figure 01). The model predicted the adjusted RR to decrease from 1.35 when baseline compliance was equal to 40% (all the other variables kept constant), to an adjusted RR equal to 1.19 for baseline compliance of 70%. The intensity of audit and feedback may also explain some of the variation in the relative effect (p = 0.01), (Figure 02). The adjusted RR was 1.55, 1.11 and 1.45 for the high, moderate and low intensity, respectively when adjusting for the other terms in the model. This indicates no clear trend for intensity, i.e. there seems not to be linearity between the intensity of audit and feedback and the adjusted RR. None of the other variables that we examined (type of intervention, complexity of targeted behaviour, study quality or seriousness of outcome) helped to explain the variation in relative effects across studies in the statistical analysis (p values for the coefficients ranged from 0.28 to 0.98), the visual analyses, or the qualitative analyses of adjusted RR.

Diagnostic analyses that included interactions between variables, particularly between the type of intervention and the intensity of audit and feedback, and in which audit and feedback with or without educational meetings were combined into a single type of intervention (compared with multifaceted interventions) suggest that more intense audit and feedback is associated with larger adjusted RRs for audit and feedback with or without educational meetings but not for multifaceted interventions. Audit and feedback was frequently a minor component of multifaceted interventions. The regression which included the type of intervention when the categories were pooled and the interaction between type of intervention and intensity, revealed that baseline compliance (p=0.003) and intensity (p=0.01) were still important, but in addition type of intervention was significant (p<0.0001) as well as the interaction between type of intervention and intensity. However, due to the small number of observations for the various categories, it was not possible to give proper estimates for the interaction.

The adjusted RDs for compliance with desired practice varied from -0.16 (a 16% absolute decrease in compliance) to 0.70 (a 70% increase in compliance) (median = 0.05, inter-quartile range = 0.03 to 0.11). None of the factors that we examined (main effects model) helped to explain the observed variation in the absolute effect (adjusted RD) of the interventions (P = 0.07 to 0.84).

In the exploratory analysis with the pooled categories for types of interventions and the interaction between the intensity of feedback and the type of intervention, the type of intervention (multifaceted versus audit and feedback with or without educational meetings) helped to explain the observed variation in the absolute effect (p = 0.0002) (Figure 03). Intensity of audit and feedback might also help to explain variation in the absolute effect (p = 0.04). The interaction was also significant (p=0.0001). However, due to the small number of observations for the various categories, it was not possible to give proper estimates for the interaction. The estimated mean adjusted RD not adjusted for other terms in the model was 2.1 for the pooled category whereas it was 9.2 for the multifaceted intervention.

For 18 out of the 64 comparisons the adjusted RD was larger than 10%. One study reported a large effect of 70%. It was a multifaceted intervention aimed at increasing the provision of skin cancer preventive advice by pharmacists in the USA (Mayer 1998). Another study of audit and feedback alone aimed at improving hand wash and glove use among nurses and patient care aids in Thailand reported the next largest effect of 19% (Moongtui 2000).

The rest of the studies reported small negative to moderate positive effects. For 30 out of the 64 comparisons the adjusted RD was close to zero (-5% to 5%). For two comparisons from the same study (Mainous 2000) there was an absolute decrease in compliance of 9%, using either audit and feedback alone or a multifaceted intervention aimed at reducing antibiotic prescribing rates for upper respiratory infections.

Continuous outcomes (Data for the studies included in this comparison are available online http://www.epoc.uottawa.ca/auditandfeedbacktables.htm.)

The 24 comparisons from 23 studies that reported continuous outcomes included over 6000 professionals. The adjusted percent change relative to control after varied from - 0.10 (a 10% decrease in desired practice) to 0.68 (a 68% increase in desired practice) (median = 0.16, inter-quartile range = 0.05 to 0.37). None of the

variables that we examined helped to explain the variation in effects across studies in the statistical analysis (p values for the coefficients ranged from 0.14 to 0.98), the corresponding visual analyses or the qualitative analyses that included studies with continuous outcomes.

Three studies showed large effects of 68%, 62% and 60%. The first study was aimed at improving test ordering in general practice (Baker 2003A). In the second study audit and feedback plus outreach visits reduced inappropriate prescriptions of tetracycline for upper respiratory infections (McConnell 1882) and in the third study audit and feedback reduced the rate of pelvimetry in hospitals (Chassin 1986).

Twenty studies did not report baseline data (14 with dichotomous and 6 with continuous outcome measures) and was not included in the primary analyses. The results in these studies were also heterogeneous. For dichotomous outcomes adjusted RDs of compliance with desired practice varied from -0.12 (a 12% absolute decrease in compliance) to 0.29 (a 29% increase in compliance).

Few studies reported patient outcomes as the primary outcome. In two studies of improving smoking cessation advice (Katz 2004;Young 2002) one study found a reduction in the proportion of participants not smoking at two and six months whereas the other study did not find a change in smoking status. One study that provided nursing homes with audit and feedback plus education about quality improvement did not improve 13 patient outcomes used as quality indicator scores (Rantz 2001).

**Comparison 2. Audit and feedback alone compared to no intervention**

A total of 51 comparisons from 44 trials reporting 35 dichotomous and 17 continuous outcomes were included in this comparison. The studies included more than 8000 health professionals. Twelve comparisons did not report baseline data and two reported patient outcomes leaving 38 comparisons in the primary analyses. The studies had a variety of outcome measures. Seven studies had a low risk of bias. (Data for the studies included in this comparison are available online http://www.epoc.uottawa.ca/auditandfeedbacktables.htm.)

The adjusted risk ratio of compliance with desired practice ranged from 0.7 to 2.1 (median = 1.07, inter-quartile range = 0.98 to 1.18). The adjusted risk difference ranged from -16% to 32% (median = 4, inter-quartile range = -0.8 to 9). The adjusted percent change for the continuous outcomes ranged from - 10.3% to 67.5% (median = 11.9, inter-quartile range = 5.1 to 22.0)

**Comparison 3. Audit and feedback with educational meetings compared to no intervention**

Twenty-four comparisons from 13 trials were included in this comparison. Eleven comparisons reported patient outcomes and four did not report baseline data, leaving nine comparisons in the primary analysis; five dichotomous and four continuous. All trials had moderate risk of bias. (Data for the studies included in this comparison are available online http://www.epoc.uottawa.ca/auditandfeedbacktables.htm)

The adjusted risk ratio of compliance with desired practice ranged from 0.98 to 3.01 (median = 1.06, inter-quartile range = 1.03 to 1.09). The adjusted risk difference ranged from -1% to 24% (median = 1.5, inter-quartile range = 1.0 to 5.5). The adjusted percent change for the continuous outcomes ranged from 3% to 41% ( (median = 28.7, inter-quartile range = 14.3 to 36.5)

A multi-centre study in four countries aimed at improving compliance with guidelines for asthma (Veninga 1999) found little effect of the intervention (adjusted risk ratio of 1.09, 0.98, 1.03 and 1.06).

**Comparison 4. Audit and feedback as part of a multifaceted intervention compared to no intervention**

Fifty comparisons from 40 trials presented as 39 dichotomous and 11 continuous outcome measures were included in this comparison. Four comparisons did not report baseline data and five reported patient outcomes leaving 41 comparisons in the primary analysis. Ten studies had low risk of bias. (Data for the studies included in this comparison are available online http://www.epoc.uottawa.ca/auditandfeedbacktables.htm.)

The adjusted risk ratio of compliance with desired practice ranged from 0.78 to 18.3 (median = 1.10, inter-quartile range = 1.03 to 1.36). The adjusted risk difference ranged from
-9% to 70% (median = 5.7, inter-quartile range = 0.85 to 13.6). The high quality studies had relative reductions in non-compliance between 1.2% and 16.0%.

The adjusted percent change for the continuous outcomes ranged from 3% to 60% ( (median = 23.8, inter-quartile range = 5.3 to 49.0).

**Comparison 5. Short term effects of audit and feedback compared to longer term effects after feedback stops**

This comparison included 8 trials with 11 comparisons. (Data for the studies included in this comparison are available online http://www.epoc.uottawa.ca/auditandfeedbacktables.htm.)

The follow-up period after audit and feedback stopped varied from three weeks to 14 months. There were mixed results. In the trial by Cohen (Cohen 1982), the control group demonstrated improvement during the three week follow-up period. The authors attributed these results to a co-intervention (an interested team leader) in the control group. In the trial by Fairbrother (Fairbrother 1999) both groups showed small improvements during follow-up. One study evaluated the effect of withdrawal of feedback on the quality of a hospital capillary blood glucose monitoring program (Jones 1996). This study showed that the improvement in performance was maintained at six months, but deteriorated by 12 months. In the trial by Norton (Norton 1985), the

experimental group demonstrated improvement in the management of cystitis but not in vaginitis when assessed 14 months later. Buntinx (Buntinx 1993) showed no improvement short term or at follow-up. In a study comparing audit and feedback plus educational meetings to educational meetings alone to improve the presentation of screening tests (Smith 1995), communication levels declined to baseline levels for both intervention groups at three months follow-up, but obstetricians and midwives continued to give more information to patients. The use of two out of three types of medication increased steadily with time in a study of secondary prevention of coronary hearth disease(Goff 2002).

**Comparison 6. Audit and feedback combined with complementary interventions compared to audit and feedback alone**

Twenty-five comparisons from 21 trials were included. In all trials a multifaceted intervention with audit and feedback was compared to audit and feedback alone. Three trials reported patient outcomes. (Data for the studies included in this comparison are available online http://www.epoc.uottawa.ca/auditandfeedbacktables.htm.)

Four trials compared audit and feedback to audit and feedback plus reminders (Baker 1997*;* Buffington 1991*;* Eccles 2001;Tierney 1986). In a factorial design adding reminders to audit and feedback gave a 47% reduction in x-ray referrals compared to audit and feedback alone (Eccles 2001). Tierney 1986 also found that reminders and audit and feedback was more effective than feedback alone (adjusted RR=1.36, adjusted RD = 8.0). The two other studies found no additive effect of combining reminders with audit and feedback.

Two studies compared audit and feedback to audit and feedback plus incentives (Fairbrother 1999*;* Hillman 1999). Fairbrother, had three arms that compared audit and feedback alone to audit and feedback plus an one-off financial bonus based on up-to-date coverage for four immunisations, and audit and feedback plus "enhanced fee for service" (five dollars for each vaccine administered within 30 days of its due date). Rates of immunisation improved significantly from 29% to 54% coverage in the bonus group after eight months (adjusted RR= 1.29). However, the percentage of immunizations received outside the practice also increased significantly in this group. The enhanced fee-for-service and audit and feedback alone groups did not change. There were only 15 physicians in each group and baseline differences, although this was controlled for in the analysis. In a high quality study (Hillman 1999), adding incentives to audit and feedback resulted in no effect when implementing guidelines for cancer screening.

Three studies (Borgiel 1999;Siriwardena 2002;Ward 1996) compared audit and feedback to audit and feedback plus outreach visits. In one study two out of seven outcomes improved, but the median calculated across all outcomes showed no effect (Siriwardena 2002). In a three arm study Ward compared feedback to feedback plus outreach by a nurse or feedback plus outreach by a peer to improve diabetes care. Both groups that received outreach had greater improvements than the feedback alone group. Borgiel found no additional effect with outreach.

Use of opinion leaders were added to audit and feedback in three studies (Guagagnoli 2000;Sauaia 2000;Soumerai 1998). One study found improvement in both groups for improving discussion of surgical treatment options for patients with breast cancer, but there was no difference between the groups (Guagagnoli 2000). Sauaia (Sauaia 2000) compared onsite verbal feedback and opinion leader to mailed feedback and found that feedback led by expert cardiologist was mostly ineffective in improving AMI care. In a high quality study Soumerai (Soumerai 1998) found no difference in the proportion of patients with acute myocardial infarction receiving study drugs when using opinion leaders in addition to audit and feedback.

One trial compared audit and feedback plus patient educational materials with audit and feedback alone (Mainous 2000). This was a four-arm study that found adding patient education to audit and feedback had no influence on antibiotic prescribing for respiratory infections.

Hayes 2001 performed a study comparing written feedback with feedback enhanced by the participation of a trained physician, quality improvement tools and an anticoagulant management of venous thrombosis project liaison. The multifaceted intervention did not provide incremental value to improve the quality of care for venous thrombosis.

One study compared audit and feedback alone to audit and feedback plus self-study (Dickinson 1981) and another to a practice-based seminar (Robling 2002). There was no difference between groups in the proportion of patients with controlled blood pressure after the intervention (Dickinson 1981), or in compliance with guidelines for MRI of the lumbar spine or knee (Robling 2002).

In one high quality study, audit and feedback plus assistance to develop an office system tailored to increase breast cancer screening rates was compared to feedback alone (Kinsinger 1998). The intervention increased the proportion of women who were recommended mammographic screening and clinical breast examination (adjusted RR=1.28), but had little impact on breast cancer screening.

Moher 2001 compared mailed feedback to feedback plus a general practitioner recall system or feedback plus a nurse recall system in a three arm study. Both GP and nurse recall systems improved the proportion of adequate assessment of risk factors and drug therapy for patients with CHD compared to feedback alone (adjusted RR= 1.37 for GP recall and for nurse recall 1.67). The differences were not reflected in clinical outcomes, such as blood pressure or cholesterol.

One study added a telephone follow-up to audit and feedback to improve pneumococcal vaccine coverage (Quinley 2004). This

intervention improved the proportion of physicians that achieved at least a 5% increase in vaccine coverage (15 % change).

**Comparison 7. Audit and feedback compared to other interventions**

Eight comparisons from seven trials were included is this comparison. Audit and feedback was compared to reminders in two studies ( Eccles 2001;Tierney 1986). The reminder group performed better in both trials; in the first there was an 18% difference in the number of knee radiographs requested in concordant with guidelines *(*Eccles 2001), and Tierney 1986 found that the reminder group performed slightly better in delivering preventive services (Tierney 1986). (Data for the studies included in this comparison are available online http://www.epoc.uottawa.ca/auditandfeedbacktables.htm.)

In one study in which audit and feedback was compared to patient education (Mainous 2000) there was no difference between groups in antibiotic prescribing rates.

Lomas 1991 compared audit and feedback to the use of local opinion leaders to implement guidelines for the management of women with a previous caesarean section in a high quality study. The opinion leader group increased the proportion of women offered trial of labor (adjusted RR=1.32) and the proportion of women with vaginal birth (adjusted RR=2.14). The audit and feedback group did not differ from the control group.

Self-study education (Dickinson 1981) and practice- based education (Robling 2002) were compared to feedback in two studies. Postintervention the proportion of patients with controlled blood pressure did not differ between the groups in the self-study trial, and Robling found no difference in compliance with guidelines for MRI of the lumbar spine or knee.

Martin 1980 compared incentives to audit and feedback to reduce tests-ordering in hospitals. Audit and feedback reduced test ordering more than incentives.

**Comparison 8. All comparisons of different ways audit and feedback are done**

Seven trials are included in this comparison. (Data for the studies included in this comparison are available online http://www.epoc.uottawa.ca/auditandfeedbacktables.htm.)

Content

Kiefe 2001 compared audit and physician-specific feedback with an identical intervention plus achievable benchmark feedback to improve five quality of care measures. Influenza vaccination improved significantly in the benchmark group, but the overall calculated median across the five outcomes showed no difference between the groups (adjusted RR= 1.03).

Two studies compared audit and feedback with and without peer comparison (Søndergaard 2002; Wones 1987). No difference was found in performance between groups in either of the studies.

One study that compared feedback on medication with feedback on performance found no difference in control of blood pressure (Gullion 1988).

Source

In one study mutual visits and feedback by peers was compared with visits and feedback by a non-physician observer to improve performance related to 208 indicators of practice management (van den Hombergh 99). Both programmes showed improvements after a year, but different aspects changed in each of the two programmes. The improvement was more noticeable after mutual practice visits than after a visit by a non-physician observer.

Ward 1996 compared audit and feedback plus outreach by a physician with audit and feedback plus outreach by a nurse to improved diabetes management. The groups did not differ significantly postintervention in the Adequate Competent Care score for diabetes (adjusted post difference = 0.5).

Recipient

In one study that compared group audit and feedback with group plus individual feedback there was no difference in prophylaxis for venous thromboembolism (Anderson 1994).

**Trials that randomised patients**

In three studies the unit of allocation was the patient and the provider received feedback for some patients and not for others (Belcher 1990; Meyer 1991; Simon 2000). In one study audit and feedback alone was compared to audit and feedback plus care management to reduce costs and follow-up visits related to patients with depression (Simon 2000). Adding care management resulted in higher costs and did not change follow-up visits. In a four arm study (Belcher 1990) that compared different combinations of multifaceted intervention in no differences was found in preventive services between the groups. Meyer (Meyer 1991) compared a single letter recommending that the number of medications received by patients should be reduced to audit and feedback plus a compliance index, peer review and recommendations; and to a control group. At four months both intervention groups had significant reductions in polypharmacy compared to the control group, but there was no difference between the two intervention groups.

**High quality studies**

Of the 118 trials 24 had high quality (with a low risk of bias). Fifteen out of the 30 new studies in the update were high quality. In seventeen of the high quality studies audit and feedback was a part of a multifaceted intervention, and only five studies compared audit and feedback alone to a control group. The high quality studies with continuous outcomes had significantly smaller effect sizes than studies of moderate quality, but the relationship was not found for dichotomous outcomes.

## DISCUSSION

Audit and feedback can be a useful intervention. The adjusted RDs of compliance with desired practice varied from -0.16 (a 16% absolute decrease in compliance) to 0.70 (a 70% increase in compliance) (median = 0.05, inter-quartile range = 0.03 to 0.11) with or without educational meetings or other complementary interventions. However, the effects of audit and feedback vary from an apparent negative effect to a very large positive effect in the trials included in this review.

In most of the included studies, the method of allocation was not clearly indicated in the published report. Although lack of allocation concealment can result in overestimates of effect (Kunz 2002), the importance of this criterion in trials where a group of health professionals is randomised at one point in time is not established. In this review we have given cluster randomised trials the benefit of the doubt and assumed that there was adequate concealment of allocation for these studies. Nonetheless, we judged only 24 of the 118 included studies to be of high methodological quality, although 50% of the new included studies had high quality.

In our primary analyses we chose to focus on comparisons where it was possible to calculate an adjusted risk ratio, risk difference and adjusted percent change relative to the control mean after the intervention. The adjustments were based on pre-intervention measurements of the outcome in the audit and feedback group. We excluded studies that we judged to be of low quality from these comparisons, and studies without baseline data. Because many studies included small numbers of health professionals, baseline differences were common and unadjusted estimates of effect often differed from the adjusted estimates.

We did not find differences in effect related to study quality. It has been recommended that the use of quality scales or summary scores should not be used in meta-regressions (Juni 1999; Juni 2001). In this review our global judgements about study quality can be considered as a type of summary score. However, we chose not to investigate any of the component criteria used to assess study quality as potential variables that might help to explain the observed variation in results. With a single variable for study quality we had five explanatory variables in the meta-regression. There is neither empirical evidence nor strong logical arguments for selecting any of the component criteria as potential explanatory variables. We considered the risk of finding spurious associations greater than the likelihood of finding a plausible association for any one of the criteria and the effects of audit and feedback.

There are a number of plausible explanations why some interventions were effective and others were not. Of the factors that we specified, baseline compliance was one factor that helped to explain variation in the relative effectiveness across studies. However, the relative effectiveness did not increase dramatically with decreasing baseline compliance (a change of 0.05 in the adjusted RR relative to a decrease of 10% in the baseline compliance). There was also more variation in the adjusted RRs when baseline compliance was lower (Figure 01).

For dichotomous outcomes the intensity of audit and feedback also appeared to explain variation in of the adjusted RR for audit and feedback with or without educational meetings. In multifaceted interventions the contribution of audit and feedback was often small. The effectiveness of multifaceted interventions may depend more on components of the intervention other than audit and feedback. We did not find any head to head comparisons of different intensities of feedback.

We did not find significant difference in the relative effectiveness of audit and feedback with or without educational meetings and multifaceted interventions. When we combined audit and feedback alone and audit and feedback with educational meetings into a single category, the absolute effect (adjusted RD) was significantly larger that for multifaceted interventions compared to audit and feedback alone or with educational meetings. However, the difference in the median adjusted RD is small and the ranges of RDs are overlapping (Figure 03). These findings are more consistent with the conclusions of a review of interventions to implement clinical practice guidelines (Grimshaw 2004) than they are with an earlier overview of systematic reviews of interventions to change professional practice (Grimshaw 2001).

Due to earlier reviews (Freemantle 1997,Grimshaw 2001) we have considered printed educational materials to have little or no effect on changing professional practice. However, a recent major review on guidelines implementation strategies (Grimshaw 2004) found that printed educational materials might have an effect. This present a problem in interpretation of our results as we have considered printed materials as no intervention. This might lead to an underestimation of the effect of audit and feedback in studies that compared audit and feedback alone to printed materials, but also to an overestimation of the effect of audit and feedback in studies where audit and feedback plus printed materials are compared to no intervention.

Fifteen of 24 high quality studies included comparisons of multifaceted interventions with no intervention and three included comparisons of audit and feedback plus educational meetings with no intervention. It is possible that an effect of methodological quality on the observed effectiveness of audit and feedback was confounded with the type of intervention that was evaluated. Our assessments of the intensity of audit and feedback may suffer from the same problem as our assessments of methodological quality. Both are complex concepts for which there is no solid basis for deriving a summary assessment. Our assessments of the intensity of audit and feedback were based on six components (the recipient, format, source, frequency, duration and content). There are theoretical and intuitive arguments for how we have categorised the overall intensity of audit and feedback, but no clear empirical basis. We considered the intensity of audit and feedback to be moderate in most (n=84) of the included studies. As with method-

ological quality, we considered the risk of finding spurious associations greater than the likelihood of finding a plausible association for any one of the components of intensity and the effects of audit and feedback.

Seven studies provided direct, randomised comparisons of different ways of providing audit and feedback. Based on these comparisons and indirect comparisons across studies it is not possible to determine what, if any features of audit and feedback have an important impact on its effectiveness. Although there are hypothetical reasons why some forms of audit and feedback might be more effective than others, there is not an empirical basis for deciding how to provide audit and feedback. Decisions about how to provide audit and feedback must be guided by pragmatic factors and local circumstances.

Forty-five of the trials included in this review included peer-comparison feedback (Table 01). The effects observed in these trials are similar to the effects of audit and feedback generally. No difference was found in the three studies that compared peer-comparison feedback to feedback without peer comparison (Kiefe 2001;Søndergaard 2002;Wones 1987). Thus, there is at present no basis for concluding that peer-comparison feedback is either more or less effective than audit and feedback generally. In contrast to the conflicting conclusions of Axt-Adams and colleagues (Axt-Adam 1993) and Balas and colleagues (Balas 1996), these results suggest that audit and feedback can be a useful intervention, although the effects are generally small, with or without peer-comparison.

A related concept that we were not able to assess is the motivation of health professionals to change the targeted behaviour. The trial by Palmer (Palmer 1985) was the only one where the investigators assessed the motivation of the providers to change practice. They did this by asking providers to indicate the 'likelihood that serious consequences for the patients' would occur if performance was poor. Contrary to what was expected, the results suggested that more improvement occurred for tasks associated with moderate to low motivation. The investigators attributed the lack of improvement in the high motivation tasks to problems with administrative systems associated with these tasks. Another possible explanation is that audit and feedback has marginal benefits for high motivation tasks because feedback is less needed or superfluous if the provider is already motivated. This is similar to the findings of Sibley and colleagues who studied the effect of continuing medical education packages (Sibley 1982), and also consistent with the findings of Foy et al (Foy 2002). They reported that quality of care improved only when topics were of low interest to the providers. Theories of behaviour change suggest that motivation is an important component of the change process (Bandura 1986;Fox 1989;Green 1988;Prochaska 1992). It is possible that differences in motivation could explain some of the observed variation in the effectiveness of audit and feedback across the included studies, but we were unable to assess this. We did not find an association between the seriousness of the targeted outcome, an indirect measure of motivation, and size of effect.

The results of this review do not support or refute the conclusions of Mugford and colleagues (Mugford 1991) that feedback close to the time of decision-making and prior agreement of clinicians to review their practice are important factors in determining the effectiveness of audit and feedback. Nor do they support the conclusions of Axt-Adams and colleagues that the variation, extent, timing, frequency and availability of peer-comparisons explain the observed variation in the effectiveness of audit and feedback (Axt-Adam 1993). Nine trials with 11 comparisons included a follow-up period after audit and feedback stopped. The length of follow-up, targeted behaviours, and the effect on performance varied in these trials. It is possible for performance to deteriorate, stay the same, or improve after feedback stops. This may depend largely on the nature of the targeted behaviour, but there are insufficient data to clarify when the effects of audit and feedback are most likely to deteriorate after feedback stops.

Four of the studies reported a large effect of audit and feedback, two of multifaceted interventions (McConnell 1882; Mayer 1998) and two of audit and feedback alone (Baker 2003A; Chassin 1986). None of these suggest that audit and feedback alone or as a part of a multifaceted intervention is likely to have large effects in most circumstances. In the study by Mayer and colleagues, pharmacists, who provided very little, if any advice on skin cancer prevention prior to the intervention, were given an intervention that included prompts, incentives and a video. In the study by McConnell and colleagues, physicians in ambulatory care who prescribed tetracycline inappropriately for upper respiratory infections received outreach visits. Baker used an balanced incomplete block design to improve test ordering, and improved lipid test ordering but not other tests. Chassin reported reduced rate of pelvimetry in a trial carried out in hospitals .

We found only seven studies of audit and feedback compared to other interventions. The results of the two comparisons of audit and feedback with reminders (Eccles 2001; Tierney 1986) are consistent with the conclusions of Buntix and colleagues (Buntinx 1993), that both can be effective, and do not provide strong support for either being clearly superior, although the reminder group performed better than audit and feedback in both of these studies. To the extent that these results can be considered reliable, they would bring into question Mugford and colleagues conclusions that feedback close to the time of decision-making is more likely to be more effective (Mugford 1991), since reminders by definition occur at the time of decision-making.

Few trials reported the cost of the interventions. Small effects may be worthwhile, if the costs of the intervention are small relative to the benefits gained. Intuitively this is more likely to be the case when an audit can easily be conducted using computerised records, but the studies included in this review do not provide empirical data to support or refute this. Moreover, the usefulness

of computerised records for audit is dependent on the quality of routinely collected data.

## AUTHORS' CONCLUSIONS

### Implications for practice

Audit and feedback can be effective in improving professional practice. The effects are generally small to moderate. The relative effects of audit and feedback are more likely to be larger when baseline adherence to recommended practice is low and, for audit and feedback with or without educational meetings, when feedback is provided more intensively.

The evidence presented here does not support mandatory use of audit and feedback as an intervention to change practice. However, audit is commonly used in the context of governance and it is essential to measure practice to know when efforts to change practice are needed. In these circumstances health professionals may receive feedback without explicitly having responsibility to implement changes based on that feedback. In these circumstances, where audit and feedback may not be planned, or conceived of, as an intervention there is, nonetheless, an opportunity to incorporate evaluations of different ways of providing feedback into routine practice.

It is not certain to what extent participants in the included trials were active participants, but it seems likely that they were for the most part passive recipients of feedback. The effects of audit and feedback might be larger when health professionals are actively involved and have specific and formal responsibilities for implementing change.

### Implications for research

It is striking how little can be discerned about the effects of audit and feedback based on the 118 trials included in this review. There are, nonetheless, four ways in which additional trials might clarify the factors that determine the effectiveness of audit and feedback and how best to do audit and feedback.

Firstly, trials need to be well designed, conducted and reported. Based on the criteria we used, only 24 of the 118 trials had a low risk of bias. Simple before and after measurements can be useful for monitoring, to ensure that desired changes have occurred in practice, but it is difficult to attribute causation based on before-after studies. They should not be used to evaluate the effects of audit and feedback since they are likely to be misleading. Baseline measurements should be undertaken both to determine the importance of intervening and to adjust for baseline differences when these are found in randomised trials. Better reporting of study methods, targeted behaviours, characteristics of participants and interventions is needed. Primary outcomes should be clearly specified and they should be clinically important.

Secondly, the effects of audit and feedback are commonly small to moderate, but may frequently be worthwhile. To detect small to moderate effects trials need to be large enough to detect small effects when these are considered important. Sample size calculations need to take account of clustering and appropriate analyses need be used to avoid unit of analysis errors.

Thirdly, there is a need for well-designed process evaluations embedded within trials to explore and provide insights into the complex dynamics underlying the variable effectiveness of audit and feedback.

Fourthly, there is a need for head-to-head comparisons of different ways of doing audit and feedback. Only seven of the included trials compared different ways of doing audit and feedback.

In this update of our review the relationship that we found between baseline compliance and the effectiveness of audit and feedback was not as consistent as with our previous update. When excluding one outlier from the analysis in this update baseline compliance could explain variation in adjusted RR, but not in adjusted RD. In addition we identified one additional explanatory factor that might help explain the variable effectiveness of audit and feedback: the intensity of audit and feedback when it is provided alone or with educational meetings. How much more informative future updates of this review will provide depends to a large extent on the extent on the availability of new, well-designed trials. There are four other ways in which future updates of this review might provide better answers.

Firstly, it is possible that we can better characterise the potential explanatory factors that we consider in our analyses, and to better explore interactions between the factors. Secondly, we can explore the extent to which individual factors, such as the characteristics of how audit and feedback was done, rather than composite measures, such as the intensity of audit and feedback, help to explain variation in the effectiveness of feedback. Thirdly, we can explore the extent to which printed educational materials, which might have a small effect, might modify the effect of audit and feedback either when they are provided with feedback or when they are used as a comparison. Fourthly, we can include the results of available process evaluations in the review.

## POTENTIAL CONFLICT OF INTEREST

None known.

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* *Indicates the major publication for the study*

## TABLES

### Characteristics of included studies

| **Study** | **Anderson 1994** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 646 physicians from 15 short-stay hospitals<br>Country: USA<br>Type of targeted behaviour: General management of a problem (prophylaxis for venous thromboembolise)<br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. A&F (non-intensive)<br>2. A&F (moderate)<br>3. Control |
| Outcomes | % patient received prophylaxis for venous thromboembolism<br>Seriousness of outcome: HIGH |
| Notes | |
| Allocation concealment | A – Adequate |

| **Study** | **Anderson 1996** |
|---|---|
| Methods | Overall quality;<br>LOW |
| Participants | 54 primary care physicians<br>Country: Canada<br>Type of targeted behaviour: General management of a problem (prescribing of anagesics)<br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. A&F (moderate)+ educational meeting<br>2. A&F (moderate)<br>3. Control |
| Outcomes | Mean number of prescriptions per physician<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | C – Inadequate |

| **Study** | **Baker 1997** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 18 general practices<br>Country: UK |

| | |
|---|---|
| | Type of targeted behaviour: Management of a problem<br><br>Complexity of targeted behaviour:<br>MODERAT |
| Interventions | 1. A&F (non-intensive)<br><br>2. A&F (moderate)<br><br>3. Control |
| Outcomes | % compliance with guidelines for use of benzodiazepines<br><br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | A – Adequate |

| **Study** | **Baker 2003** |
|---|---|
| Methods | Overall quality; HIGH |
| Participants | 81 general practices<br><br>Country: UK<br><br>Type of targeted behaviour: Management of a problem (asthma and angina)<br><br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. A&F (non-intensive)+ review criteria<br><br>2. Review criteria<br>3. Control |
| Outcomes | % compliance with guidelines for asthma and angina and patient symptom scores<br><br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | D – Not used |

| **Study** | **Baker 2003A** |
|---|---|
| Methods | Balanced incomplete block<br><br>Overall quality;<br>MODERATE |
| Participants | 33 general practices<br><br>Country: UK<br><br>Type of targeted behaviour: Test ordering<br><br>Complexity of targeted behaviour:<br>LOW |
| Interventions | 1. A&F (moderate)<br><br>2. A&F (moderate) |
| Outcomes | Median number of tests for lipids per 100 registered patients requested<br><br>Seriousness of outcome:<br>LOW |

**Characteristics of included studies** (*Continued*)

| | |
|---|---|
| Notes | |
| Allocation concealment | D – Not used |

| **Study** | **Balas 1998** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 10 community based physicians from 5 dialysis centres<br>Country: USA<br>Type of targeted behaviour: General management of a problem (patients with end-stage renal disease)<br>Complexity of targeted behaviour:<br>HIGH |
| Interventions | 1. A&F (moderate)<br>2. Control |
| Outcomes | % patients on peritoneal dialysis versus hemodialysis<br>Seriousness of outcome:<br>HIGH |
| Notes | |
| Allocation concealment | A – Adequate |

| **Study** | **Belcher 1990** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 1224 patients randomised to unclear number of physcians in primary care<br>Country: USA<br>Type of targeted behaviour: Preventive care<br>Complexity of targeted behaviour: MODERATE |
| Interventions | 1. Multifacted with A&F (A&F (non-intensive)+ educational meetings+ reminders )<br>Contribution of A&F;<br>MINOR<br>2. Multifacted with A&F (A&F (non-intensive)+ educational meetings + reminders + patient mediated promts )<br>Contribution of A&F;<br>MINOR<br>3. Multifacted with A&F<br>(A&F (non-intensive) + educational meeting + reminders+ prompts + patient invitation<br>Contribution of A&F;<br>MINOR<br>4.Control |
| Outcomes | % patients receiving recommended preventive services<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | A – Adequate |

**Characteristics of included studies** (*Continued*)

| **Study** | **Berman 1998** |
|---|---|
| Methods | Overall quality;<br>LOW |
| Participants | 27 resident anesthesiologists<br>Country: USA<br>Type of targeted behaviour: Prescribing for three procedures<br>Complexity of targeted behaviour:<br>HIGH |
| Interventions | 1. A&F (moderate)<br>2. Control |
| Outcomes | Costs of anaesthetics<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | B – Unclear |

| **Study** | **Boekeloo 1990** |
|---|---|
| Methods | Overall quality;<br>LOW |
| Participants | 29 internal medecine interns from 1 hospital<br>Country: USA<br>Type of targeted behaviour: Prescribing (high blood cholesterol)<br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1.Reminders<br>2. A&F (moderate)<br>3. Multifacted with A&F (A&F (moderate) + reminders)<br>Contribution of A&F;<br>MODERATE<br>4. Didactic meeting |
| Outcomes | % cholesterol assessed<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | A – Adequate |

| **Study** | **Bonevski 1999** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 19 general practitioners<br>Country: Australia<br>Type of targeted behaviour: General management of a problem<br>Complexity of targeted behaviour: |

**Characteristics of included studies** (*Continued*)

| | |
|---|---|
| | MODERATE |
| Interventions | 1. A&F (moderate)<br>2. Written materials/control |
| Outcomes | Accuracy of classification of patient risk status for preventive care<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | B – Unclear |

| **Study** | **Borgiel 1999** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 56 family physicians<br>Country: Canada<br>Type of targeted behaviour: General management of a problem (four areas)<br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. A&F (non-intensive)<br>2. A&F (moderate) + educational meeting (outreach) |
| Outcomes | Quality of care in family practice<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | A – Adequate |

| **Study** | **Brady 1988** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 45 physicians (residents) from 1 outpatient clinic in 1 hospital<br>Country: USA<br>Type of targeted behaviour: Prescribing<br>(influenza vaccination or mammography screening)<br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. A&F (non-intensive) +educational materials + didactic meetings<br>2. A&F (non-intensive) + educational materials + didactic meetings + self-audit<br>3. A&F (non-intensive) + educational materials + conferences |
| Outcomes | % ordered influenza vaccination and mammography screening<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | A – Adequate |

**Characteristics of included studies** (*Continued*)

| **Study** | **Brown 1994** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 24 private dental practices without hygenists<br>Country: Australia<br>Type of targeted behaviour: General management of a problem (periodontal care)<br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. A&F (intensive) + outreach visits (ed meeting)<br>2. Control |
| Outcomes | % records containing at least one periodontal notation<br>Seriousness of outcome:<br>LOW |
| Notes | * There were three study groups but only two (without hygenists) were randomly allocated into experimental and control groups. |
| Allocation concealment | A – Adequate |

| **Study** | **Buffington 1991** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 45 physicians from 13 practices<br>Country: USA<br>Type of targeted behaviour: Prescribing<br>(influenza immunisations)<br>Complexity of targeted behaviour:<br>LOW |
| Interventions | 1. Multifacted with A&F (A&F (moderate) + patient mediated interventions + conferences + other)<br>Contribution of A&F:<br>MODERATE<br>2. A&F (moderate)+ conferences + other (visits to office staff to aid data collection + telephone consultation facility)<br>3. Control |
| Outcomes | % patients influenza vaccinated<br>Seriousness of outcome:<br>MODERATE |
| Notes | Patient mediated=mailed postcard reminder |
| Allocation concealment | A – Adequate |

| **Study** | **Buntinx 1993** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 179 physicians for unclear number of practices<br>Country: Belgium<br>Type of targeted behaviour: General management of a problem (quality of cervical smears)<br>Complexity of targeted behaviour: |

**Characteristics of included studies** (*Continued*)

| | |
|---|---|
| | MODERATE |
| Interventions | 1. Multifacted with A&F (A&F (moderate)+ reminders)<br>Contribution of A&F: MODERATE<br><br>2. Multifacted with A&F (A&F (moderate)+ specific advice + reminders)<br>Contribution of A&F:<br><br>3. Reminders<br><br>4. Educational materials/control |
| Outcomes | Quality of smears<br><br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | B – Unclear |

| **Study** | **Chassin 1986** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 1483 physicians from 120 hospitals<br><br>Country: USA<br><br>Type of targeted behaviour:<br>Prescribing (pelvimetry for pregnancy)<br><br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. A&F (moderate) + didactic meetings + written materials<br><br>2. Control |
| Outcomes | Mean rate of pelvimetry per 1000 deliveries<br><br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | A – Adequate |

| **Study** | **Cohen 1982** |
|---|---|
| Methods | Balanced incomplete block<br><br>Overall quality; MODERATE |
| Participants | Physicians (residents & physicians) from 4 firms in 1 hospital<br><br>Country: USA<br><br>Type of targeted behaviour: Prescribing<br>(lab tests and x-rays)<br><br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. A&F (moderate) on lab tests<br><br>2. A&F (moderate) on x-rays |
| Outcomes | Mean number of lab tests per admission<br><br>Seriousness of outcome: |

| | |
|---|---|
| | MODERATE |
| Notes | |
| Allocation concealment | A – Adequate |

| **Study** | **De Almeida Neto 2000** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 24 pharmacists 24 pharmacies<br>Country: Australia<br>Type of targeted behaviour: General management of a problem (identification of inappropriate over the counter analgesics)<br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. A&F (moderate) + educational meetings<br>2. Control |
| Outcomes | % analgesic misuse identified and discussed<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | B – Unclear |

| **Study** | **Dickinson 1981** |
|---|---|
| Methods | Factoriel design<br>Overall quality; MODERATE |
| Participants | 40 physicians (residents & faculty) from 1 family medicine centre<br>Country: USA<br>Type of targeted behaviour: Prescribing<br>(hypertension control)<br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. A&F (moderate)<br>2. Self-study<br>3. A&F + self study<br>4. Control |
| Outcomes | % patients with controlled blood pressure<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | A – Adequate |

| **Study** | **Eccles 2001** |
|---|---|
| Methods | Factoriel design<br>Overall quality; MODERATE |

**Characteristics of included studies** (*Continued*)

| | |
|---|---|
| Participants | 244 general practices<br>Country: UK<br>Type of targeted behaviour: Referrals of radiographs<br>Complexity of targeted behaviour:<br>LOW<br>Seriousness:<br>LOW |
| Interventions | 1. A&F (non-intensive)<br>2. Reminders<br>3. A&F (non-intensive) + reminders<br>4. Control |
| Outcomes | Requests per 1000 of knee and lumbar spine radiographs<br>Seriousness of outcome:<br>LOW |
| Notes | |
| Allocation concealment | D – Not used |

| **Study** | **Everett 1983** |
|---|---|
| Methods | Overall quality;<br>LOW |
| Participants | 24 physicians (residents) from 5 ward teams in 1 hospital<br>Country: USA<br>Type of targeted behaviour: Prescribing (various clinical conditions)<br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. A&F (intensive) + written materials<br>2. Control |
| Outcomes | Costs and use of lab tests<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | B – Unclear |

| **Study** | **Fairbrother 1999** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 61 pediatricians and family physicians<br>Country: USA<br>Type of targeted behaviour: Preventive care (immunizaton coverage)<br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. A&F<br>2. Multifacted with A&F (A&F (moderate) + one-off bonus) |

**Characteristics of included studies** (*Continued*)

| | |
|---|---|
| | Contribution of A&F:<br>MODERATE<br><br>3. Multifacted with A&F<br>(A&F (moderate) + enhanced fee-for-service)<br><br>Contribution of A&F:<br>MODERATE<br><br>4. Control |
| Outcomes | % immunization coverage<br><br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | B – Unclear |

| **Study** | **Fallowfield 2002** |
|---|---|
| Methods | Factoriel design<br><br>Overall quality; MODERATE |
| Participants | 160 oncologists<br><br>Country: UK<br><br>Type of targeted behaviour: ?<br><br>Complexity of targeted behaviour:<br>HIGH<br><br>Seriousness:<br>MODERATE |
| Interventions | 1. A&F (moderate)<br><br>2. Educational meeting<br><br>3. A&F (moderate) + educational meeting<br><br>4. Control |
| Outcomes | Communication skills |
| Notes | |
| Allocation concealment | D – Not used |

| **Study** | **Feder 1995** |
|---|---|
| Methods | Balanced incomplete block<br><br>Overall quality; MODERATE |
| Participants | 39 physicians from 24 general practices<br><br>Country: UK<br><br>Type of targeted behaviour: General management of a problem (asthma and diabetice care)<br><br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | IBD<br>1. Multifacted with A&F<br>(non-intensive) for asthma + written materials + educational meetings (outreach) + phys prompts) |

**Characteristics of included studies** (*Continued*)

| | |
|---|---|
| | Contribution of A&F:<br>MINOR<br><br>2. Multifacted with A&F<br>(A&F (non-intensive) for diabetes + written materials + educational meetings (outreach) + phys prompts)<br>Contribution of A&F:<br>MINOR |
| Outcomes | % compliance with guidlines for diabetes and asthma |
| Notes | |
| Allocation concealment | B – Unclear |

| **Study** | **Ferguson 2003** |
|---|---|
| Methods | Balanced incomplete block<br><br>Overall quality; HIGH |
| Participants | Cardiac surgeons from 359 hospitals<br><br>Country: USA<br><br>Type of targeted behaviour:<br>General management of a problem (surgery)<br><br>Complexity of targeted behaviour:<br>HIGH<br><br>Seriousness:<br>HIGH |
| Interventions | IBD<br>1. Multifacted with A&F (A&F moderate) for IMA + opinion leader + written material<br><br>2. Multifacted with A&F (A&F moderate) for beta-blockers + opinion leader + written material<br><br>3. Control |
| Outcomes | % compliance with guidelines for use of beta-blockers and IMA<br><br>Seriousness of outcome:<br>HIGH |
| Notes | |
| Allocation concealment | D – Not used |

| **Study** | **Finkelstein 2001** |
|---|---|
| Methods | Overall quality;<br>MODERATE |
| Participants | 157 general practitioners form 12 general practices<br><br>Country: USA<br><br>Type of targeted behaviour:<br>Prescribing of antibiotic for children<br><br>Complexity of targeted behaviour:<br>LOW<br><br>Seriousness:<br>LOW |
| Interventions | 1. Multifacted with A&F (moderate) + outreach + opinion leader |

| | |
|---|---|
| | 2. Control |
| Outcomes | total number of antimicrobials dispensed diveded by total number of person-year<br>Seriousness of outcome: LOW |
| Notes | |
| Allocation concealment | D – Not used |

| **Study** | **Frijiling 2002** |
|---|---|
| Methods | Balanced incomplete block<br>Overall quality; MODERATE |
| Participants | 185 general practitioners from 124 practices<br>Country: The Netherlands<br>Type of targeted behaviour: General management of a problem (diabetes and cardiovascular)<br>Complexity of targeted behaviour: MODERATE<br>Seriousness: MODERATE |
| Interventions | 1. Multifacted with A&F (moderate) + outreach<br>2. Control |
| Outcomes | % compliance with guidelines for diabetes or cardiovascular care<br>Seriousness of outcome: MODERATE |
| Notes | |
| Allocation concealment | D – Not used |

| **Study** | **Gama 1991** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 5 physicians in general medicine<br>Country: UK<br>Type of targeted behaviour: General management of a problem (laborotary use)<br>Complexity of targeted behaviour: MODERATE |
| Interventions | 1. A&F (moderate)<br>2. Control |
| Outcomes | Laboratory use and costs<br>Seriousness of outcome: MODERATE |
| Notes | |
| Allocation concealment | B – Unclear |

**Characteristics of included studies** (*Continued*)

| **Study** | **Gehlbach 1984** |
|---|---|
| Methods | Overall quality;<br>LOW |
| Participants | 31 physicians (residents & faculty) ,<br>Country: USA<br>Type of targeted behaviour: Prescribing (drugs)<br>Complexity of targeted behaviour:<br>LOW |
| Interventions | 1. A&F (moderate)<br>2. Control |
| Outcomes | % generic precriptions<br>Seriousness of outcome:<br>LOW |
| Notes | |
| Allocation concealment | A – Adequate |

| **Study** | **Goff 2002** |
|---|---|
| Methods | Overall quality;<br>HIGH |
| Participants | 605 physcisians in 131 practices<br>Country: USA<br>Type of targeted behaviour:<br>Prescribing for CHD<br>Complexity of targeted behaviour:<br>LOW<br>Seriousness:<br>MODERATE |
| Interventions | 1. Multifacted with A&F (moderate) + reminders<br>2. Control |
| Outcomes | % compliance with guidelines for CHD prescribing<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | D – Not used |

| **Study** | **Goldberg 1998** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 95 physicians from 15 small group practices<br>Country: USA<br>Type of targeted behaviour: Compliance with guidelines (hypertension and depression)<br>Complexity of targeted behaviour: |

**Characteristics of included studies** (*Continued*)

| | |
|---|---|
| | MODERATE |
| Interventions | 1. A&F (moderate) + educational meetings (outreach)<br>2. A&F (moderate) + educational meetings (outreach) + CQI team facilitation<br>3. Control |
| Outcomes | % compliance with guidelines for management of hypertension and depression<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | A – Adequate |

| **Study** | **Grady 1997** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 95 primary care physicians from 65 practices<br>Country: USA<br>Type of targeted behaviour: Referrals (mammography)<br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. Multifacted with A&F (A&F (moderate) + didactic meeting + phys prompts + incentives)<br>Contribution of A&F:<br>MODERATE<br>2. Didactic meeting + phys prompts<br>3. Didactic meeting |
| Outcomes | % mammography referrals<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | A – Adequate |

| **Study** | **Guagagnoli 2000** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | Unclear number of surgeons from 28 hospitals<br>Country: USA<br>Type of targeted behaviour: Communication skills<br>Complexity of targeted behaviour:<br>HIGH |
| Interventions | 1. Multifacted with A&F (low) + opinion leaders<br>2. A&F (low) |
| Outcomes | % patients reporting that their surgeon did discuss both breast-conserving surgery and mastectomy as treatment option<br>Seriousness of outcome:<br>HIGH |

**Characteristics of included studies** (*Continued*)

| | |
|---|---|
| Notes | |
| Allocation concealment | D – Not used |

| **Study** | **Gullion 1988** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 111 physicians in private practice<br>Country: USA<br>Type of targeted behaviour: General management of a problem (hypertensive care)<br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. A&F (moderate) on medication (medical records) + written materials + educational meeting (conference call)<br>2. A&F (moderate) on performence (survey) + written materials + educational meeting (conference call)<br>3. Combined 1 + 2<br>4. Control |
| Outcomes | % patients with controlled blood pressure<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | B – Unclear |

| **Study** | **Hayes 2001** |
|---|---|
| Methods | Overall quality; HIGH |
| Participants | Unclear number health professionals from 29 hospitals<br>Type of targeted behaviour: General management of a problem (venous thrombosis)<br>Complexity of targeted behaviour:<br>MODERATE<br>Seriousness:<br>HIGH<br>Country: USA |
| Interventions | 1. A&F (non-intensive)<br>2. Multifacted with A&F (non-intensive) + educational meetings + opinion leader |
| Outcomes | Rates of achieving a quality indicator<br>Seriousness of outcome:<br>HIGH |
| Notes | |
| Allocation concealment | D – Not used |

| **Study** | **Heller 2001** |
|---|---|
| Methods | Overall quality;<br>HIGH |
| Participants | Unclear number of health professionals from 37 public hospitals |

**Characteristics of included studies** (*Continued*)

| | |
|---|---|
| | Type of targeted behaviour: General management of a problem (angina)<br><br>Complexity of targeted behaviour:<br>HIGH<br><br>Seriousness:<br>HIGH<br><br>Country: UK |
| Interventions | 1. A&F (moderate)<br><br>2. Control |
| Outcomes | Correct action in management of unstable angina<br><br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | D – Not used |

| **Study** | **Hemminiki 1992** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 53 hospitals<br><br>Country: Finland<br><br>Type of targeted behaviour: General management of a problem (cesarean rates)<br><br>Complexity of targeted behaviour:<br>LOW |
| Interventions | 1. A&F (non-intensive)<br><br>2. Control |
| Outcomes | % vaginal deliveries<br><br>Seriousness of outcome:<br>HIGH |
| Notes | |
| Allocation concealment | A – Adequate |

| **Study** | **Henderson 1979** |
|---|---|
| Methods | Overall quality;<br>LOW |
| Participants | Unclear number of hospital physicians (interns)<br><br>Country: USA<br><br>Type of targeted behaviour: General management of a problem (costs)<br><br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. A&F (moderate)<br><br>2 Control |
| Outcomes | Costs<br><br>Seriousness of outcome:<br>MODERATE |

**Characteristics of included studies** (*Continued*)

| | |
|---|---|
| Notes | |
| Allocation concealment | B – Unclear |

| **Study** | **Hendryx 1998** |
|---|---|
| Methods | Overall quality;<br>HIGH |
| Participants | 20 rural hospitals<br>Country: USA<br>Type of targeted behaviour: Compliance with guidelines (intensive care)<br>Complexity of targeted behaviour:<br>HIGH |
| Interventions | 1. A&F (moderate) + educational meeting (outreach) + written materials + seminars + telephone consultation service<br>2. Control |
| Outcomes | % compliance with intensive care unit guidelines/+ patient outcomes<br>Seriousness of outcome:<br>HIGH |
| Notes | |
| Allocation concealment | A – Adequate |

| **Study** | **Hershey 1986** |
|---|---|
| Methods | Overall quality;<br>MODERATE |
| Participants | 48 physicians (residents) from 4 firms in 1 hospital<br>Country: USA<br>Type of targeted behaviour: Prescribing<br>(drug)<br>Complexity of targeted behaviour:<br>HIGH |
| Interventions | 1. A&F (moderate)<br>2. Control |
| Outcomes | Cost per resident, prescription per resident<br>Mean charge per prescription<br>Mean charge per patient<br>Prescriptions per patient<br>Seriousness of outcome:<br>LOW |
| Notes | |
| Allocation concealment | B – Unclear |

| **Study** | **Hillman 1998** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 52 primary care practices<br>Country: USA |

**Characteristics of included studies** (*Continued*)

| | |
|---|---|
| | Type of targeted behaviour: Preventive care (cancer screening)<br><br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. Multifacted with A&F<br>(A&F (moderate)+ incentive)<br>Contribution of A&F:<br>MODERATE<br><br>2. Control |
| Outcomes | % cancer screening<br><br>Seriousness of outcome:<br>HIGH |
| Notes | |
| Allocation concealment | B – Unclear |

| **Study** | **Hillman 1999** |
|---|---|
| Methods | Overall quality;<br>HIGH |
| Participants | 49 primary care practices<br><br>Country: USA<br><br>Type of targeted behaviour: Preventive care (pediatric)<br><br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. Multifacted with A&F<br>(A&F (moderate) + incentive)<br>Contribution of A&F:<br>MODERATE<br><br>2. A&F (moderate)<br><br>3. Control |
| Outcomes | % compliance with well child care guidelines<br><br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | A – Adequate |

| **Study** | **Holm 1990** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 365 physicians from general practice<br><br>Country: Denmark<br><br>Type of targeted behaviour: General management of a problem (long-term use of hypnotics/sedatives)<br><br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. A&F (moderate) + written materials<br><br>2. Meeting (didactic?) + written materials |

**Characteristics of included studies** (*Continued*)

| | |
|---|---|
| | 3. Control |
| Outcomes | Prescribed DDD of hypnotics per 1000 patients per week<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | B – Unclear |

| **Study** | **Howe 1996** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 19 general practitioners<br>Country: UK<br>Type of targeted behaviour: General management of a problem (psychological distress)<br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. A&F (moderate) + written materials + self-assessement of video<br>2. Control |
| Outcomes | % detection of psychological distress rate per physicians<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | B – Unclear |

| **Study** | **Hux 1999** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 251 primary care physicians<br>Country: Canada<br>Type of targeted behaviour: Prescribing (antibiotic)<br>Complexity of targeted behaviour:<br>LOW |
| Interventions | 1. A&F (moderate) + written materials<br>2. Control |
| Outcomes | % first line antibiotics prescribed<br>Seriousness of outcome:<br>LOW |
| Notes | |
| Allocation concealment | B – Unclear |

| **Study** | **Jones 1996** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 124 nurses from one hospital<br>Country: USA<br>Type of targeted behaviour: General management of a problem (capillary blood glucose monitoring) |

| | |
|---|---|
| | Complexity of targeted behaviour:<br>LOW |
| Interventions | 1. A&F continued (moderate)<br><br>2. A&F withdrawn (moderate) |
| Outcomes | Mean accuracy of blood glucose monitoring<br><br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | B – Unclear |

| **Study** | **Kafuko 1999** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 127 health units from 6 districts in 4 regions<br><br>Country: Uganda<br><br>Type of targeted behaviour: Prescribing<br>(rational drug use)<br><br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. A&F (intensive) + written materials + educational meetings<br><br>2. Multifacted with A&F<br>(A&F (intensive) + written materials + educational meetings + support)<br>Contribution of A&F:<br>MODERATE<br><br>3. Written materials |
| Outcomes | % of all cases treated according to guidelines for drug use<br><br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | A – Adequate |

| **Study** | **Katz 2004** |
|---|---|
| Methods | Overall quality; HIGH |
| Participants | 75 mixed professionals from 8 community practices<br><br>Country: USA<br><br>Type of targeted behaviour: General management of a problem (smoking cessation)<br><br>Complexity of targeted behaviour:<br>MODERATE<br><br>Seriousness:<br>MODERATE |
| Interventions | 1. Multifacted with A&F (moderate) + educational meeting + prompts + telephone support<br><br>2. Control |
| Outcomes | % not smoking at 2 and 6 months<br><br>Seriousness of outcome: |

**Characteristics of included studies** (*Continued*)

| | |
|---|---|
| | MODERATE |
| Notes | |
| Allocation concealment | D – Not used |

| **Study** | **Kerry 2000** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 175 physicians from 69 general practices<br>Country: UK<br>Type of targeted behaviour: Test ordering (x-ray referrals)<br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. A&F (moderate) + written materials<br>2. Control |
| Outcomes | Number of referrals for x-rays<br>Seriousness of outcome:<br>LOW |
| Notes | |
| Allocation concealment | A – Adequate |

| **Study** | **Kerse 1999** |
|---|---|
| Methods | Overall quality;<br>HIGH |
| Participants | 42 physicians in general practice<br>Country: Australia<br>Type of targeted behaviour: Preventive care (health promotion for eldery people)<br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. Multifacted with A&F<br>(A&F (non-intensive) + educational meetings (outreach) + phys prompts + didactic seminar or home study + written materials)<br>Contribution of A&F:<br>MINOR<br>2. Control |
| Outcomes | % patients recall discussion about exercise<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | A – Adequate |

| **Study** | **Kiefe 2001** |
|---|---|
| Methods | Overall quality;<br>MODERATE |
| Participants | 70 community physicians |

**Characteristics of included studies** (*Continued*)

| | |
|---|---|
| | Country: USA<br><br>Type of targeted behaviour: General management of a problem (diabetes)<br><br>Complexity of targeted behaviour:<br>MODERATE<br><br>Seriousness:<br>MODERATE |
| Interventions | 1. A&F (moderate) with peer comparison<br><br>2. A&F (moderate) with peer somparison and benchmark |
| Outcomes | % rates performence of five quality of care measures<br><br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | D – Not used |

| **Study** | **Kim 1999** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 48 primary care physicians<br><br>Country: Scotland<br><br>Type of targeted behaviour: Preventive care (immunization and mammography)<br><br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. A&F (intensive) + educational meetings (outreach) + written materials<br><br>2. Written materials |
| Outcomes | % patients offered preventive services<br><br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | B – Unclear |

| **Study** | **Kinsinger 1998** |
|---|---|
| Methods | Overall quality;<br>HIGH |
| Participants | 62 practices from family medicine and internal medicine<br><br>Country: USA<br><br>Type of targeted behaviour: Screening<br>(breast cancer)<br><br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. A&F (non-intensive)<br><br>2. A&F (non-intensive) + facilitation of office system |
| Outcomes | % women who were recommended mammogram and CBE<br><br>Seriousness of outcome: |

**Characteristics of included studies** (*Continued*)

| | |
|---|---|
| | MODERATE |
| Notes | |
| Allocation concealment | A – Adequate |

| **Study** | **Kogan 2003** |
|---|---|
| Methods | Overall quality;<br>MODERATE |
| Participants | 44 internal medicine residents<br>Country: USA<br>Type of targeted behaviour: General management of a problem (prevention and disease management )<br>Complexity of targeted behaviour:<br>MODERATE<br>Seriousness:<br>MODERATE |
| Interventions | 1. A&F (moderate)<br>2. Control |
| Outcomes | Total performence scores (% of indicated action taken) for prevetive health and disease management<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | D – Not used |

| **Study** | **Lemelin 2001** |
|---|---|
| Methods | Overall quality;<br>HIGH |
| Participants | 140 family physicians from 46 practices<br>Country: Canada<br>Type of targeted behaviour: Prevention<br>Complexity of targeted behaviour:<br>MODERATE<br>Seriousness:<br>MODERATE |
| Interventions | 1. Multifacted with A&F (moderate) + nurse facilitator<br>2. Control |
| Outcomes | % overall preventive performence<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | D – Not used |

| **Study** | **Leviton 1999** |
|---|---|
| Methods | Overall quality;<br>HIGH |

**Characteristics of included studies** (*Continued*)

| | |
|---|---|
| Participants | Obstetricians in 27 hospitals<br>Country: USA<br>Type of targeted behaviour: General management of a problem (use of antenatal corticosteroids for fetal maturation)<br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. Multifacted with A&F (A&F (moderate) + educational meetings + opinion leaders + phys prompts + written materials)<br>Contribution of A&F:<br>MINOR<br>2. Control |
| Outcomes | % patients receiving antenatal corticosteroids<br>Seriousness of outcome:<br>HIGH |
| Notes | |
| Allocation concealment | A – Adequate |

| **Study** | **Linn BS 1980** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 298 physicians from 20 hospitals<br>Country: USA<br>Type of targeted behaviour: General management of a problem (burn care)<br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. A&F (moderate) + written materials + conferences (didactic?) + acess to hotline<br>2. Control |
| Outcomes | Average number of patients with early complications<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | A – Adequate |

| **Study** | **Lobach 1996** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 45 primary care physicians<br>Country: USA<br>Type of targeted behaviour: General management of a problem (diabetes)<br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. A&F (moderate)<br>2. Control |
| Outcomes | % compliance with diabetes quidelines |

| | |
|---|---|
| | Seriousness of outcome:<br>HIGH |
| Notes | |
| Allocation concealment | B – Unclear |

| **Study** | **Lomas 1991** |
|---|---|
| Methods | Overall quality;<br>HIGH |
| Participants | 76 physicians in 16 community hospitals<br>Country: Canada<br>Type of targeted behaviour: General managemnet of a problem (cesarean rates)<br>Complexity of targeted behaviour: MODERATE |
| Interventions | 1. A&F (moderate) + educational meetings<br>2. Local opinion leaders + written materials + educational meetings<br>3. Written materials |
| Outcomes | % women who underwent a trial of labour<br>Seriousness of outcome:<br>HIGH |
| Notes | |
| Allocation concealment | A – Adequate |

| **Study** | **Mainous 2000** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 216 primary care physicians<br>Country: USA<br>Type of targeted behaviour: Prescribing<br>(antibiotic for respiratory infections)<br>Complexity of targeted behaviour: MODERATE |
| Interventions | 1. A&F (moderate)<br>2. Patient education materials<br>3. Multifacted with A&F<br>(A&F (moderate) + patient education)<br>Contribution of A&F:<br>MODERATE<br>4. Control |
| Outcomes | % antibiotic prescriptions for viral respiratory infections in children<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | B – Unclear |

| **Study** | **Manfredi 1998** |
|---|---|
| Methods | Overall quality; |

**Characteristics of included studies** (*Continued*)

| | |
|---|---|
| | HIGH |
| Participants | 51 private phsycisian practices<br>Country: USA<br>Type of targeted behaviour: Preventive care (cancer screening)<br>Complexity of targeted behaviour: MODERATE |
| Interventions | 1. Multifacted with A&F (A&F (moderate) + educational meetings (outreach) + phys prompts + patients prompts + written matrials)<br>Contribution of A&F:<br>MINOR<br>2. Written materials |
| Outcomes | % patients screened for cancer<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | A – Adequate |

| **Study** | **Manheim 1990** |
|---|---|
| Methods | Overall quality;<br>LOW |
| Participants | 105 physicians (interns) from 2 hospitals<br>Country: USA<br>Type of targeted behaviour: Length of stay, costs<br>Complexity of targeted behaviour:<br>HIGH |
| Interventions | 1. A&F (moderate) + educational meetings<br>2. Control |
| Outcomes | Length of stay<br>Cost of episode<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | B – Unclear |

| **Study** | **Martin 1980** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 24 physicians (residents) from 3 ward teams in 1 hospital<br>Country: USA<br>Type of targeted behaviour: Test ordering<br>(laboratory and radiologic)<br>Complexity of targeted behaviour: MODERATE |
| Interventions | 1. A&F (intensive) + seminar (didactic?) + written materials<br>2. Seminar (didactic?) + written materials + incentives |

| | |
|---|---|
| | 3. Seminar (didactic?) + written matreials |
| Outcomes | Mean tests per patient admission<br><br>Seriousness of outcome:<br>LOW |
| Notes | |
| Allocation concealment | B – Unclear |

| **Study** | **Marton 1985** |
|---|---|
| Methods | Factorial design<br><br>Overall quality; MODERATE |
| Participants | 57 physicians ('housestaff') from 3 hospitals<br><br>Country: USA<br><br>Type of targeted behaviour: Test ordering (laboratory use)<br><br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. A&F (moderate)<br><br>2. Written materials<br><br>3. A&F + written materials<br><br>4. Control |
| Outcomes | Mean number tests per patient visit<br><br>Seriousness of outcome:<br>HIGH |
| Notes | |
| Allocation concealment | B – Unclear |

| **Study** | **Mayefsky 1993** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 28 physicians (pediatric house officers) from 2 outpatient clinics in 2 hospitals<br><br>Country: USA<br><br>Type of targeted behaviour: General management of a problem (child care)<br><br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. A&F (moderate)<br><br>2. Audit no Feedback |
| Outcomes | % compliance with criteria for well child care<br><br>Seriousness of outcome:<br>LOW |
| Notes | |
| Allocation concealment | B – Unclear |

**Characteristics of included studies** (*Continued*)

| **Study** | **Mayer 1998** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 138 pharmacists from 54 pharmacies<br>Country: UK<br>Type of targeted behaviour: Preventive care (promoting skin cancer)<br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. Multifacted with A&F (A&F (moderate) + prompts + incentives + video)<br>Contribution of A&F:<br>MAJOR<br>2. Control |
| Outcomes | % patients receiving skin cancer prevention counseling<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | A – Adequate |

| **Study** | **McAlister 1986** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 60 physicians from 60 practices<br>Country: Canada<br>Type of targeted behaviour: Compliance with guidelines (hypertensive care)<br>Complexity of targeted behaviour: MODERATE |
| Interventions | 1. Multifacted with A&F (moderate) + patient reminders<br>Contribution of A&F: MODERATE<br>2. Control |
| Outcomes | % patients followed up for hypertension<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | A – Adequate |

| **Study** | **McCartney 1997** |
|---|---|
| Methods | Balanced incomplete block<br>Overall quality; MODERATE |
| Participants | 28 general practices<br>Country: UK<br>Type of targeted behaviour: Preventive care? (aspirin prescribing)<br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | IBD<br>1. A&F (non-intensive) |

| | |
|---|---|
| | 2. Control |
| Outcomes | % patients with hearth disease on prophylactc aspirin<br>% women prescribed HRT after hysterectomy<br><br>Seriousness of outcome:<br>HIGH |
| Notes | |
| Allocation concealment | A – Adequate |

| **Study** | **McConnell 1882** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 35 physicians<br><br>Country: USA<br><br>Type of targeted behaviour: prescribing<br><br>Complexity of targeted behaviour:<br>LOW |
| Interventions | 1. Multifacted with A&F (moderate) + outreach<br><br>Contribution of A&F: MODERATE<br><br>2. Control |
| Outcomes | Median prescribtion of tetracycline<br><br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | D – Not used |

| **Study** | **Meyer 1991** |
|---|---|
| Methods | Overall quality;<br>LOW |
| Participants | 141 physicians and nurses from 1 outpatient clinic in 1 hospital<br><br>Country: USA<br><br>Type of targeted behaviour: Compliance with guidelines (polypharmacy)<br><br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. A&F (moderate)<br><br>2. A&F (moderate) + peer review + recommendations<br><br>3. Control |
| Outcomes | Mean number of prescriptions<br><br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | A – Adequate |

| **Study** | **Moher 2001** |
|---|---|
| Methods | Overall quality; |

**Characteristics of included studies** (*Continued*)

| | |
|---|---|
| | MODERATE |
| Participants | Unclear number of physicians from 21 general practices<br>Country: UK<br>Type of targeted behaviour: General management of a problem (CHD)<br>Complexity of targeted behaviour:<br>MODERATE<br>Seriousness: HIGH |
| Interventions | 1. A&F (non-intensive)<br>2. A&F (non-intensive) + doctor recall system<br>3. A&F (non-intensive) + nurse recall system |
| Outcomes | % adequate assessement of risk factors and drug therapy for patients with CHD<br>Seriousness of outcome:<br>HIGH |
| Notes | |
| Allocation concealment | D – Not used |

| **Study** | **Moongtui 2000** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 91 nurses and patient care aides<br>Country: Thailand<br>Type of targeted behaviour: Compliance with guidelines<br>Complexity of targetd behaviour:<br>LOW |
| Interventions | 1. A&F (moderate)<br>2. Control |
| Outcomes | Compliance rate for handwash and glove use<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | A – Adequate |

| **Study** | **Nilsson 2001** |
|---|---|
| Methods | Balanced incomplete block<br>Overall quality;<br>MODERATE |
| Participants | 40 general practitioners<br>Country: Sweden<br>Type of targeted behaviour: Prescribtion for<br>peptic ulcer and hypertension<br>Complexity of targeted behaviour:<br>LOW |

| | |
|---|---|
| | Seriousness: LOW |
| Interventions | 1. Multifacted with A&F (moderate) + outreach + opinion leader versus control for peptic ulcer.<br>2. Same for hypertension. |
| Outcomes | 1. % of prescribed defined daily dose for peptic ulcer/dyspepsia<br>2. % of prescribed defined daily dose for hypertension<br>Seriousness of outcome: LOW |
| Notes | |
| Allocation concealment | D – Not used |

| **Study** | **Norton 1985** |
|---|---|
| Methods | Balanced incomplete block<br>Overall quality; MODERATE |
| Participants | 6 physicians in a teaching unit<br>Country: Canada<br>Type of targeted behaviour: Compliance with guidelines (vaginitis and cystitis)<br>Complexity of targeted behaviour: MODERATE |
| Interventions | 1. A&F (moderate) on cystitis<br>2. Control (A&F (moderate) on vaginitis) |
| Outcomes | Compliance rate with standards for cystitis and vaginitis<br>Seriousness of outcome: MODERATE |
| Notes | |
| Allocation concealment | B – Unclear |

| **Study** | **O'Connell 1999** |
|---|---|
| Methods | Overall quality; HIGH |
| Participants | 2440 general practitioners<br>Country: Australia<br>Type of targeted behaviour: Prescribing (five main drugs)<br>Complexity of targeted behaviour: MODERATE |
| Interventions | 1. A&F (moderate)<br>2. Control |
| Outcomes | Median prescribing rates for five drugs<br>Seriousness of outcome: LOW |
| Notes | |
| Allocation concealment | A – Adequate |

**Characteristics of included studies** (*Continued*)

| **Study** | **Palmer 1985** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 111 internists, 94 paediatricians, 343 residents and 163 non-physicians (mostly nurse practitioners), total = 711, in 16 primary care practices<br>Country: USA<br>Type of targeted behaviour: Compliance with guidelines (preventive services)<br>Complexity of targeted behaviour: VARIOUS |
| Interventions | 1. A&F (moderate) + educational meetings + written materials<br>2. Control |
| Outcomes | Various mean case-variant scores<br>arious mean case-variant scores<br>Seriousness of outcome: MODERATE |
| Notes | |
| Allocation concealment | A – Adequate |

| **Study** | **Pimlott 2003** |
|---|---|
| Methods | Overall quality; HIGH |
| Participants | 374 primary care physicians<br>Country: Canada<br>Type of targeted behaviour: Precribtions<br>Complexity of targeted behaviour: LOW<br>Seriousness: MODERATE |
| Interventions | 1. A&F (moderate)<br>2. Control |
| Outcomes | % long acting/total benzodiazepine prescriptions<br>Seriousness of outcome: MODERATE |
| Notes | |
| Allocation concealment | D – Not used |

| **Study** | **Quinley 2004** |
|---|---|
| Methods | Overall quality; HIGH |
| Participants | unclear number of primary care physicians<br>Country: USA<br>Type of targeted behaviour: Prevention (vaccination)<br>Complexity of targeted behaviour: LOW |

| | |
|---|---|
| | Seriousness:<br>MODERATE |
| Interventions | 1. A&F (moderate) + educational meettin + assistent<br>2.1. A&F (moderate) + educational meettin + assistent + telephone support |
| Outcomes | % physicians achieved at least a 5% increase in pneumococcal vaccine coverage<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | D – Not used |

| **Study** | **Raasch 2000** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 46 family physicians<br>Country: Australia<br>Type of targeted behaviour: General management of a problem (diagnosis and management of suspicious skin lesions)<br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. A&F (moderate)<br>2. Control |
| Outcomes | % correct clinical diagnosis for skin cancer<br>Seriousness of outcome:<br>HIGH |
| Notes | |
| Allocation concealment | A – Adequate |

| **Study** | **Rantz 2001** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 113 nursing facilities<br>Country. USA<br>Type of targeted behaviour: Prevention (vaccination)<br>Complexity of targeted behaviour:<br>HIGH<br>Seriousness:<br>HIGH |
| Interventions | 1. A&F (moderate) + educational meeting<br>2 Multifacted with A&F (moderate) + educational meeting + outreach<br>3. Control |
| Outcomes | 13 quality indicators scores in nursing homes<br>Seriousness of outcome:<br>MODERATE |
| Notes | |

| | |
|---|---|
| Allocation concealment | D – Not used |

| **Study** | **Reid 1977** |
|---|---|
| Methods | Overall quality;<br>LOW |
| Participants | 21 physicians (internal medicine)<br>Country: USA<br>Type of targeted behaviour: General management of a problem<br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. A&F (moderate)<br>2. Control |
| Outcomes | Number of services, costs, consultation time<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | B – Unclear |

| **Study** | **Robling 2002** |
|---|---|
| Methods | Factorial design<br>Overall quality; MODERATE |
| Participants | 39 general practices<br>Country. UK<br>Type of targeted behaviour: Test ordering (MRI)<br>Complexity of targeted behaviour:<br>MODERATE<br>Seriousness:<br>LOW |
| Interventions | 1. A&F (non-intensive)<br>2. Educational meeting<br>3. Multifacted with A&F (non-intensive) + educational meeting<br>4.Control |
| Outcomes | % compliance with guidelines for lumbar spine and knee MRI<br>Seriousness of outcome:<br>LOW |
| Notes | |
| Allocation concealment | D – Not used |

| **Study** | **Roski 1998** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 20 primary care practices<br>Country: USA |

**Characteristics of included studies** (*Continued*)

| | |
|---|---|
| | Type of targeted behaviour: Compliance with guidelines<br><br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. Multifacted with A&F<br>(A&F (non-intensive) + educational meetings (outreach) + incentives + free NRT)<br>Contribution of A&F:<br>MINOR<br><br>2. Control |
| Outcomes | % smoking status assessed<br><br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | A – Adequate |

| **Study** | **Ruangkanchanastr 19** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 18 physicians in pediatric out-patient hospital<br><br>Country: Thailand<br><br>Type of targeted behaviour: Tests<br>(laboratory)<br><br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. A&F (intensive) + seminar (didactic?)<br><br>2. Control |
| Outcomes | Mean number of lab tests ordered per patient by residents first year<br><br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | A – Adequate |

| **Study** | **Rust 1999** |
|---|---|
| Methods | Overall quality;<br>LOW |
| Participants | 32 physicians in a hospital based primary care clinic<br><br>Country: USA<br><br>Type of targeted behaviour: General management of a problem (immunization)<br><br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. A&F (moderate)<br><br>2 Control |
| Outcomes | Rates of immunisation<br><br>Seriousness of outcome:<br>MODERATE |

**Characteristics of included studies** (*Continued*)

| | |
|---|---|
| Notes | |
| Allocation concealment | B – Unclear |

| **Study** | **Sanazaro 1978** |
|---|---|
| Methods | Overall quality;<br>LOW |
| Participants | Physicians from 50 hospitals<br>Country: USA<br>Type of targeted behaviour: Compliance with guidelines (7 conditions)<br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. A&F (moderate) + local concensus + written materials<br>2. Control<br>Contribution of A&F:<br>MAJOR |
| Outcomes | Adherence to treatment criteria<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | C – Inadequate |

| **Study** | **Sandbaek 1999** |
|---|---|
| Methods | Overall quality;<br>LOW |
| Participants | 133 physicians from general practice<br>Country: Denmark<br>Type of targeted behaviour: Preventive care (AIDS)<br>Complexity of targeted behaviour:<br>LOW |
| Interventions | 1. Multifacted with A&F (A&F (moderate) + educational meetings + written materials + reminders)<br>Contribution of A&F:<br>2. Control |
| Outcomes | % advised about AIDS<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | B – Unclear |

| **Study** | **Sauaia 2000** |
|---|---|
| Methods | Overall quality;<br>HIGH |
| Participants | Unclear numbers of physicians from 20 hospitals<br>Country: USA |

**Characteristics of included studies** (*Continued*)

| | |
|---|---|
| | Type of targeted behaviour: General management of a problem (acute myocardial infarction)<br><br>Complexity of targeted behaviour:<br>HIGH<br><br>Seriousness:<br>HIGH |
| Interventions | 1. A&F (non-intensive)<br><br>2. Multifacted with A&F (moderate)+ opinion leader + support |
| Outcomes | Quality indicators for AMI<br><br>Seriousness of outcome:<br>HIGH |
| Notes | |
| Allocation concealment | D – Not used |

| **Study** | **Schectman 1995** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 63 internists and family physicians<br><br>Country: USA<br><br>Type of targeted behaviour: Prescribing<br>(increase use of cimetidine over other histamine 2 receptor blockers)<br><br>Complexity of targeted behaviour: LOW |
| Interventions | 1. A&F (non-intensive) + written materials<br><br>2. Written materials |
| Outcomes | % of H2 blockers persecribed that are cimetidine<br><br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | B – Unclear |

| **Study** | **Schectman 2003** |
|---|---|
| Methods | Factorail design<br><br>Overall quality;<br>MODERATE |
| Participants | 85 pysicians from 14 practices<br><br>Country: USA<br><br>Type of targeted behaviour: Compliance with guidelines (low back pain)<br><br>Complexity of targeted behaviour:<br>MODERATE<br><br>Seriousness:<br>MODERATE<br><br>% influenza and pneumococcal vaccination uptake |
| Interventions | 1. Multifacted with A&F + educational meeting + opinion leader<br><br>2. Patient pamplet + video |

| | |
|---|---|
| | 3. 1+2<br>4. Control |
| Outcomes | % compliance with guidelines for low back pain<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | D – Not used |

| **Study** | **Simon 2000** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 613 patients<br>Country: USA<br>Type of targeted behaviour: General management of a problem (depression)<br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. A&F (moderate)<br>2. A&F + care management for patients |
| Outcomes | Costs<br>Frequency of follow-up visits<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | A – Adequate |

| **Study** | **Sinclair 1982** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 4 units from a child and family clinic<br>Country: Canada<br>Type of targeted behaviour: General management of a problem (child mental health)<br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. A&F (moderate) + educational meetings<br>2. Control |
| Outcomes | Mean score for overall quality of care for pediatric mental health<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | B – Unclear |

| **Study** | **Siriwardena 2002** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | Unclear number of physicians from 30 practices |

| | |
|---|---|
| | Country: USA<br>Type of targeted behaviour: Prevention (vaccination)<br>Complexity of targeted behaviour: MODERATE<br>Seriousness: MODERATE |
| Interventions | 1. Multifacted with A&F (moderate) + outreach<br>2. A&F (non-intensive) |
| Outcomes | % influenza and pneumococcal vaccination uptake<br>Seriousness of outcome: MODERATE |
| Notes | |
| Allocation concealment | D – Not used |

| **Study** | **Smith 1995** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 9 obstetricians and 26 midwives<br>Country: UK<br>Type of targeted behaviour: Screening<br>Complexity of targeted behaviour: MODERATE |
| Interventions | 1. A&F (moderate) + educational meetings + written materials<br>2. Educational meetings + written materials<br>3. Control |
| Outcomes | Mean score for information-giving and communication skills (mean of two outcomes)<br>Seriousness of outcome: MODERATE |
| Notes | |
| Allocation concealment | A – Adequate |

| **Study** | **Smith 1998** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 222 physicains<br>Country: USA<br>Type of targeted behaviour: Prescribing (drug use)<br>Complexity of targeted behaviour: MODERATE |
| Interventions | 1. A&F (moderate) + written materials<br>2. Control |
| Outcomes | Median drug use for sedative hypnotic medications (median of three outcomes) |

| | |
|---|---|
| | Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | B – Unclear |

| **Study** | **Socolar 1998** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 147 physicians<br>Country: USA<br>Type of targeted behaviour: General management of a problem (evaluation for child sexual abuse)<br>Complexity of targeted behaviour:<br>LOW |
| Interventions | 1. A&F (moderate) + written materials<br>2. Control<br>n/a |
| Outcomes | Documentation and knowledge of child sexual abuse<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | A – Adequate |

| **Study** | **Sommers 1984** |
|---|---|
| Methods | Overall quality;<br>LOW |
| Participants | 103 physicians from 4 hospitals<br>Country: USA<br>Type of targeted behaviour: Compliance with guidelines<br>(anemia)<br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | Phase 1<br>1. A&F (moderate) + local consensus process<br>2. A&F (moderate)<br>3. Control<br>Phase 2<br>all 3 groups received concurrent reminders for care (no control group)<br>Contribution of A&F:<br>MAJOR |
| Outcomes | Compliance with criteria for anaemia<br>Seriousness of outcome:<br>MODERATE |
| Notes | |

| | |
|---|---|
| Allocation concealment | B – Unclear |

| **Study** | **Soumerai 1998** |
|---|---|
| Methods | Overall quality;<br>HIGH |
| Participants | 772 physicians from 37 community hospitals<br>Country: USA<br>Type of targeted behaviour: Prescribing for patients with acute myocardial infarction<br>Complexity of targeted behaviour:<br>LOW |
| Interventions | 1. Multifacted with A&F (low) + opinion leaders<br>2. A&F |
| Outcomes | % patients with acute myocardial infarction receiving study drugs<br>Seriousness of outcome:<br>HIGH |
| Notes | |
| Allocation concealment | A – Adequate |

| **Study** | **Steele 1989** |
|---|---|
| Methods | Overall quality;<br>MODERATE |
| Participants | |
| Interventions | |
| Outcomes | Seriousness of outcome:<br>LOW |
| Notes | |
| Allocation concealment | D – Not used |

| **Study** | **Søndergaard 2002** |
|---|---|
| Methods | Overall quality;<br>HIGH |
| Participants | 292 general practitioners from 178 practices<br>Country: Danemark<br>Type of targeted behaviour: Prescribtion for asthma<br>Complexity of targeted behaviour:<br>LOW<br>Seriousness:<br>LOW |
| Interventions | 1. A&F (feedback about individual patients)<br>2. A&F (feedback with aggegated data plus peer comparison)<br>3. Control<br>(guidelines) |
| Outcomes | % asthmatic patients treated with inhaled steroids |

| | |
|---|---|
| | Seriousness of outcome:<br>LOW |
| Notes | |
| Allocation concealment | D – Not used |

| **Study** | **Søndergaard 2003** |
|---|---|
| Methods | Overall quality;<br>HIGH |
| Participants | 299 general practitioners from 181 practices<br><br>Country: Danemark<br><br>Type of targeted behaviour: Prescribtion for asthma<br><br>Complexity of targeted behaviour:<br>LOW<br><br>Seriousness:<br>LOW |
| Interventions | 1. A&F<br><br>2. Control (guidelines) |
| Outcomes | % prescribtions for narrow-spectrum penicillins<br><br>Seriousness of outcome:<br>LOW |
| Notes | |
| Allocation concealment | D – Not used |

| **Study** | **Thompson 2000** |
|---|---|
| Methods | Overall quality;<br>HIGH |
| Participants | 179 members of adult care teams (physcians, nurses and other members) from 5 primary care clinics<br><br>Country: USA<br><br>Type of targeted behaviour: Compliance with guidelines (domestic violence)<br><br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. Multifacted with A&F<br>(A&F (non-intensive) + educational meetings+ written materials + phys prompts + patient prompts + opinion leaders)<br>Contribution of A&F:<br>MINOR<br><br>2. Control |
| Outcomes | % asked about domestic violence<br><br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | A – Adequate |

**Characteristics of included studies** (*Continued*)

| **Study** | **Tierney 1986** |
|---|---|
| Methods | Balanced incomplete block<br>Overall quality; MODERATE |
| Participants | 135 physicians (residents) from 4 hospital clinics<br>Country: USA<br>Type of targeted behaviour: Preventive care<br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 2x2 design<br>1. A&F (moderate)<br>2. Reminders<br>Contribution of A&F:<br>MODERATE |
| Outcomes | % patients who received preventive care according to guidelines<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | B – Unclear |

| **Study** | **Veninga 1999** |
|---|---|
| Methods | Balanced incomplete block<br>Overall quality;<br>MODERATE |
| Participants | 565 physicians from general practice<br>Country: Netherlands, Sweden, Norway and SK<br>Type of targeted behaviour: General management of a problem<br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. A&F (moderate) on asthma + educational meetings<br>2. A&F (moderate) on UTI +educational meetings |
| Outcomes | % correct prescribing for asthma<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | B – Unclear |

| **Study** | **Verstappen 2003** |
|---|---|
| Methods | Balanced incomplete block<br>Overall quality;<br>HIGH |
| Participants | 174 primary care physicians from 26 practices<br>Country: The Netherlands |

**Characteristics of included studies** (*Continued*)

| | |
|---|---|
| | Type of targeted behaviour: Test ordering<br><br>Complexity of targeted behaviour:<br>LOW<br><br>Seriousness:<br>LOW |
| Interventions | IBD<br>1. Multifacted with A&F (moderate) + educational meeting + discussions<br><br>2. Control |
| Outcomes | mean number of inappropriate tests, per physician per 6 months<br><br>Seriousness of outcome:<br>HIGH |
| Notes | |
| Allocation concealment | D – Not used |

| **Study** | **Vingerhoets 2001** |
|---|---|
| Methods | Overall quality;<br>HIGH |
| Participants | 55 physicians from 43 practices<br><br>Country: The Netherlands<br><br>Type of targeted behaviour: Patient evaluation<br><br>Complexity of targeted behaviour:<br>HIGH<br><br>Seriousness:<br>LOW |
| Interventions | 1. A&F (moderate)<br><br>2. Control |
| Outcomes | patients evaluations of general practice<br><br>Seriousness of outcome:<br>LOW |
| Notes | |
| Allocation concealment | D – Not used |

| **Study** | **Vinicor 1987** |
|---|---|
| Methods | Overall quality;<br>LOW |
| Participants | 86 physicians (residents) from 1 clinic in 1 hospital<br><br>Country: USA<br><br>Type of targeted behaviour: General management of a problem (diabetes)<br><br>Complexity of targeted behaviour:<br>HIGH |
| Interventions | 1. Physician education; Multifacted with A&F (A&F (intensive) + reminders + patient mediated intervention + consultation facility + educational meetings + written materials + hotline)<br>Contribution of A&F:<br>MODERATE |

| | |
|---|---|
| | 2. Patient education;<br>Contribution of A&F:<br>MINOR<br><br>3. Physician and patient education<br><br>4. Control |
| Outcomes | Fasting plasma glucose<br>Glycosylated haemoglobin (Ahgb) 2 hour post prandial glucose<br>Weight<br>Systolic and diastolic blood pressure<br><br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | B – Unclear |

| **Study** | **Wahlström 2003** |
|---|---|
| Methods | Overall quality;<br>MODERATE |
| Participants | 122 health professionals from 24 hospital departements<br><br>Country: Lao<br><br>Type of targeted behaviour: General management of a problem (diabetes)<br><br>Complexity of targeted behaviour:<br>MODERATE<br><br>Seriousness:<br>HIGH |
| Interventions | 1. A&F + educational meeting<br><br>2. Control |
| Outcomes | Mean performence score for malaria, diarrhoea and pneumonia<br><br>Seriousness of outcome:<br>HIGH |
| Notes | |
| Allocation concealment | D – Not used |

| **Study** | **Ward 1996** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 139 physicians from general practice<br><br>Country: Australia<br><br>Type of targeted behaviour: General management of a problem (diabetes)<br><br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. A&F (moderate)<br><br>2. A&F (moderate) + educational meeting (outreach) by peer<br><br>3. A&F (moderate) + educational meeting (outreach) by nurse |
| Outcomes | Adequate competent care score for diabetes |

| | |
|---|---|
| | Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | B – Unclear |

| **Study** | **Wells 2000** |
|---|---|
| Methods | Overall quality;<br>HIGH |
| Participants | 181 physicians from 46 primary care practices<br><br>Country: USA<br><br>Type of targeted behaviour: General management of a problem (depression)<br><br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. Multifacted with A&F (A&F (moderate) + opinion leaders + educational meetings (outreach) + written materals) +phys prompts in medication<br>Contribution of A&F:<br>MODERATE<br><br>2. Multifacted with A&F (A&F (moderate) + opinion leaders + educational meetings (outreach) + written materals) + phys prompts in CBT<br>Contribution of A&F:<br>MODERATE<br><br>3. Control |
| Outcomes | % overall appropriate care for depression<br><br>Seriousness of outcome:<br>HIGH |
| Notes | |
| Allocation concealment | A – Adequate |

| **Study** | **Winickoff 1984** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 16 physicians from 1 practice<br><br>Country: USA<br><br>Type of targeted behaviour: Screening for colorectal cancer<br><br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. A&F (moderate)<br><br>2. Control |
| Outcomes | % screened for colorectal cancer<br><br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | B – Unclear |

**Characteristics of included studies** (*Continued*)

| **Study** | **Winickoff 1985** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 32 physicians and nurses from 16 practices<br>Country: USA<br>Type of targeted behaviour: Compliance with guidelines (hypertension)<br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1.Multifacted with A&F<br>(A&F (moderate) + reminders )<br>Contribution of A&F:<br>2. Control |
| Outcomes | % patients with controlled blood pressure<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | B – Unclear |

| **Study** | **Winkens 1995** |
|---|---|
| Methods | Balanced incomplete block<br>Overall quality;<br>LOW |
| Participants | 79 family physcians<br>Country: Netherlands<br>Type of targeted behaviour: Test ordering<br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. A&F (intensive) for one set of tests<br>2. A&F (intensive) for a second set of tests |
| Outcomes | Mean number of test requests per physician according to guideline<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | B – Unclear |

| **Study** | **Wones 1987** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 21 physicians (residents) from unclear number of practices<br>Country: USA<br>Type of targeted behaviour: Lab tests<br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. A&F peer (moderate) |

| | |
|---|---|
| | 2. A&F without peer (moderate)<br>3. Control |
| Outcomes | Charges per patient day<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | B – Unclear |

| **Study** | **Young 2002** |
|---|---|
| Methods | Balanced incomplete block<br>Overall quality; MODERATE |
| Participants | 60 family physicians from 39 practices<br>Country: Australia<br>Type of targeted behaviour: Prevention<br>Complexity of targeted behaviour:<br>LOW<br>Seriousness:<br>MODERATE |
| Interventions | IBD<br>1. Multifacted with A&F (moderate) + prompts + educational meeting<br>2. Control |
| Outcomes | % Patients recall of a question about their smoking status<br>Patients asked about cervical screening<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | D – Not used |

| **Study** | **Zwar 1999** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 157 physicians from general practice<br>Country: Australia<br>Type of targeted behaviour: Prescribing<br>(antibiotic)<br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. A&F (moderate) + educational meetings + written materials on URT<br>2. A&F (moderate) + educational meetings + written materials on benzdiazepines |
| Outcomes | Antibiotic prescriptions for upper respiratory infections per 100 diagnosis<br>Seriousness of outcome:<br>MODERATE |
| Notes | |

| | |
|---|---|
| Allocation concealment | B – Unclear |

| **Study** | **van den Hombergh 99** |
|---|---|
| Methods | Overall quality; MODERATE |
| Participants | 90 physicians from 68 practices<br>Country: Netherlands<br>Type of targeted behaviour: General management of a problem<br>Complexity of targeted behaviour:<br>HIGH |
| Interventions | 1. A&F by peer (moderate)<br>2. A&F by non-physician observer (moderate) |
| Outcomes | 208 indicators of practice management<br>Seriousness of outcome:<br>HIGH |
| Notes | |
| Allocation concealment | B – Unclear |

| **Study** | **van der Weijden 1999** |
|---|---|
| Methods | Overall quality;<br>LOW |
| Participants | 32 physicians from general practice<br>Country: Netherlands<br>Type of targeted behaviour: Compliance with guidelines (cholesterol)<br>Complexity of targeted behaviour:<br>MODERATE |
| Interventions | 1. Multifacted with A&F (A&F (moderate) + educational meetings (outreach) + opinion leaders + written materials)<br>Contribution of A&F:<br>MINOR<br>2. Written materials |
| Outcomes | OR for Appropriate cholesterol case finding<br>Seriousness of outcome:<br>MODERATE |
| Notes | |
| Allocation concealment | A – Adequate |

## Characteristics of excluded studies

| **Study** | **Reason for exclusion** |
|---|---|
| Anonymous I 1990 | Not audit and feedback |
| Ballard 2002 | Not RCT |
| Berwick 1986 | Randomisation not specified |

| | |
|---|---|
| Billi 1987 | Not audit and feedback |
| Brown 1988 | Not RCT |
| Buekens 1993 | Not RCT |
| Carney 1992 | Not feedback on performence |
| De Silva 1994 | Outcome was based on self-report |
| Del Mar 1998 | Not audit and feedback |
| Denton 2001 | Not RCT |
| Dranitsaris 1995 | Not feedback |
| Everett | Insufficient data on results |
| Fihn 2004 | Outcome not professional practice or patient outcome |
| Furniss 2000 | Not feedback |
| Gask 1991 | Outcome was teaching interviewing skills to medical students; feedback did not include audit |
| Gerbert 1988 | Not RCT |
| Goldberg 1980 | Not audit and feedback |
| Grimshaw 1998 | Insufficient data on results |
| Gunn 2003 | Not RCT |
| Hall 2001 | Not audit and feedback |
| Hampshire 1999 | Insufficient data on results |
| Hanlon 1996 | Not audit and feedback |
| Hargraves 1996 | Not audit and feedback |
| Hershey 1988 | No appropriate comparison |
| Hetlevik 1998 | Not feedback |
| Horowitz 1996 | |
| Johansen 1997 | Not audit and feedback |
| Johnson 1976 | Not audit or summery of performence |
| Kroenke 1990 | Not RCT |
| Linn 1980 | Not audit and feedback |
| MacCosbe 1985 | Not audit and feedback |
| Mandel 1985 | Missing results |
| Mazzuca 1988 | Not audit and feedback |
| McDermott 2003 | Insufficient data on result |
| McDonel 1997 | Not feedback |
| McPhee 1989 | Insufficient data on result |
| Munroe 1997 | Not RCT |
| Nattinger 1989 | Non-equivalent group design with pre-post measures |
| North of England1992 | Missing results |
| Ogwal-Okeng 2001 | Insufficient data on results |
| Ottolini 1998 | Not audit and feedback |
| Pearson 2001 | Not RCT, not feedback |
| Putnam 1985 | Insufficient data on results |
| Restuccia 1982 | Intervention did not include audit |
| Rollman 2002 | Not audit and feedback |
| Rubenstein 1989 | Not feedback on performence |
| Rubenstein 1999 | Not feedback |

**Characteristics of excluded studies** (*Continued*)

| | |
|---|---|
| Shaughnessy 1991 | Not audit, no summery of performence |
| Spector 1989 | Intervention was a federal survey process |
| Szczepura 1994 | Missing results |
| Taylor 1997 | Not RCT |
| The SUPPORT 1995 | No feedback on performence |
| Velikova 2004 | Not audit and feedback |
| Weingarten 2000 | |
| White 1995 | Not feedback on performence |
| Wing 1987 | Not audit and feedback |
| Wing 1987 (II) | Not audit and feedback |
| Winkens 1997 | Insufficient data on results |

## ADDITIONAL TABLES

**Table 01. Quality of included trials**

| Study | Concealment of allo | Follow-up prof | Follow-up pat | Blinded ass prim out | Baseline measurement | Reliable prim outcom | Prot of contamin | Summary |
|---|---|---|---|---|---|---|---|---|
| Anderson 1994 | DONE | DONE | NA | NOT CLEAR | NOT DONE | DONE | DONE | MODERATE |
| Anderson 1996 | NOT DONE | NOT DONE | NA | DONE | DONE | NOT CLEAR | NOT CLEAR | LOW |
| Baker 1997 | DONE | DONE | NA | NOT DONE | DONE | DONE | DONE | MODERATE |
| Baker | DONE | DONE | NA | NOT CLEAR | NOT CLEAR | NOT CLEAR | DONE | MODERATE |
| Baker | DONE | DONE | NA | DONE | DONE | DONE | DONE | HIGH |
| Balas 1998 | DONE | DONE | NOT CLEAR | DONE | NOT CLEAR | NOT CLEAR | NOT CLEAR | MODERATE |
| Belcher 1990 | DONE | NOT CLEAR | NOT DONE | DONE | NOT CLEAR | DONE | NOT CLEAR | MODERATE |
| Berman 1999 | NOT CLEAR | NOT CLEAR | NA | NOT CLEAR | NOT DONE | NOT CLEAR | NOT CLEAR | LOW |
| Boekeloo 1990 | DONE | NOT CLEAR | NA | NOT CLEAR | NOT DONE | NOT CLEAR | NOT CLEAR | LOW |
| Bonevski 1999 | NOT CLEAR | DONE | NA | DONE | NOT DONE | NOT CLEAR | NOT CLEAR | MODERATE |
| Borgiel 1999 | DONE | DONE | NA | NOT CLEAR | DONE | NOT CLEAR | NOT CLEAR | MODERATE |
| Brady 1988 | DONE | DONE | NA | NOT CLEAR | NOT DONE | NOT CLEAR | NOT CLEAR | MODERATE |

**Table 01. Quality of included trials** (*Continued*)

| Study | Concealment of allo | Follow-up prof | Follow-up pat | Blinded ass prim out | Baseline measurement | Reliable prim outcom | Prot of contamin | Summary |
|---|---|---|---|---|---|---|---|---|
| Brown 1994 | DONE | DONE | NA | NOT CLEAR | NOT DONE | NOT CLEAR | DONE | MODERATE |
| Buffington 1991 | DONE | DONE | NA | NOT DONE | NOT DONE | NOT DONE | NOT CLEAR | MODERATE |
| Buntinx 1993 | NOT CLEAR | DONE | NA | DONE | DONE | NOT DONE | NOT CLEAR | MODERATE |
| Chassin 1986 | DONE | NOT CLEAR | NA | NOT CLEAR | NOT CLEAR | DONE | DONE | MODERATE |
| Cohen 1982 | DONE | NOT CLEAR | DONE | NOT CLEAR | DONE | NOT CLEAR | DONE | MODERATE |
| De Almeida Neto 2000 | NOT CLEAR | DONE | NA | NOT CLEAR | DONE | NOT CLEAR | DONE | MODERATE |
| Dickinson 1981 | DONE | NOT CLEAR | DONE | NOT CLEAR | NOT CLEAR | NOT CLEAR | DONE | MODERATE |
| Eccles | DONE | DONE | NA | DONE | NOT DONE | DONE | DONE | MODERATE |
| Everett 1983 | NOT CLEAR | DONE | NA | NOT CLEAR | NOT CLEAR | NOT CLEAR | NOT CLEAR | LOW |
| Fairbrother 1999 | NOT CLEAR | DONE | NA | DONE | NOT DONE | NOT CLEAR | DONE | MODERATE |
| Fallowfield | NOT CLEAR | DONE | NA | DONE | NOT CLEAR | NOT CLEAR | NOT CLEAR | MODERATE |
| Feder 1995 | NOT CLEAR | DONE | NA | DONE | NOT CLEAR | NOT DONE | DONE | MODERATE |
| Feijiling | DONE | DONE | NA | NOT DONE | DONE | NOT CLEAR | DONE | MODERATE |
| Ferguson | DONE | DONE | DONE | DONE | DONE | DONE | DONE | HIGH |
| Finkenstein | DONE | DONE | DONE | DONE | NOT DONE | DONE | DONE | MODERATE |
| Gama 1991 | NOT CLEAR | DONE | NA | NOT CLEAR | NOT DONE | NOT CLEAR | NOT CLEAR | LOW |
| Gehlbach 1984 | DONE | NOT DONE | NA | DONE | DONE | DONE | NOT CLEAR | MODERATE |
| Goff | DONE | DONE | NA | DONE | DONE | DONE | DONE | HIGH |
| Goldberg 1998 | DONE | DONE | NA | NOT CLEAR | NOT CLEAR | NOT CLEAR | DONE | MODERATE |
| Grady 1997 | DONE | DONE | DONE | NOT CLEAR | DONE | NOT CLEAR | DONE | MODERATE |

**Table 01. Quality of included trials** (*Continued*)

| Study | Concealment of allo | Follow-up prof | Follow-up pat | Blinded ass prim out | Baseline measurement | Reliable prim outcom | Prot of contamin | Summary |
|---|---|---|---|---|---|---|---|---|
| Guadagnoli | DONE | DONE | NA | NOT CLEAR | DONE | NOT CLEAR | DONE | MODERATE |
| Guillion 1988 | NOT CLEAR | NOT CLEAR | NOT CLEAR | DONE | DONE | DONE | NOT CLEAR | MODERATE |
| Hemminiki 1992 | DONE | DONE | NA | DONE | NOT DONE | NOT CLEAR | DONE | MODERATE |
| Henderson | NOT CLEAR | NOT CLEAR | NOT CLEAR | NOT CLEAR | NOT DONE | NOT CLEAR | NOT CLEAR | LOW |
| Hendryx 1998 | DONE | DONE | NA | DONE | DONE | DONE | DONE | HIGH |
| Hershey 1986 | NOT CLEAR | NOT CLEAR | NA | DONE | DONE | DONE | DONE | MODERATE |
| Hillman 1998 | NOT CLEAR | DONE | NA | NOT CLEAR | DONE | NOT CLEAR | DONE | MODERATE |
| Hillman 1999 | DONE | DONE | NA | DONE | DONE | DONE | DONE | HIGH |
| Holm 1990 | NOT CLEAR | DONE | NA | NOT CLEAR | DONE | NOT CLEAR | DONE | MODERATE |
| Howe 1996 | NOT CLEAR | DONE | NA | NOT CLEAR | DONE | NOT CLEAR | NOT CLEAR | MODERATE |
| Hux 1999 | NOT CLEAR | NOT DONE | NA | DONE | DONE | DONE | DONE | MODERATE |
| Jones 1996 | NOT CLEAR | DONE | NA | NOT CLEAR | DONE | NOT CLEAR | DONE | MODERATE |
| Kafuko | DONE | DONE | NA | NOT CLEAR | DONE | NOT CLEAR | DONE | MODERATE |
| Kerry 2000 | DONE | NOT CLEAR | NA | DONE | NOT CLEAR | DONE | DONE | MODERATE |
| Kerse 1999 | DONE | DONE | DONE | DONE | DONE | NOT CLEAR | DONE | HIGH |
| Kim 1999 | NOT CLEAR | DONE | NOT CLEAR | DONE | DONE | NOT CLEAR | NOT CLEAR | MODERATE |
| Kinsinger 1998 | DONE | DONE | NA | DONE | DONE | NOT CLEAR | DONE | HIGH |
| Leviton 1999 | DONE | DONE | NOT CLEAR | DONE | DONE | NOT CLEAR | DONE | HIGH |
| Linn 1980 | DONE | DONE | NA | NOT CLEAR | NOT DONE | NOT CLEAR | DONE | MODERATE |
| Lobach | NOT | DONE | NA | DONE | DONE | NOT | DONE | MODER- |

**Table 01. Quality of included trials** (*Continued*)

| Study | Concealment of allo | Follow-up prof | Follow-up pat | Blinded ass prim out | Baseline measurement | Reliable prim outcom | Prot of contamin | Summary |
|---|---|---|---|---|---|---|---|---|
| 1996 | CLEAR | | | | | CLEAR | | ATE |
| Lomas 1991 | DONE | DONE | NA | NOT CLEAR | DONE | DONE | DONE | HIGH |
| Mainous 2000 | NOT CLEAR | DONE | NOT CLEAR | DONE | NOT CLEAR | NOT CLEAR | DONE | MODERATE |
| Manfredi 1998 | DONE | DONE | NA | DONE | NOT CLEAR | NOT CLEAR | DONE | HIGH |
| Manheim 1990 | NOT CLEAR | NOT CLEAR | NA | NOT CLEAR | NOT CLEAR | NOT CLEAR | NOT CLEAR | LOW |
| Martin 1980 | NOT CLEAR | NOT CLEAR | NA | NOT CLEAR | DONE | NOT CLEAR | NOT CLEAR | MODERATE |
| Marton 1985 | NOT CLEAR | DONE | NA | NOT CLEAR | DONE | NOT CLEAR | NOT CLEAR | MODERATE |
| Mayefsky 1993 | NOT CLEAR | DONE | NA | NOT CLEAR | DONE | DONE | NOT CLEAR | MODERATE |
| Mayer 1998 | DONE | NOT DONE | NA | DONE | DONE | NOT CLEAR | DONE | MODERATE |
| McAlister 1986 | DONE | DONE | NOT CLEAR | 3 | DONE | NOT DONE | NOT CLEAR | MODERATE |
| Mc Cartney 1997 | DONE | NOT CLEAR | NOT CLEAR | DONE | DONE | NOT CLEAR | DONE | MODERATE |
| McConnell | DONE | DONE | NA | DONE | NOT DONE | NOT CLEAR | NOT CLEAR | MODERATE |
| Meyer 1991 | DONE | NA | DONE | DONE | DONE | DONE | NOT DONE | MODERATE |
| Moongtui 2000 | DONE | NOT CLEAR | NA | NOT DONE | NOT CLEAR | DONE | DONE | MODERATE |
| Norton 1985 | NOT CLEAR | DONE | NA | DONE | NOT CLEAR | NOT CLEAR | NOT CLEAR | MODERATE |
| OConnell 1999 | DONE | NOT CLEAR | NA | DONE | DONE | DONE | DONE | HIGH |
| Palmer 1985 | DONE | DONE | NA | NOT CLEAR | NOT CLEAR | DONE | DONE | MODERATE |
| Raasch 2000 | DONE | DONE | NA | DONE | NOT DONE | NOT DONE | NOT CLEAR | MODERATE |
| Reid 1977 | NOT CLEAR | NOT CLEAR | NA | DONE | NOT CLEAR | NOT CLEAR | NOT CLEAR | LOW |
| Roski | DONE | NOT | NOT | NOT | NOT | NOT | DONE | MODER- |

**Table 01. Quality of included trials** (*Continued*)

| Study | Concealment of allo | Follow-up prof | Follow-up pat | Blinded ass prim out | Baseline measurement | Reliable prim outcom | Prot of contamin | Summary |
|---|---|---|---|---|---|---|---|---|
| | | CLEAR | DONE | CLEAR | CLEAR | CLEAR | | ATE |
| Runangkanchasnastr 1993 | DONE | NOT CLEAR | NA | DONE | DONE | NOT CLEAR | NOT CLEAR | MODERATE |
| Rust 1999 | NOT CLEAR | NOT CLEAR | NA | NOT DONE | DONE | NOT CLEAR | NOT CLEAR | LOW |
| Sanazaro 1978 | NOT DONE | NOT CLEAR | NOT CLEAR | NOT CLEAR | NOT CLEAR | DONE | DONE | LOW |
| Sandbaek 1999 | NOT CLEAR | DONE | NA | NOT DONE | NOT DONE | NOT CLEAR | NOT CLEAR | LOW |
| Scheetman 1995 | NOT CLEAR | DONE | NA | DONE | NOT CLEAR | DONE | NOT CLEAR | MODERATE |
| Simon 2000 | DONE | NA | DONE | DONE | DONE | NOT CLEAR | DONE | MODERATE |
| Sinclair 1982 | NOT CLEAR | DONE | NA | DONE | NOT CLEAR | NOT CLEAR | DONE | MODERATE |
| Smith 1995 | DONE | NOT CLEAR | NOT CLEAR | DONE | DONE | NOT CLEAR | DONE | MODERATE |
| Smith 1998 | NOT CLEAR | NOT DONE | NA | NOT CLEAR | NOT DONE | NOT CLEAR | NOT CLEAR | MODERATE |
| Socolar 1998 | DONE | NOT DONE | NA | DONE | DONE | DONE | DONE | MODERATE |
| Sommers 1984 | NOT CLEAR | NOT DONE | NA | NOT CLEAR | DONE | NOT CLEAR | NOT CLEAR | LOW |
| Thompson 2000 | DONE | DONE | NA | DONE | NOT CLEAR | DONE | DONE | HIGH |
| Tierney 1986 | NOT CLEAR | NOT CLEAR | NA | DONE | NOT CLEAR | DONE | NOT CLEAR | MODERATE |
| van der Homberg 1999 | NOT CLEAR | DONE | NA | NOT CLEAR | NOT CLEAR | NOT CLEAR | DONE | MODERATE |
| van der Weijden | DONE | DONE | NA | DONE | NOT CLEAR | NOT CLEAR | DONE | MODERATE |
| Veninga | NOT CLEAR | NOT CLEAR | NOT CLEAR | DONE | DONE | NOT CLEAR | DONE | MODERATE |
| Vinicor 1987 | NOT CLEAR | NOT CLEAR | NOT DONE | NOT DONE | NOT CLEAR | NOT CLEAR | NOT CLEAR | LOW |
| Ward 1996 | NOT | NOT | DONE | DONE | NOT | NOT | NOT | MODER- |

**Table 01. Quality of included trials** (*Continued*)

| Study | Conceal-ment of allo | Follow-up prof | Follow-up pat | Blinded ass prim out | Baseline measure-ment | Reliable prim outcom | Prot of contamin | Summary |
|---|---|---|---|---|---|---|---|---|
| | CLEAR | CLEAR | | | DONE | CLEAR | CLEAR | ATE |
| Wells 2000 | DONE | DONE | DONE | NOT CLEAR | DONE | NOT CLEAR | DONE | HIGH |
| Winicoff 1984 | NOT CLEAR | DONE | NA | DONE | DONE | DONE | NOT DONE | MODER-ATE |
| Winicoff 1985 | NOT CLEAR | NOT CLEAR | NOT CLEAR | DONE | DONE | DONE | NOT CLEAR | MODER-ATE |
| Wienkens 1995 | NOT CLEAR | DONE | NA | NOT DONE | NOT CLEAR | NOT CLEAR | NOT CLEAR | LOW |
| Wones 1987 | NOT CLEAR | DONE | NA | DONE | NOT CLEAR | DONE | NOT CLEAR | MODER-ATE |
| Zwar 1999 | NOT CLEAR | DONE | NA | NOT DONE | DONE | NOT CLEAR | NOT CLEAR | MODER-ATE |

## GRAPHS AND OTHER TABLES

This review has no analyses.

## INDEX TERMS

**Medical Subject Headings (MeSH)**

Education, Medical, Continuing; *Feedback, Psychological; Health Personnel [standards]; Health Services Research; Medical Audit; *Outcome Assessment (Health Care); Physician's Practice Patterns [*standards]; Professional Practice [*standards]

**MeSH check words**

Humans

## COVER SHEET

**Title** Audit and feedback: effects on professional practice and health care outcomes

**Authors** Jamtvedt G, Young JM, Kristoffersen DT, O'Brien MA, Oxman AD

**Contribution of author(s)** GJ, JY and ADO prepared the protocol. GJ and JY applied the inclusion criteria, assessed the quality and extracted the data for the included studies. DTK conducted the quantitative analyses. GJ, JY, and ADO conducted the qualitative analyses. GJ drafted the manuscript with input from JY and ADO. DTK and MAO provided comments on the manuscript. Cynthia Fraser conducted searches for the literature. MAO and ADO prepared the protocol for the first review and together with Nick Freemantle and Emma Harvey applied the inclusion criteria, assessed the quality and extracted the data for the included studies for the first version of this review.

**Issue protocol first published** 1996/3

| | |
|---|---|
| **Review first published** | 1998/1 |
| **Date of most recent amendment** | 17 May 2006 |
| **Date of most recent SUBSTANTIVE amendment** | 22 February 2006 |
| **What's New** | Thirty new studies have been included. The total number of included studies is now 118. Results from continuous outcomes are analysed quantitatively and correspond with the findings from dichotomous outcomes. Seriousness of outcome is assessed for all studies. The main findings of this review are consistent with the previous conclusion that the effectiveness of audit and feedback varies. When it is effective, it generally has small to moderate effects. The factors that we identified that predict when audit and feedback is most likely to be effective are low baseline adherence to recommended practice and high intensity of the feedback. |
| **Date new studies sought but none found** | Information not supplied by author |
| **Date new studies found but not yet included/excluded** | 22 February 2006 |
| **Date new studies found and included/excluded** | 22 February 2006 |
| **Date authors' conclusions section amended** | Information not supplied by author |
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| **DOI** | 10.1002/14651858.CD000259.pub2 |
| **Cochrane Library number** | CD000259 |
| **Editorial group** | Cochrane Effective Practice and Organisation of Care Group |
| **Editorial group code** | HM-EPOC |

**Figure 01. Adjusted RR versus Baseline ComplianceWeighted Regression Line IncludedOne Study Excluded**

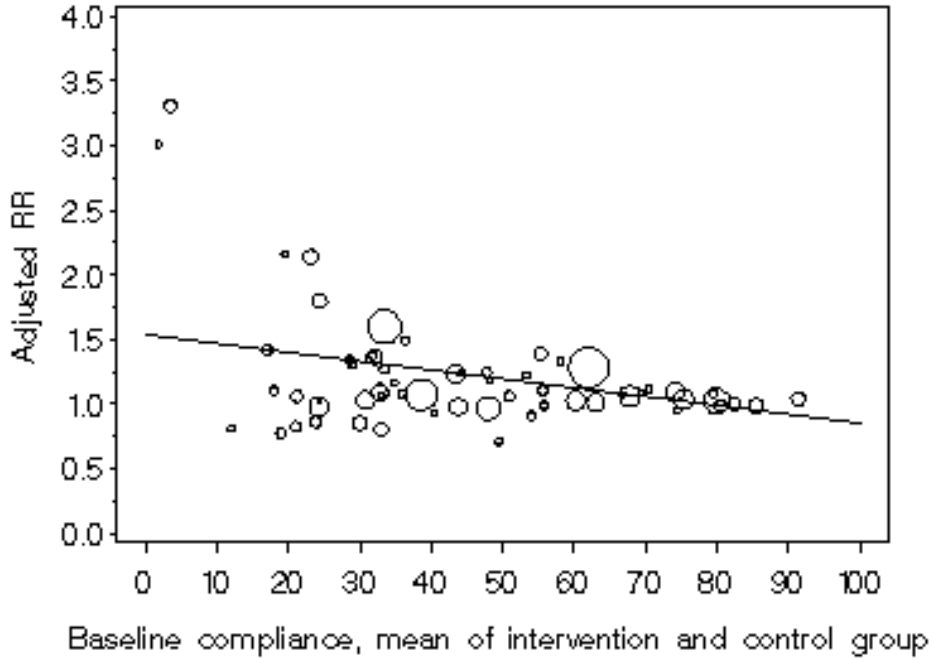

**Figure 02. Box Plot. Adjusted RR versus IntensityOne study excluded**

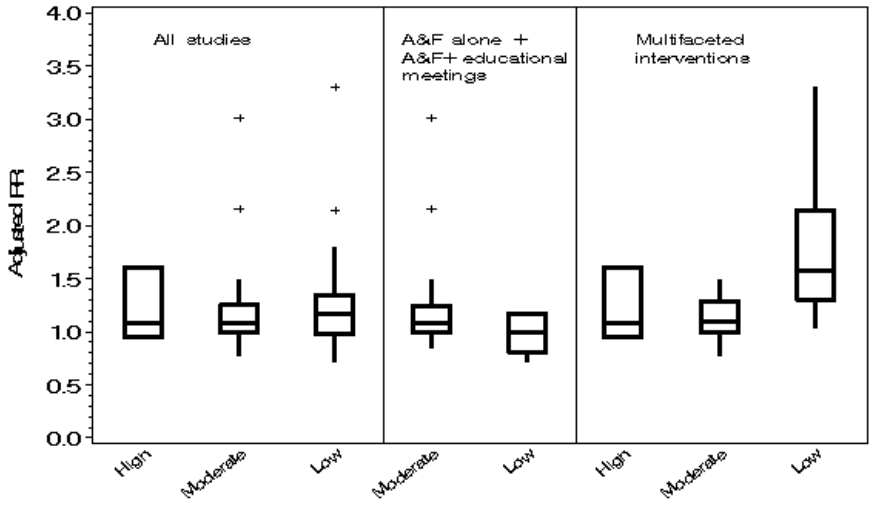

**Figure 03. Box Plot. Adjusted RD versus Intervention TypeOne study excluded**