EXTENDING THE CURE

POLICY RESPONSES TO THE GROWING THREAT OF ANTIBIOTIC RESISTANCE

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Is Physician Education Effective in Promoting Antibiotic Stewardship?

Inappropriate antibiotic prescribing in the United States is a common problem and imposes a significant cost on society in two ways. First, it increases the rate at which bacteria that are resistant to clinically important antibiotics emerge and spread both in hospitals and the community. And second, it comes in the way of the patient being treated for the true underlying cause of disease.

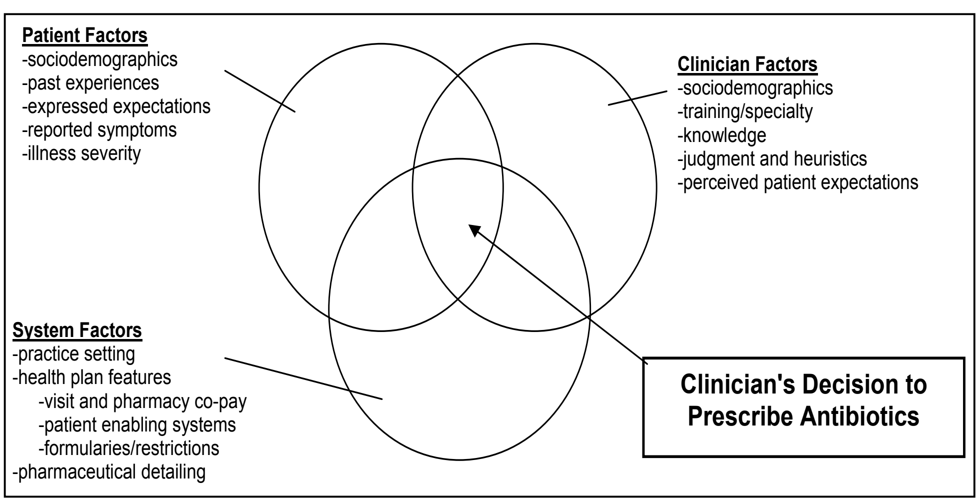
Interventions that target physicians' prescribing behavior involve education either alone or in combination with other strategies, in ambulatory care and inpatient hospital settings. This policy brief reviews the evidence on the effectiveness of clinician education interventions and suggests directions for future research.

Physician-Based Interventions

Educational interventions aim to modify both the doctor's decision to prescribe an antibiotic for a specific condition, and the doctor's choice of drug and drug regimen when antimicrobial therapy is deemed appropriate. Both goals are fitting given observed prescribing patterns. Between 40 to 50 percent of outpatients in the United States who seek medical attention for acute respiratory infections (ARIs) receive antibiotics even though most of these infections are viral and will not respond to antibiotic treatment (Steinman et al. 2009). Moreover, broad-spectrum antibiotics are often used when the patient could be treated using narrow-spectrum drugs that are less likely to contribute to the evolution of resistance across organisms. Between 1989 and 1999, extended-spectrum antibiotics were among the most common antibiotics prescribed to adults with pharyngitis, despite clinical recommendations to the contrary (Vega 2009).

Several factors influence a clinician's decision to prescribe antibiotics (Figure 1). Clinicians more likely to prescribe antibiotics inappropriately are less likely to be involved in medical teaching, have been in practice longer, and/or practice in rural locations with less access to current medical information (Steinke et al. 2000; O'Brien et al. 2007; Gonzales et al. 1999).

Figure 1. Factors affecting decision to prescribe antibiotics (AHRQ 2006)



Interventions include general clinician education, establishing financial and regulatory prescribing incentives and disincentives, and creating systems to encourage or mandate appropriate prescribing behavior, for example through audit and feedback systems, clinician reminders and decision support systems, compulsory order forms, and prescription review (AHRQ 2006; Davey et al. 2005). There is no standard intervention—the setting (inpatient vs. outpatient) and cultural and logistical barriers must be considered.

Clinician education can be characterized passive or active depending on whether or not it actively engages the clinician in the learning process (Table 1).

Findings on Effectiveness

Studies of the effectiveness of education interventions in changing practicing physicians' prescribing behaviors can help hospital administrators, educational providers, and policymakers determine the best strategies to reduce inappropriate antibiotic use. Several systematic reviews, listed in Table 2, have performed qualitative and quantitative analyses of the effectiveness of various educational strategies. Despite some methodological differences in the studies, their findings are generally consistent:

1. Interventions targeting physician education are moderately effective at reducing inappropriate prescribing of antibiotics (median absolute reduction: 8.9 to 9.7 percent) and improving the appropriate selection of antibiotics (median absolute improvement: 10.6 percent) (AHRQ 2006; Ranji et al. 2008).

2. No single strategy stands out as consistently more effective than the others, but education strategies that engage the physicians in the learning process and target a specific behavior are generally more effective than passive education strategies[1].

3. Combinations of strategies can be more effective in changing physician behavior than any one strategy. Interventions that incorporate both interactive meetings and didactic meetings are more effective (median adjusted absolute improvement: 13.6 percent) than those that use only one or the other (median adjusted absolute improvement: 6 percent) (Forsetlund et al. 2009).

Table 1. Educational strategies to promote appropriate use of antibiotics

Category	***Strategy***
Passive	Printed educational materials delivered to clinician by mail or electronically.
	Clinical practice guidelines handed out by hospital.
	Traditional continuing medical education (formal didactic lectures, seminars, and conferences).
	Educational courses.
Active	Discussion groups for health professionals working in same facility.
	Personal visit by trained health professional (educational outreach visits and academic detailing).
	Interactive role-playing, hands-on-training, problem and case solving, and educational workshops or conferences outside provider's setting.
	Sequenced education sessions (learn-work-learn).

[1] A meta-analysis of the effectiveness of continuing medical education (CME) showed that active methods had a medium effect on prescribing behavior (r = 0.33) while passive methods had a small effect (r = 0.20) (Mansouri and Lockyer 2007). A review of studies testing interventions that changed the proportion of visits at which patients were prescribed antibiotics in ambulatory care showed a median effect of 12.9 percent (interquartile range 8.1–19.2 percent) for active education interventions versus 7.0 percent (interquartile range 3.0–10.1 percent) for passive education interventions (Ranji et al. 2008). Other reviews, however, found that passive education interventions had no effect (Arnold and Straus 2005; Satterlee et al. 2008). r = correlation (Pearson correlation effect sizes: 0.10 = small, 0.24 = medium, and 0.37 = large)

A MULTIFACETED EDUCATION INTERVENTION (Finkelstein et al. 2001)

A study conducted December 1997 to November 1998, tested the effectiveness of an educational outreach intervention for both physicians and patients in outpatient settings, in decreasing antimicrobial drug prescribing in children.

METHODS: Twelve outpatient practices in eastern Massachusetts and western Washington were randomly assigned to intervention and control groups. Physicians in the intervention group received academic, evidence-based summaries and participated in 90-minute, small-group discussions of antibiotic resistance and ways to prevent antibiotic overuse, led by a trained practicing peer. Four months later, the peer leaders revisited the intervention sites to reinforce the recommendations for judicious use and reported on practitioner and practice-level antibiotic prescribing rates over the previous year.

Families in the intervention practices received CDC pamphlets designed to reduce parental demand for unnecessary antibiotics, with cover letters signed by their pediatrician. The messages were reinforced by other educational materials and posters in waiting and examining rooms.

RESULTS: The intervention sites achieved a 12 to 16 percent reduction in prescribing rates beyond the decrease in the control practices, compared with the previous year, and an absolute reduction of 0.23 and 0.13 fewer antibiotic courses per person-year for children aged 3–36 months and 36–72 months, respectively.

CONCLUSION: Interventions that target both physicians' and patients' behavior can reduce prescribing rates.

Limitations of Existing Research

Several limitations in the existing literature on physician education programs point to directions for future research.

1. Since the studies have short observation and follow-up periods, it is difficult to ascertain whether any observed improvements are sustained over time. Moreover, potential secondary effects, such as antimicrobial resistance levels in a health facility or region, cannot be observed. The use of interrupted time series analyses (with data from both before and after the intervention) is a recommended design for future hospital and ambulatory studies that require a longer follow-up period (Arnold and Straus 2005; Davey et al. 2005).

2. The cost-effectiveness of the strategies was not determined in most of the studies. The studies that attempt to examine costs report only cost savings resulting from changing prescribing behavior, without accounting for the costs of implementing the intervention (Forsetlund et al. 2009; AHRQ 2006). With no formal cost-effectiveness analysis, health systems cannot determine whether they will be able to recover implementation costs through any savings in antibiotic costs.

3. The studies, despite sharing similar objectives, are wide-ranging in their individual design and methodology. This variation limits the opportunities for comparing and extrapolating the effects of various interventions.

Recommendations for Future Research and Practice

Existing studies indicate that education strategies, particularly active education strategies, can alter clinicians' prescribing behavior, at least in the short term. Formal cost-benefit analyses and more long-term follow-up are essential to help hospital administrators, intervention planners, and policymakers determine the value of these interventions.

The clinician interventions discussed here address only a small part of the problem of prescribing behavior: the decision to prescribe an antibiotic is not solely determined by the physician's knowledge (or lack thereof) but rather is a result of a complex combination of multiple factors involving the interactions of physicians, patients, and the local health care system (Arnold and Straus 2005; AHRQ 2006) (Figure 1).

Clinicians are influenced, for example, by misinformed patients' expectations and even demand for certain antibiotics, and some health plans (or the lack thereof) may limit the selection of antibiotics a clinician can prescribe (Ranji et al. 2008; AHRQ 2006).

Interventions that combine physician, patient, and community education strategies have had the most success in reducing antibiotic prescribing (Ranji et al. 2008; Davey et al. 2005; Arnold and Straus 2005) (Box 1). In 2002, France launched a nationwide program with mass media campaigns to educate the public about appropriate antibiotic use, one-on-one educational visits to primary-care physicians, and clinical guidelines for health care facilities; this multifaceted approach has reportedly reduced the number of antibiotic prescriptions by an impressive 26.5 percent in the first five years (Huttner and Harbath 2009).

The nature of such programs makes it difficult to identify which components are the most effective (Arnold and Straus 2005; Huttner and Harbath 2009), and thus they may be difficult to adapt for different scales and settings. Research to determine which facets of these interventions were most beneficial would be useful for intervention planners.

Table 2. Systematic Reviews Assessing Clinician Education Interventions (compiled by author)

Study	***All interventions (education interventions) (n)***	***Location***	***Setting***	***Quantitative results***	***Intervention***
Arnold and Straus (2005)	39 (23)	Australia, Canada, Finland, Great Britain, Indonesia, Mexico, New Zealand, Norway, South Africa, Spain, Sri Lanka, Sweden, Netherlands, U.S., Zambia,	Ambulatory care	No overall quantitative result reported.	Dissemination of educational materials including audiovisual Group educational meetings (providers participated in conferences, lectures, workshops) Educational outreach visits Multifaceted interventions: combinations of educational interventions involving patients, public and physicians)
Forsetlund et al. (2009)	81	North America, Europe, Australia, Brazil, Indonesia, Mali, Mexico, Peru, New Zealand, South Africa, Sri Lanka, Thailand,	General practice community-based care Hospital-based care (inpatient or outpatient)	Median adjusted risk difference in compliance with desired practice 6% (IQR 1.8%–15.9%)	Educational meetings (interactive, didactic, mixed) alone, with or without educational materials Multifaceted interventions that included educational meetings

		Zambia			
AHRQ (2006)	54 (34)	Africa, Australia, Canada, Europe, U.S.	Outpatient primary care clinics	Absolute reduction in antibiotic prescribing rates 8.9% (IQR 6.7%–12.7%) Absolute improvement in prescribing recommended antibiotics 10.6% (IQR 3.4%–18.2%)	Dissemination of published educational materials Lectures Traditional CME Educational outreach visits Interactive small group meetings (consensus building) Workshops
Davey et al. (2005)	63 (36)	Australia, Brazil, Canada, Colombia, France, Netherlands, Norway, Spain, Thailand, U.K., U.S.	Hospital inpatients	Intervention effect range of differences between intervention and control groups (in proportions) 8%–69%	Distribution of educational materials Educational meetings Local consensus process Educational outreach visits Multifaceted interventions that included any of above
Mansouri and Lockyer (2007)	31	Canada, U.S.	Any practicing physicians	Effect size for Active methods r = 0.33 [0.33] Mixed methods r = 0.33 [0.26] Passive method r = 0.20 [0.16]	Active CME (workshops, individual training) Passive CME (conferences, print-only) Mixed CME interventions
O'Brien et al. (2007)	69	North America, Europe, Australia, Indonesia, Thailand, U.K.	Practicing physicians in community settings, hospitals, nursing homes	Median adjusted risk difference (RD) in compliance with desired practice 5.6% (IQR 3.0%–9.0%).	Educational outreach visits
Ranji et al. (2008)	43 (30)	North America	Ambulatory care	Median reduction in proportion of subjects receiving antibiotics over 6 months median follow-up. 9.7% (IQR 6.6%–13.7%)	Dissemination of educational materials Educational outreach visits Educational seminars Education workshops Education meetings

CME = continuing medical education; IQR = interquartile range

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