Evidence Summary Title:
Antibiotic prescribing practices in ambulatory care: Evidence and implications for public health

Review Quality Rating: 8 (strong)

Review on which this evidence summary is based:

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This is an evidence summary written to condense the work of the authors of this systematic review, referenced above. The intent of this summary is to provide an overview of the findings and implications of the full review. For more information on individual studies included in the review, please see the review itself.

Review content summary
The goal of this review was to evaluate the effectiveness of interventions designed to improve the selection, dose and treatment duration of antibiotics prescribed by primary care providers in the outpatient setting (e.g. walk-in clinic, private doctors’ offices); and to evaluate the impact of these interventions on reducing the incidence of antimicrobial resistant pathogens. Thirty-nine studies (including 25 RCTs) examined the effect of printed educational materials for physicians, audit and feedback, educational meetings, educational outreach visits, financial and healthcare system changes, physician reminders and patient-based interventions. Four studies assessed the effectiveness of printed educational materials with mixed results. Educational meetings were effective, while lectures were not. Three RCTs employed prescription delay, showing that patients in the delayed arm were less likely to obtain their antibiotic prescriptions, however, only 2 of the 3 studies reported on clinical outcomes. Finally, using interventions in combination worked better than using one method alone. Review authors acknowledge the difficulty in generalizing results from these individual studies to generate widely applicable recommendations given variance between physicians and community norms. Patient-based interventions and physician reminders show promise but need additional research to determine their long-term effectiveness.

Comments on this review’s methodology
This study is methodologically strong. Medline and EMBASE were searched from inception, and both reference lists and the personal files of key informants were consulted. Two of the authors independently assessed each study’s methodological quality, and resolved disagreements through discussion. Most of the studies had methodological limitations, particularly failure to describe randomization methods and allocation concealment. Due to heterogeneity, studies were synthesized qualitatively based on intervention type. Conclusions, however, were not weighted by individual study quality. The difference in absolute change from baseline to follow-up was calculated along with the 95% confidence interval where possible, and summarized in tables. When baseline data were not available, results were expressed as the relative percentage change.

Why this issue is of interest to public health
The ineffectual use of antibiotics for viral infections and the excessive use of broad spectrum antibiotics is a global concern, as they have contributed to increasing rates of antimicrobial resistance (AMR). International public health authorities are urging countries to implement integrated AMR surveillance systems. Currently, there is no comprehensive national program for monitoring human antimicrobial use in Canada. The Canadian Integrated Program for Antimicrobial Resistance Surveillance and the Public Health Agency of Canada have been utilizing Intercontinental Medical Statistics Health data to quantify and describe antimicrobial drug consumption in humans. It is estimated that resistance adds between $40 to $52 million per year to direct and indirect health care expenditures in Canada. While multiple factors contribute to AMR, Health Canada has identified incorrect diagnosis and ineffective prescribing practices as a key cause of AMR. In Canada, one analysis demonstrated that 85% of outpatient antibiotic prescriptions for respiratory tract infections in children under the age of 5 years in one province were inappropriate. Another Canadian study followed 852 primary care physicians for their first 6-9 years in practice and found that international medical graduates, physicians with high-volume practices and those who were in practice longer were more likely to prescribe antibiotics inappropriately. Compared to other countries, Canada has the advantage of relatively low current levels of drug resistance. However, today’s relatively low prevalence and cost can create a false sense of security. A report prepared for the Canadian Committee on Antibiotic Resistance suggests that should drug resistance continue to increase in prevalence and rise from current Canadian levels to the higher levels presently reported in the United States, the added direct expense in Canadian hospitals would rise to more than $104-187 million.
## Evidence and implications

Evidence points are not weighted or ranked according to strength.

### What’s the evidence?

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<th>What’s the evidence?</th>
<th>Implications for practice and policy:</th>
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| 1. **Printed educational material vs. other intervention or controls** (4 studies)  
  Published or printed recommendations for clinical care, including clinical practice guidelines, audio-visual materials and electronic publications. The materials may have been delivered personally or through mass mailings.  
  1.1. The results of these studies are mixed with regard to the effectiveness of printed educational material to improve prescribing practices  
  1.1.1. Two studies reported the distribution of printed educational materials was not effective in changing prescribing behaviour as compared with other interventions or controls;  
  1.1.2. One study found a very small improvement in prescribing behaviour; and  
  1.1.3. One study reported those exposed to printed educational materials were significantly more likely than those receiving other interventions or nothing to change prescribing behaviour.  
| 1. **Printed educational material vs. other intervention or controls**  
  With the exception of one study conducted in Finland (with specific guidelines for specific antibiotics), education materials sent to physicians were not effective in changing physician prescribing behaviour.  
  1.1. Printed education materials should not be used as the sole intervention in a public health program aimed at improving antibiotic prescribing practices in ambulatory care settings  
  1.2. Programs that include the distribution of printed education material along with other interventions should undergo rigorous program evaluation to ascertain their effectiveness.  
  1.3. Program reports and publications should include detailed descriptions of all interventions. |

| 2. **Audit and feedback with or without other educational materials vs. other intervention or controls** (4 studies, 3 randomized controlled trials [RCTs], one controlled pre-post trial [CBA])  
  Audit and feedback material included: an explanation of the prescribing data, anonymous comparative data for other physicians or groups of physicians, or educational materials promoting more optimal prescribing practices.  
  2.1. The results of these studies were mixed.  
  2.1.1. Participants exposed to audit and feedback were no more or less likely to change their prescribing behaviours (1 RCT) or their use of first line antibiotics (1 CBA)  
  2.1.2. Participants exposed to the intervention prescribed antibiotics for shorter duration than did those in controls. (-7.7 defined daily doses [DDD]) (1 CBA)  
  2.1.3. One RCT found that physicians exposed to the intervention increased their prescribing of first-line antibiotics from baseline by 5.1% (p<0.01) as compared with those in control groups. This change was associated with a median cost saving of $3.32 per physician (p<0.002).  
  2.1.4. In one RCT, of participants exposed to the audit and feedback intervention alone or audit and feedback together with patient education materials, significantly fewer patients received antibiotics compared with controls (T=2.374, p<0.05). However, audit and feedback together with patient education materials were more effective in reducing the proportion of patients receiving antibiotics than audit and feedback alone.  
| 2. **Audit and feedback with or without other educational materials vs. other intervention or controls**  
  Audit and feedback should not be used as the sole intervention in a public health program aimed at improving antibiotic prescribing practices in ambulatory care settings. Instead, audit and feedback should be combined with printed educational materials to reduce the proportion of patients prescribed antibiotics.  
  2.1. Audit and feedback should not be used as the sole intervention in a public health program aimed at improving antibiotic prescribing practices in ambulatory care settings. Instead, audit and feedback should be combined with printed educational materials to reduce the proportion of patients prescribed antibiotics.  
  2.2. Due to the conflicting evidence such programs should undergo rigorous program evaluations to ascertain the effectiveness of this and other interventions and to add to the body of knowledge in this area.  
  2.3. Due to the lack of data on sustained effectiveness, long term studies are required. |

| 3. **Educational meetings vs other intervention or controls** (10 studies - 7 RCTs; 1 quasi-RCT, 2 CBA studies)  
  Educational meetings involved health care providers participating in conferences, lectures, workshops, or traineeships and included one or more of the following: audiovisual review of recommendations for appropriate prescribing practices for particular conditions or particular antibiotics, review of a clinical | 3. **Educational meetings vs other intervention or controls**  
  Educational meetings should not be the sole strategy used in public health programs that aim to change prescribing behaviour.  
  3.1. Educational meetings should not be the sole strategy used in public health programs that aim to change prescribing behaviour.  
  3.2. Educational sessions that are more interactive should be implemented as part of a multi-component program. |
practice guideline or other published recommendations, a combination of the two, and provision of audit and feedback. It excluded educational outreach visits.

3.1. **Treatment for Infections** (3 RCTs)

3.1.1. Proportion of patients (3 studies)

3.1.1.1. The proportion of participants in the intervention group who were prescribed first line antibiotics for urinary tract infections changed from 1.0% - 17% (p<0.001) as compared with controls (2 RCTs)

3.1.1.2. Modest reductions in the proportion of patients with viral upper respiratory infections who were prescribed an antibiotic were observed following physician exposure to group meetings targeting this behaviour in Mexico (-7.4% in one clinic type, -32.9% in the second clinic type)

3.1.2. Duration of antibiotic therapy (2 studies)

3.1.2.1. Patients of physicians attending educational meetings and receiving audit and feedback, had a 13.1% increase in being prescribed short-course first-line antibiotic therapy relative to those in controls (p<0.0001)(1 RCT)

3.1.2.2. A change in defined daily doses of antibiotics of -1.89 (p=0.05) was noted among participants attending educational meetings and exposed to audit and feedback (1 RCT)

3.2. **Overall antibiotic use in the developing countries** (4 RCTs)

3.2.1. The changes in the proportion of patients receiving an antibiotic compared with controls in these studies were -21.6%, -8.1%, -6.9%, & -6.7% for formal large group seminars and -13.7% for small, interactive discussion groups

3.2.2. Participants attending meetings with interactive components were significantly more likely to show desired changes in prescribing behaviour compared with controls

3.3. **Overall use of antibiotics in Great Britain** (2 studies)

3.3.1. No statistically significant intervention effect was noted for two studies: one using multiple small group meetings compared to controls and the other using small group interactive prescribing workshops compared to large, formal microbiology tutorials

4. **Educational outreach visits vs. other intervention or controls** (8 studies)

Educational outreach visits involve the use of a trained person (academic detailer) who meets with providers in their practice settings to give information with the intent of changing the providers’ practices. The information given may have included feedback on the performance of the provider(s).

Details in these studies were clinical or research pharmacists except for one study in which the effects of physician and pharmacist detailers were compared.

4.1. **Specific antibiotics** (3 RCTs, one CBA)

These studies examined the effect of academic detailing on prescribing of certain antibiotics considered contraindicated or overused by community physicians.

4.3. Such programs should undergo rigorous program evaluations to ascertain the effectiveness of this and other interventions and to add to the body of knowledge in this area.

4.4. Due to the lack of data on sustained effectiveness, long term studies are required

4. Educational outreach visits vs. other intervention or controls

4.1. Educational outreach visits should not be used as the sole intervention in a public health program aimed at improving antibiotic prescribing practices in ambulatory care settings

4.2. Programs that include educational outreach visits among multiple interventions should undergo rigorous program evaluations to ascertain the effectiveness of this and other interventions and to add to the body of knowledge in this area.

4.3. Program reports and publications should include a detailed description of the interventions implemented.
The results of these studies are mixed with regard to the effectiveness of educational outreach visits to improve prescribing practices.

4.1. Three studies reported statistically significant intervention effects to:

4.1.1. reduce the mean number of prescriptions for tetracycline (-6.4 prescriptions, p<0.05)

4.1.2. reduce the mean number of units of cephalaxin prescribed (-382, p=0.0006) using pharmacist detailers and printed educational materials

4.1.2. Two studies reported no significant intervention effect to:

4.1.2.1. reduce prescriptions of various oral and injectable antibiotics

4.1.2.2. reduce prescriptions for cephalaxin using pharmacist detailers alone

4.1.2.3. reduce prescriptions of contraindicated antibiotics and oral cephalosporins by physician detailers compared with controls

4.2. First-line antibiotics (2 RCTs, 1 CBA)
The results of these studies are mixed with regard to the effectiveness of educational outreach visits to improve prescribing practices for first-line antibiotics.

4.2.1. Significant treatment effects were noted in two studies.

4.2.2. One study (an RCT) did not report significant treatment effects (-3.3% for the median proportion of prescriptions for first-line agents).

4.3. Amoxicillin for acute otitis media (1 RCT) – no statistically significant treatment effect was noted.

5. Financial and healthcare system changes vs. other intervention or controls (2 studies – 1 time series, 1 controlled before/after study)
Financial interventions refer to methods of physician remuneration, patient-oriented approaches such as user fees and formularies.

5.1. In the time series study, the absolute change (change in study group minus change in control group) in average monthly prescriptions was -1441.5 and in number of prescriptions was -1532.24 (SE 88.10, p<0.001)

5.2. Regions that had undergone primary care reform prescribed fewer monthly packages of antibiotics compared with those regions that had not yet undergone reform (-454 monthly packages, 24.1%)

6. Reminders vs. other intervention and controls (3 RCTs)
Reminders involve patient or encounter-specific information provided verbally, on paper or on a computer screen, which is designed or intended to prompt a health professional to recall information. This would usually be encountered through their general education, in the medical records or through interactions with peers and so remind them to perform or avoid some action to aid individual patient care. Computer-aided decision support and drug dosage are included.

6.1. Physicians exposed to an online prescription writer that presented computer-based point-of-care evidence on the optimal duration of antibiotics for acute otitis media in children experienced a 44.43% increase in the proportion of short course prescriptions compared with the control group which experienced an increase of 10.48% (p=0.01) (1 RCT).

6.2. Physicians that were provided a score card and patient encounter form were almost twice as likely to prescribe compared with physicians that were provided a patient encounter form that required the physician to calculate a
sore throat score (OR 0.44, 95% CI 0.21 to 0.92). The card requiring calculation aimed to help determine the likelihood that a patient was suffering from streptococcal pharyngitis utilizing common signs and symptoms followed by management recommendations. (1RCT)

Physicians that received repeated prompts to use the same checklist and score were no more or less likely to reduce prescribing for sore throat with the intervention (OR=0.57, 95% CI 0.27 to 1.17).

7. Patient-based interventions vs. other intervention and controls (5 RCTs)
Patient-based interventions included patient educational materials with or without physician audit and feedback; a patient information leaflet regarding antibiotics for acute bronchitis; and the use of delayed prescriptions for infections where patients desired antibiotics but physicians did not feel antibiotics were necessary.

7.1. All 5 RCTs resulted in statistically significant intervention effects

7.1.1. In one RCT, while prescribing increased across all study groups, in those groups that received patient-based interventions, the proportion of children receiving antibiotics for viral upper respiratory infections was significantly reduced compared with controls (-9.9% for patient materials alone; -7.2% for patient materials plus physician audit and feedback).

7.1.2. Of patients who were seeking but did not require antibiotics, a smaller proportion of those who received patient-based educational material took antibiotics compared with controls (absolute difference in proportions= -15.2%) (1RCT)

7.1.3. A significantly smaller proportion of patients who received a prescription with instructions to delay filling obtained the prescription compared with those patients who were to fill the prescription immediately (absolute difference in proportion ranged from -45% to -74.5%) (3 studies). No adverse outcomes were reported related to the delay in prescriptions.

8. Multi-faceted interventions vs. other intervention or controls (7 studies – 4 CDC-sponsored [3 CBA, 1 RCT]; 1 RCT; 2 CBA)
These interventions generally employed physician education in a variety of forums as well as education of the patient or parent and the general public on the appropriate use of antibiotics. The public education message in these studies has focused on the individual and public health hazards of antibiotic overuse.

8.1. The 4 CDC-sponsored studies reported significant reductions in the inappropriate use of antibiotics for viral respiratory tract infections

8.2. Participants exposed to the multi-faceted intervention (treating women aged 16-55 years for a urinary tract infection) were significantly less likely to prescribe antibiotics than those from controls (same intervention with children over 3 years of age treated for sore throat). (p=0.032)

8.3. Participants exposed to multi-faceted interventions experienced a greater reduction in monthly prescription rates compared with the control receiving no intervention and limited intervention groups (education materials + audit and feedback). (p=0.02) (1 CBA)

8.4. Participants exposed to the multi-faceted intervention were no more or less likely to experience a change in prescribing practices for first line antibiotics (OR 1.02, 95%CI 0.99-1.06); but 60% more likely to experience a reduction of second line antibiotics (OR 1.40, 95%CI 1.02-1.96).
### Effect of any intervention vs. control on bacterial resistance

9. Three studies reported significant intervention effects for bacterial resistance reduction.

9.1. Participants who received an intervention were ½ as likely to experience bacterial resistance as compared with controls. The true treatment effect ranges from 0.4-0.5 times as likely (OR 0.05, 95% CI 0.4-0.5).

9.1.2. The proportion of pneumococcal isolates that were penicillin non-susceptible (with intermediate or full resistance) decreased from 41% to 29% in region A (intervention region) but did not significantly change in the control regions B and C (24% to 22%). However this effect was not sustained after 2 or 3 years.

9.1.3. Participants who received an intervention were no more or less likely to have penicillin resistance as compared with controls (OR 0.46, 95% CI 0.18-1.18).

9.2. Despite a reduction in antibiotic use the proportion of isolates resistant to penicillin did not change over the three years of the study (60% year 1, 74% year 2 and 71% year 3).

### Effect of delayed antibiotics vs. immediate antibiotics on resolution of patient symptoms

10. The results of the two studies are mixed with regard to the impact of delayed vs immediate antibiotics on patient symptoms.

10.1. Parents of children with otitis media who delayed antibiotics reported that symptoms resolved faster than those in control groups (Absolute difference -1.10 days, 95% CI -0.54 to -1.48; p< 0.01).

10.1.1. Parents in the control group reported fewer days of crying and sleep disturbance, and less paracetamol use as compared with the delayed antibiotic group.

10.1.2. There was no significant difference between group difference in mean pain scores, episodes of distress, or absence from school.

10.2. The second study reported no statistically significant intervention impact.

### Methodological issues with primary studies

11. Unit of analysis errors

11.2. Inadequate descriptions of interventions

11.3. Multiple targeted behaviours, settings, and interventions (making generalization difficult)

11.4. Lack of long term data

11.5. Lack of cost effectiveness data

### Cost benefit or cost-effectiveness information

12. One study performed an economic analysis reporting a cost saving from unsolicited mailed audit and feedback only.

### General Implications

- Multifaceted and more interactive interventions appear more effective than simple, single, passive interventions
- Multi-faceted interventions involving physicians, patient, and community education consistently produced moderate changes in prescribing behaviours
- A lack of long term effectiveness data was noted thus rigorous program evaluations and long term studies should be conducted
- Delayed prescriptions (asking patients to wait a few days before filling prescription) appears to be an effective strategy in reducing antibiotic use, is low cost to consumers and may address an underlying issue of patient pressure on physician to prescribe

**Legend:** CI – Confidence Interval; OR – Odds Ratio; RR – Relative Risk

**for definitions see the healthevidence.org glossary [http://www.healthevidence.org/glossary.aspx]**
References used to outline issue


Other quality reviews on this topic


Related links

- Canadian Antimicrobial Resistance Alliance (CAN-R) http://www.canr.info/
- Canadian Committee on Antibiotic Resistance http://www.ccar-ccra.com/
- Department of Microbiology, Mt. Sinai Hospital, Toronto, ON http://microbiology.mtsinai.on.ca/default.asp

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