Interventions to reduce unnecessary antibiotic prescribing: a systematic review and quantitative analysis

Ranji S R, Steinman M A, Shojania K G, Gonzales R

CRD summary

The authors concluded that antibiotic use in outpatients can be reduced by quality improvement strategies, but that further reductions could be achieved. Conclusions were based on generally poor quality and diverse studies and so may not be robust.

Authors' objectives

To evaluate the effectiveness of interventions aimed at reducing unnecessary antibiotic prescribing for acute nonbacterial illnesses in outpatient settings.

Searching

The Cochrane EPOC Register of trials was searched from 1966 to August 2005. Search terms were reported as being available online. In addition, MEDLINE was searched from June 2005 to March 2007 and reference lists of included studies were screened. Only English language reports were eligible.

Study selection

Randomised controlled trials (RCTs), controlled before-and-after studies and interrupted time series were eligible if they evaluated interventions aimed at reducing unnecessary antibiotic prescribing for acute nonbacterial illnesses in outpatient settings and reported data on antibiotic prescribing or antibiotic use before and after the intervention. Studies had to use one of the following six quality improvement strategies: clinician education; patient education; delayed prescriptions; audit and feedback; clinician reminder and decision support system; and financial and regulatory incentives or disincentives.

Studies included in quantitative analysis evaluated clinician education alone, patient education alone, combined patient and clinician education with and without audit and feedback and other quality improvement strategies alone or in combination (including audit and feedback, mass media, education of clinicians and patients, and decision-support systems). The primary quantitative review outcome was the proportion of patient visits at which an antibiotic was prescribed. Some studies assessed adverse effects/safety. Studies not included in the quantitative analysis evaluated community-based interventions and noncommunity-based interventions targeting clinicians and patients and delayed prescriptions. Most of the included studies were clustered studies, most were conducted in the United States or in Europe, most were set in outpatient primary care clinics and most focused on prescribing for patients with acute respiratory infections. Some studies included only children, others only adults and some included all patients.

Two reviewers independently selected studies.

Assessment of study quality

Studies included in the quantitative analysis were assessed for internal validity (methods used to assign treatment, blinding and analysis) and generalisability (documentation of inappropriate antibiotic prescribing, conditions targeted, type of control and prescribing data assessed by chart review). Two reviewers independently extracted validity data. Discrepancies were resolved through discussion with a third reviewer.

Data extraction

Two reviewers independently extracted data onto a standardised form. Discrepancies were resolved through discussion with a third reviewer. For each study included in the quantitative analysis, the baseline proportion of patients receiving antibiotics was presented for each intervention and control group together with the absolute reduction in the proportion of patients receiving antibiotics. For each intervention group, an effect size was calculated to measure the absolute change in the rate of antibiotic prescribing attributable to the intervention. Each intervention-control comparison in studies with multiple intervention arms was treated as a separate trial.

Methods of synthesis

Median effect sizes across all studies with characteristics of interest were calculated for studies reporting the proportion of eligible patients who received antibiotics (quantitative analysis); interquartile ranges were also reported. Nonparametric statistics were used to test differences between types of strategies and other study characteristics (baseline prescribing rate, sample size, study location, study population and target disease). Studies that did not present adequate quantitative data were combined in a narrative synthesis. Studies evaluating delayed prescribing were analysed separately.

Results of the review

Forty-three studies were included (n greater than 320,177). These included 22 RCTs (n greater than 47,873), three quasi-RCTs (n=4,076) and 19 controlled before-and-after studies (n greater than 268,228). One study was listed both as an RCT and as a controlled before-and-after study. These studies provided 55 separate comparisons.

The authors stated that the overall study quality was fair; most studies failed to meet most or all of the internal validity and generalisability criteria. Most of the included studies were clustered studies in which the unit of allocation differed from the unit of analysis. Only nine studies reported the number of clusters and only one study reported the intracluster correlation.

Quantitative analysis
The median reduction in the proportion of patients receiving antibiotics was 9.7 per cent (interquartile range 6.6 per cent to 13.7 per cent; 30 comparisons from 20 studies). No single quality improvement strategy appeared to be more effective than the others (p=0.85 for comparison across all strategies). Active clinician education strategies were associated with a non statistically significant decrease in antibiotic prescribing compared to passive education strategies (12.9 per cent versus 7.0 per cent, p=0.096).

Non quantitative analysis (18 comparisons from 16 studies): three of four studies of active clinician education plus mass media campaign and two large studies of active clinician education plus patient education were associated with significant reductions in antibiotic prescribing. Three trials evaluating reminders reported no reductions in prescribing.

Delayed prescriptions (seven studies): The median rate of antibiotic use was lower in intervention compared to control groups (37.5 per cent, interquartile range: 27.3 per cent to 39.7 per cent versus 75.0 per cent, interquartile range 62.3 per cent to 87.0 per cent, six studies, p not reported).

Cost information

The two studies that assessed costs of antibiotic prescribing both reported reduced prescribing costs in intervention groups (relative reductions were 18 per cent and 31 per cent). No formal cost-benefit analyses were performed.

Authors' conclusions

Antibiotic use in outpatients can be reduced by quality improvement strategies but further reductions could be achieved. Active clinician education strategies appeared more effective than passive strategies.

CRD commentary

The review question was clear and inclusion criteria were broadly but clearly defined. A database based on several relevant sources was searched initially, but limiting the updated search to English language studies listed in one database may have resulted in the omission of other studies and raised the potential of publication and language bias. Appropriate methods were used to minimise reviewer error and bias during the review process. Study validity was assessed using specified criteria, but describing the overall study quality as fair seemed rather optimistic when most studies failed to meet most or all of the quality criteria. In view of the heterogeneity among studies, a narrative synthesis was appropriate. Reporting overall median values may not have been appropriate since it failed to account for differences between studies. In addition, results were not discussed with reference to study design. The effect of various factors on results was examined. The conclusions were based on generally poor quality and diverse studies and may not be robust.

Implications of the review for practice and research

Practice: The authors did not state any implications for practice.

Research: The authors stated that there was a need for further research to evaluate the effect of quality improvement strategies on long-term prescribing practices, antimicrobial resistance patterns and potential harms. Cost-benefit analyses were also required. Future studies should directly compare quality improvement strategies and report the number of patients, clusters and the intracluster correlation coefficient.

Funding
Department of Veterans Affairs HSR&D Research Career Development Award; Government of Canada Research Chair in Patient Safety and Quality Improvement. The study was based on work contracted by Agency for Healthcare Research and Quality (contract non. 290-02-0017).

Bibliographic details
Ranji S R, Steinman M A, Shojania K G, Gonzales R. Interventions to reduce unnecessary antibiotic prescribing: a systematic review and quantitative analysis. Medical Care 2008; 46(8): 847-862

PubMedID
18665065

DOI
10.1097/MLR.0b013e318178eabd

Other publications of related interest
Ranji SR, Steinman MA, Shojania KG, Sundaram V, Lewis R, Arnold S, Gonzales R. Antibiotic Prescribing Behavior. Vol. 4 of: Shojania KG, McDonald KM, Wachter RM, Owens DK, editors. Closing the Quality Gap: A Critical Analysis of Quality Improvement Strategies. Technical Review 9 (Prepared by the Stanford University-UCSF Evidence-based Practice Center under Contract No. 290-02-0017). AHRQ Publication No. 04(06)-0051-4. Rockville MD; Agency for Healthcare Research and Quality. January 2006.

Indexing Status
Subject indexing assigned by NLM

MeSH
Ambulatory Care /statistics & numerical data; Anti-Bacterial Agents /administration & dosage; Drug Utilization /statistics & numerical data; Humans; Practice Patterns, Physicians'; Randomized Controlled Trials as Topic; United States

AccessionNumber
12008104791

Date bibliographic record published
03/11/2008

Date abstract record published
24/06/2009

Record Status
This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.