Performance Improvement

Physician Champions Are Key to Improving Antibiotic Prescribing Quality

Eva M. Aagaard, M.D.; Ralph Gonzales, M.D., M.S.P.H.; Carlos A. Camargo, Jr., M.D., Dr.P.H.; Ruthann Auten; Sara K. Levin, M.A.; Judith Maselli, M.S.P.H.; Joshua Metlay, M.D., Ph.D.

The increase in antimicrobial resistance is adversely affecting the clinical course and health care costs of community-acquired infections.[1,2] Because antimicrobial resistance is strongly correlated with antibiotic use patterns, many groups[3–5] consider reducing unnecessary antibiotic use to be critical to efforts to combat resistance. Among humans, the vast majority of unnecessary antibiotic prescriptions are used to treat acute respiratory tract infections (ARIs) of viral etiology.[6]

Several factors have been implicated as barriers to provider compliance with published guidelines.[7] The decision to prescribe antibiotics for ARIs, in particular, results from complex interactions between patient, providers, and system factors (Figure 1, page 110). Effective strategies to reduce inappropriate prescribing address each of these domains,[8–15] assess barriers to change, are responsive to local circumstances, have an active educational outreach component, and are consistent with clinicians' values.[16–20]

The IMPAACT (Improving Antibiotic Use in Acute Care Treatment) study was a cluster randomized controlled trial of a patient and physician educational intervention designed to reduce antibiotic prescribing for ARIs in emergency departments (EDs) in the United States.[21] The study was performed at 16 EDs (8 Department of Veterans Affairs [VA] and 8 non–VA pairs) in eight metropolitan areas across four Census regions. ED pairs were randomized to usual care versus a multidimensional intervention to translate evidence-based guidelines for antibiotic use for ARIs into practice. The methods of site selection[22] and the patient and physician educational interventions[21] have been previously published.

The intervention design, which was framed by the Predisposing, Reinforcing and Enabling Constructs in Educational Diagnosis and Evaluation (PRECEDE) model of change,[23–29] attempted to reduce inappropriate antibiotic prescribing through education and behavior change at the patient, physician, and microsystem level[30,31] (Figure 1, page 110). Patient education included waiting room posters, brochures,

Article-at-a-Glance

Background: The previously reported IMPAACT study was a cluster randomized controlled trial of a patient and physician educational intervention designed to reduce antibiotic prescribing for acute respiratory tract infections (ARIs) in emergency departments (EDs) in the United States. On average, the intervention resulted in a modest improvement in antibiotic prescribing behavior at the end of Year 1 and further improvement after Year 2. Yet the intervention's impact was large at some sites but minimal or even negative at others. A study was undertaken to identify organizational factors that influenced the effectiveness (Organizational Effect Modifiers [OEMs]) of the intervention.

Methods: Focus groups of nurses and ED staff and semi-structured interviews of local project leaders, nurse managers, and quality improvement (QI) officers were performed at seven EDs across the United States. Effectiveness of the local project leader, institutional emphasis on patient satisfaction ratings, and institutional history with and approach to QI were initially identified as key potential OEMs. Two investigators independently read the transcripts for each site and, using prespecified rating scales, rated the presence of each OEM.

Findings: The perceived effectiveness of the local project leader was most strongly linked to the effectiveness of the intervention. Perceived institutional emphasis on patient satisfaction and institutional history of and approach to QI (top down or bottom up) did not appear to be closely linked with intervention effectiveness.

Discussion: An effective local leader to serve as a physician champion was key to the success of this project. Organizational factors modify the effectiveness of QI interventions targeting individual physician performance and should be addressed during program implementation.

Explanatory Model of Physician Antibiotic Prescribing Behavior For Acute Respiratory Tract Infections

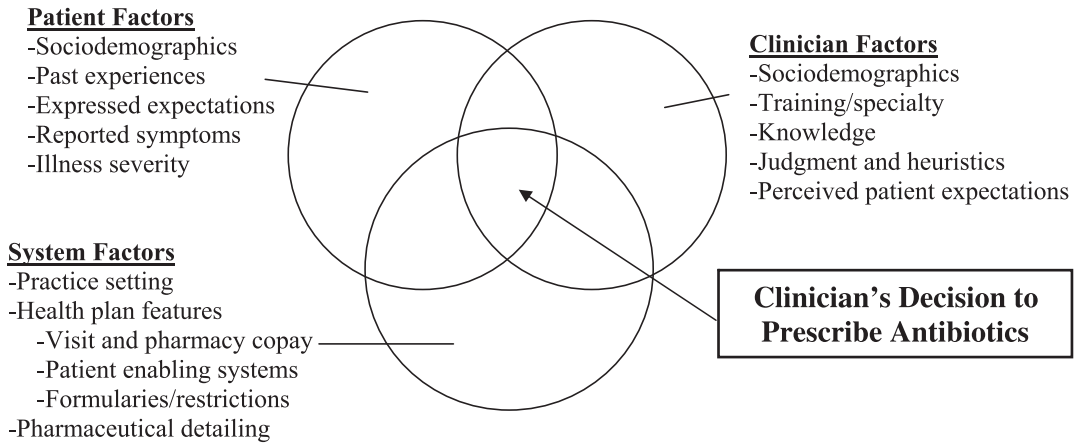

Figure 1. *The decision to prescribe antibiotics for acute respiratory tract infections (ARIs), in particular, results from complex interactions between patient, provider, and system factors.*

and an interactive computer kiosk that provided symptom-tailored management strategies for ARIs. Provider education used a train-the-trainer model whereby we identified local project leaders (LPLs) to implement the intervention and educate fellow physicians at each site. The LPLs participated in a day-long training on appropriate antibiotic prescribing for ARIs and were given evidence-based articles, lecture materials, and instructions for how to disseminate this information at their site. Medical records were reviewed during the baseline and intervention years and the percentage of visits for ARI that were treated with antibiotics was extracted. LPLs were provided with site-based aggregate feedback on baseline antibiotic prescribing rates benchmarked against the average for all other VA or non–VA sites (as appropriate), as well as against evidence-based benchmarks, and these were incorporated into the provider education materials. Sites were not given feedback on their postintervention prescribing rates until after the study was completed.

On average, the IMPAACT intervention resulted in a modest improvement in antibiotic prescribing behavior at the end of Year 1[21] and further improvement after Year 2 (data not shown). However, the impact of the intervention was large at some sites, whereas others showed minimal or even worsening performance (Figure 2, page 111). Recent research has demonstrated increased awareness that the organizational context of a quality improvement (QI) intervention can play an important role in its implementation.[32] One of the key goals of implementation research is to understand the organizational effect modifiers (OEMs)[32] that affect the uptake and effectiveness of interventions across diverse sites. The present study used mixed qualitative and quantitative methods to identify and evaluate OEMs that might explain the variability observed in the implementation of and response to the IMPAACT interventions across sites.

Methods

Categorization of Sites

Within Year 1 of the intervention, one site (Site 7) underwent restructuring with conversion of the ED into a continuity clinic. Although included in the intention-to-treat analysis of the IMPAACT intervention overall,[21] it was not included in the process evaluation described herein since it no longer functions as an ED.

We categorized sites as responders or nonresponders. Responders reached goal antibiotic prescription rates for ARI (< 20% of all visits) or showed an absolute decrease in antibiotic prescription rates of > 20% during a two-year follow-up period. These criteria were predefined by the IMPAACT research group, which considered the baseline prescription rates in these EDs, the clinical significance of the change, and prior research aimed at reducing antibiotic use for ARIs.[6,16–18,20,33] Four of the seven intervention sites met these criteria (Sites 2, 5, 6, 8). Complete descriptions of site characteristics have been previously published[21,34] and are included in Table 1 (page 112).

Intervention Implementation Rating

During each year of the intervention, we held telephone

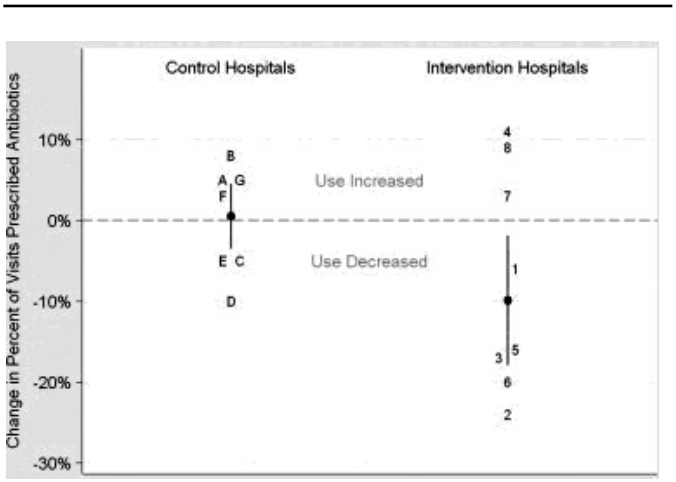

Figure 2. *Adjusted difference in levels of antibiotic prescribing for visits diagnosed as upper respiratory tract infections and acute bronchitis (Year 2 minus Year 1). Levels of antibiotic prescribing for visits diagnosed as upper respiratory infection or acute bronchitis were calculated using alternating logistic regression, controlling for provider type, recorded temperature at visit, current patient smoking history, patient gender, and Department of Veterans Affairs (VA)/non-VA sites. Individual hospital values are estimated from the regression (letters represent control sites and numbers intervention sites), as was the overall mean, approximately weighted for the number of visits per hospital (plotted as a dot). The line represents the overall 95% confidence interval, calculated using the delta method. Reprinted by permission from Elsevier from Metlay J.P., et al.: Cluster-randomized trial to improve antibiotic use for adults with acute respiratory infections treated in emergency departments.* Ann Emerg Med *50:221–230, Sep. 2007. Epub May 23, 2007. IMPAACT, Improving Antibiotic Use in Acute Care Treatment.*

interviews with LPLs about program implementation at their sites. They reported on the numbers of examination-room posters displayed, practice guidelines and pocket guides distributed, and provider educational seminars held and on the percentage of ED providers reached. We also employed impartial "stealth observers" (nonphysician IMPAACT staff not affiliated with the site) to assess the intervention implementation and corroborate LPL reports. These observers noted the presence and placement of the materials and whether or not the computer kiosk was functioning. Where there were inconsistencies in the ratings made by the LPL and stealth observer, focus groups and interviews from the process evaluation were used to resolve discrepancies. On the basis of these data, we derived an overall implementation rating for each site: Implementation was described as "poor" if none or almost none of the intervention components were implemented and as "excellent" if all of the components were implemented and the majority of the providers were made aware of the project. All others were described as having fair implementation.

Identification of OEMs

From January through June 2007, we conducted site visits to explore OEMs that may have influenced the success or failure of the intervention at specific sites. Using inductive qualitative research methodology,[35] we [E.M.A., R.A.] conducted one-hour focus groups ($N = 7$) with the ED staff, including nurses, medical assistants, nurse practitioners, and physician assistants. Physicians were excluded from these focus groups. Personal interviews (30–60 minutes) were conducted with the LPLs ($N = 7$), ED nurse managers ($N = 6$), and hospital QI officers ($N = 6$). Focus groups and interviews were conducted following a semistructured template. Open-ended questions asked subjects to reflect on QI at their site and how it works and on the IMPAACT project in particular (what aspects they remember, what went well and what did not, perceived barriers to improving appropriate antibiotic use, and potential suggestions for future interventions). Interviewing was iterative, wherein as new themes emerged they were incorporated into the interviews and focus groups. Focus groups and interviews were audiotaped and transcribed without identifiers; recordings were electronically shredded after transcription was completed. We also conducted a grand rounds or similar educational seminar where individual site data and the overall results of the study were presented to the faculty and housestaff (if applicable). At this session's conclusion, one of the investigators [E.M.A.] moderated a structured discussion of the findings on the strengths and weakness of the IMPAACT project, barriers to appropriate antibiotic use, and suggestions for future interventions. This discussion was conducted in the same manner as the previously described focus groups/interviews and was hand transcribed. The study was approved by the Institutional Review Boards at each site and those of the principal investigators.

Using standard thematic analysis techniques,[36] we reviewed transcripts to identify key themes from the focus groups, interviews, and grand rounds notes, with a specific attention to those OEMs that may have influenced implementation and/or effectiveness of the interventions. Agreement on themes was sought between all members of the research team to ensure reliability. In an iterative manner, we returned to the transcripts and notes to further characterize and code these themes by hand. Key subthemes emerged from this process. Two reviewers (one physician investigator, one nonphysician staff member), drawn from a pool of reviewers [E.M.A., R.G., R.A., SK.L., J.M., J.M.] who were not present at the site visit, independently read the transcripts and notes for each site, identifying key excerpts where these OEMs and subthemes were discussed to further check the reliability of the coding scheme.

Table 1. Intervention Site Response, Implementation Ratings, and Organizational Effect Modifier Ratings*

Site	Responder vs. Nonresponder	ARI Antibiotic Prescription Rates Year 1 (%)	ARI Antibiotic Prescription Rates Year 3 (%)	Percent Change in Antibiotic Prescription Rates†	Overall Implementation Rating‡	QI History/ Approach	Institutional Priorities/ Patient Satisfaction	Leadership
1	Nonresponder (near goal)	39	33	–6	Poor	3.5	4	3
3	Nonresponder	77	59	–18	Poor	2	4	2
4	Nonresponder	45	66	+21	Fair	4.5	2	2.5
2	Responder	51	22	–29	Excellent	3.5	4	5
5	Responder	75	51	–24	Fair	4	4.5	4.5
6	Responder	77	39	–38	Fair	2	2	4
8	Responder	18	6	–12	Excellent	5	5	5

* ARI, acute respiratory tract infection; QI, quality improvement.

† Percent change calculated as Year 1 to Year 3. A responder is defined as a site that either met goal targets or had a greater than 20% reduction in antibiotic prescription rates.

‡ Combines local opinion leader, stealth observer, and focus-group/interview data on all aspects of intervention. Poor = none or almost none of the intervention components were implemented; excellent = all the components were implemented and the majority of the providers were made aware of the project.

Finally, all investigators met to review and discuss the findings of the reviewer pairs, along with their supporting evidence, in an attempt to reduce bias. These methods are similar to those described in a similar planned mixed-methods study.[2]

Assessment of Impact of OEMs on Effectiveness

Following identification of the OEMs, we generated specific hypotheses on the basis of our review of the transcripts and notes as to the impact of these OEMs on the effectiveness of the IMPAACT interventions. We subsequently developed qualitative rating scales to describe the relative presence or absence of each OEM as informed by the identified subthemes and our hypotheses. Again, two reviewers independently (one physician investigator and one nonphysician staff member) rated the site on each of these OEMs. Although reviewers were not present at the site visit they reviewed, it was not feasible to blind reviewers to the identity of each site because specific individuals and unique local characteristics were mentioned in the transcripts. Variability in ratings between reviewers was resolved by consensus of all six reviewers at open discussions. We then assessed the validity of our hypotheses by comparing our qualitative ratings of the sites with the sites' relative effectiveness in reducing antibiotic prescribing rates for ARIs.[37]

Findings

Transcripts

The following OEMs emerged from the transcripts: (1) leadership, (2) QI history, and (3) institutional priorities.

Leadership. Although none of our LPLs had previous experience with or leadership roles in antibiotic-specific QI projects before this study, highly effective LPLs were able to "own the problem." They were seen as opinion leaders who were passionate and knowledgeable on the issue and a resource for other physicians. They made a consistent effort to keep the issue of antibiotic overuse at the forefront of their discussions with peers, trainees, and, in some cases, the community at large.

At two sites, the LPLs became intimately associated with the problem of antibiotic overuse. At one site, the LPL noted, "They've been calling me the antibiotic [tyrant] around here for a while." Of this same local project leader, the nurse manager said, "He is passionate on this," and, "He talks in the ED and the community." Similarly, at another site, the LPL stated:

> Because I became so heavily associated with antibiotic use and the appropriate use of antibiotics, it comes up a lot of times just when we interact. There have been a number of times when physicians have come up to me and said, "I thought about you the other day when I had a patient with a cold and I didn't give them antibiotics." And I would say to them, "Very good. I'm glad you did that, etcetera, and keep up the good work."

This influence also extended to the residents: "Residents will come up to me and say, 'I know you'll know the answer to this because you're the antibiotic guy. What should I do in this situation?'" This LPL went on to become a champion of effective antibiotic use at the state level.

QI History and Approach. In virtually every interview and focus group, participants cited recent work-flow changes related to The Joint Commission/Centers for Medicare & Medicaid (CMS) core measures. There was general agreement at all sites that there are too many quality indicators and that choices must

be and are made by departments as to which measures to prioritize. At one site, the nurse manager noted, "It's almost as if you can't decide yourself what's important. It's because there's so many outside impositions on things."

Although some form of QI process was present at each site, the interviews and focus groups revealed a wide variety of previous experience with and approach to QI. Some sites described a very "bottom-up" culture of QI, wherein staff at all levels were engaged in the identification, development, implementation, and assessment of QI measures. Regardless of whether the initiative was hospital- or ED–driven, providers described the process as one of teamwork. As one nurse stated—and many other nurses voiced similar sentiments—"Everyone is very receptive to change and getting better." A core issue relevant to successful QI initiatives at such sites was the need for everyone's input and buy-in before implementation. For example, as a member of a nurse focus group stated, "You can always ask questions and get answers. The answer is an explanation for why the new thing is better, not just 'because I told you so.'" Although not a specified component of the IMPAACT project, nurses were educated about the IMPAACT initiatives and able to identify them. Some of the nurses used components of the initiatives themselves for patient education: "I've used these (the posters) to talk to patients."

Other sites described a more top-down approach, where QI efforts are handed down from administration with little to no input from the staff responsible for implementation. At one site, QI initiatives were handed down from the central office. The quality manager did not initiate projects but was responsible for carrying them out. The nurses at this site described the situation as follows:

> You know, my supervisor verbally coming around and just keeps reinforcing to us about the policy which is now being put in place….And if they don't comply, they hear it from their superior and it rolls downhill.

Institutional Priorities. At nearly all sites, physicians and nurses felt that patient satisfaction and demand had a major influence on unnecessary antibiotic prescribing. Physicians voiced concerns that not meeting patient expectations would make patients angry or label them as bad physicians. One LPL noted, "The whole culture of you've got a cough and you don't give antibiotics, you're a bad doctor.…I really think the stigma of not giving antibiotics, you see that everywhere." They also noted feelings that even if they stood up to patient demands, another physician in the community would simply prescribe antibiotics in their stead, further increasing patient dissatisfaction with them. At one site, physicians stated, "It hasn't been easy to always be the bad guy. The PCPs (primary care physicians) get paid by seeing their patients, *and they want to keep them happy and coming back*—or words to that effect. A physician at another site, referring to the fact that whatever is done at this hospital to reduce antibiotics prescriptions needs to be done all over, said, "Patients will go to another hospital if we don't give antibiotics, so it has to be across the board"

The importance placed on patient satisfaction by the institution varied across sites. At some of the sites, patient satisfaction was not measured and was only perceived to be a potential issue influencing QI. At a few sites, however, the hospital and/or ED actively measured patient satisfaction and acted on the results, with direct implications for either the physicians or the department. One nurse, referring to their monthly feedback on the patient satisfaction survey, noted, "At this facility, patient satisfaction is probably the number one issue." At this site, the LPL stated:

> A lot of hospitals put a lot of emphasis on customer satisfaction. You've got a patient who writes a letter and wasn't satisfied, oh my God. It's like a whole brouhaha. You go out on a witch hunt . . . and this emphasis on patient satisfaction is really starting to affect the way we deliver care."

At yet at another site, the LPL said, "I've heard reports of docs getting disciplined or even fired because of repeated low satisfaction scores related to not prescribing antibiotics."

Hypotheses and Rating Scale

On the basis of our review of the transcripts, we developed specific hypotheses as to how each OEM might alter the effectiveness of the IMPAACT intervention.

Leadership. We hypothesized that the presence of an effective and involved LPL would result in enhanced effectiveness of the IMPAACT interventions. Effective leaders would not just implement the interventions but champion them, serving as local experts in the area of appropriate antibiotic use. In addition, we believed that these "physician champions," because of their place of respect within the health care community, knowledge of the subject matter, and effective role modeling of appropriate antibiotic use, had the ability to overcome some of the physician knowledge and attitude barriers that may exist. We created the following rating scale to represent this hypothesis:

- Low = "unknown to participants or not seen as a leader"
- Medium = "neutral"

■ High = "clear strong advocate; leader among peers"

QI History. We hypothesized that previous experience with QI at the institution would result in larger reductions in antibiotic prescriptions for ARIs through more effective processes for implementation. In addition, we felt that a bottom-up approach would be more effective than a top-down approach because it would engage the entire health care team and create opportunities for nonphysician involvement that may reinforce or enhance the IMPAACT interventions. We created the following rating scale to represent this hypothesis:

■ Low = "no significant prior experience with QI or negative experience"

■ Medium = "prior experience with QI; top-down approach"

■ High= "prior experience with QI; bottom-up approach"

Institutional Priorities. As described, a commonly held physician belief is that not prescribing antibiotics to patients with ARIs will result in patient dissatisfaction. Thus, we hypothesized that a strong emphasis on patient satisfaction and, specifically, personal or departmental consequences for low satisfaction scores would result in reduced effectiveness of the IMPAACT interventions. We created the following rating scale to represent this hypothesis:

■ Low = "patient satisfaction not mentioned as a barrier"

■ Medium = "patient satisfaction mentioned as a barrier; appears to moderately influence decisions"

■ High = "patient satisfaction is measured and reported; appears to greatly influence decisions"

Impact of Implementation and OEMs on IMPAACT Effectiveness

Both of the sites with excellent levels of program implementation were responder sites, while both of the sites with weak implementation were nonresponder sites (Table 1). The LPLs at the responder sites were uniformly more highly rated than those at the nonresponder sites, with no responder site having a leadership rating less than medium-high. Implementation ratings were also highest among sites with highly rated LPLs. There was no clear relationship between QI history/approach and either program implementation or effectiveness. We observed a weak relationship between the institutional focus on patient satisfaction and intervention effectiveness; however, it was not the relationship anticipated. Specifically, sites with a greater attention to patient satisfaction at both management and staff levels realized greater reductions in antibiotic prescribing compared with sites without this emphasis.

Discussion

A multidimensional educational intervention to reduce antibiotic prescribing for ARIs led to variable levels of performance improvement among a national sample of EDs. The level of performance was closely associated with the degree of implementation of the intervention. In addition, three OEMs were consistently identified by sites as influential in the success of QI programs. Among these factors, the one most clearly related to the variation in the effect size of our intervention was the strength of the local leadership.

Physician champions have been shown to influence the effectiveness of QI programs in outpatient and hospital settings.[21,23,27,38–47] Physician champions "make a decisive contribution to the innovation process by actively and enthusiastically promoting the innovation, building support, overcoming resistance, and ensuring that the innovation is implemented."[48(p. 40)] Similarly, we found that the presence of an LPL who served as a strong physician champion was important to the success of the project. Moreover, the descriptions of successful LPLs at responder sites were consistent with those described for physician champions in the literature. Unfortunately, we did not specifically identify or recruit LPLs who had these qualities at all sites, nor did we recruit individuals with previous leadership experience and/or passion in the area of antibiotic overuse, which may, in part, explain the relative failure of the IMPAACT intervention at our nonresponder sites.

Our findings suggest that for problems requiring a change in physician attitudes and behavior, the presence of a strong hospital or ED history with QI, even one with a history of successful implementation of multiple projects, may in and of itself be insufficient to create change. Moreover, the type of QI culture—top-down or ground-up—did not appear to influence the success of this project. This is contrary to current recommendations,[49,50] as well as literature that suggests that an organizational culture that values QI facilitates implementation of new measures.[23,27] It is important to note, however, that this intervention, which was aimed primarily at physician and patient knowledge, attitudes, and behavior, was not specifically intended to involve nurses. We cannot rule out the possibility that specific involvement of nurses and/or more specific involvement of the institutional QI process would have improved our results.

We hypothesized that increased hospital- or ED–level attention to patient satisfaction would create a barrier to implementation of the IMPAACT project. We observed the opposite to be true. A strong institutional focus on patient satisfaction may have primed project leaders to directly address this issue in their

educational sessions and may have supported the higher levels of improvement at these sites. Alternatively, increased attention to patient satisfaction may be a marker of other OEMs that successfully influence the implementation of QI projects.[51] In contrast, the absence of attention to patient satisfaction did not seem to create an environment in which a substantial reduction of antibiotic overuse was easy to obtain.

Limitations

This study has several limitations. First, although stealth observers, interview, and focus group participants were unaware of the level of performance improvement at each site, the investigators who ultimately reviewed the data, performed the coding, and assigned implementation and OEM ratings did have this knowledge. To reduce potential bias, the coders/raters for each site were individuals who were not present at the site visit, and consensus of all six coders/raters was required before assignment of a rating. Bias among interviewees is also a potential limitation in that sites that successfully improved antibiotic prescribing may be more likely to express positive comments about their LPLs or local environments than those with poor response to this intervention. This is unlikely to be a major factor because questions regarding the abilities of the LPL, the implementation of the IMPAACT project, and the local QI environment were always asked before providing the results for the study sites. The focus groups did not assess the impact of preexisting knowledge and attitudes regarding antibiotic use in ARIs among patients and physicians.[52] Moreover, because focus groups were performed at one point in time rather than over a series of visits and used a semistructured script, it is possible that additional important OEMs were not identified.[27,31,51] The results, particularly those regarding the importance of QI history/approach and patient satisfaction, primarily reflect the attitudinal and operational characteristics of EDs and may not be generalizable to the hospitals as a whole. However, the interviews and focus groups included both hospital and ED staff, and the rating scale specifically took into account the pervasiveness of the themes across both of these types of individuals/groups. Because this study focuses on the process evaluation of a project aimed at improving antibiotic use for ARIs and because the study involved only a limited number of EDs, its generalizability to other QI interventions is unclear. However, the study did include EDs from all geographic regions of the United States, as well as VA and non–VA nonteaching and teaching sites, enhancing its generalizability. Finally, although we believe that this study offers important insights into OEMs that may influence the impact of a specific QI intervention, the results are formative and require further exploration and confirmation in future studies.

Summary

The results of this study suggest that the presence of strong local leadership in the form of a physician champion is key to the success of QI interventions aimed specifically at changing physician behavior. Individuals who wish to implement QI projects that are intended to change physician behavior and practice patterns should dedicate significant effort to finding local champions who can not only serve in this role but also have the qualities essential to a strong physician champion. We recommend that QI studies evaluate the effect of OEMs on their intervention so that this important area of research may be better understood and so that the relative importance of previously identified OEMs can be further assessed. J

This study was funded jointly by the Agency for Healthcare Research and Quality and the Health Service Research and Development Service of the Veterans Health Administration. A description of the research reported in this article was presented in poster format at the Society of General Internal Medicine National Meeting, April 2008, in Pittsburgh.

Eva M. Aagaard, M.D., is Associate Professor of Medicine, University of Colorado Denver School of Medicine, Aurora, Colorado. **Ralph Gonzales, M.D., M.S.P.H.,** is Professor of Medicine, University of California, San Francisco, and Director of the UCSF Program in Implementation and Dissemination Sciences. **Carlos A. Camargo Jr., M.D., Dr.P.H.,** is Associate Professor of Medicine, Massachusetts General Hospital, and Harvard Medical School, Boston. **Ruthann Auten** is a doctoral candidate, School of Communication and Information, Rutgers University, New Brunswick, New Jersey. **Sara K. Levin, M.A.,** is a doctoral student in clinical psychology, Wright Institute, Berkeley, California. **Judith Maselli, M.S.P.H.,** is Senior Statistician, Department of Medicine, University of California, San Francisco. **Joshua Metlay, M.D., Ph.D.,** is Associate Professor of Medicine, University of Pennsylvania, Philadelphia. Please address correspondence to Eva Aagaard, eva.aagaard@ucdenver.edu.

References

1. Goossens H., et al.: Outpatient antibiotic use in Europe and association with resistance: A cross-national database study. *Lancet* 365(9549):579–587, Feb. 12–18, 2005.
2. Simpson S.A., et al.: Stemming the Tide of Antibiotic Resistance (STAR): A protocol for a trial of a complex intervention addressing the "why" and "how" of appropriate antibiotic prescribing in general practice. *BMC Fam Pract* 10:20, Mar. 2009.
3. European Surveillance of Antimicrobial Consumption: *Editorial.* Jan. 24, 2008. http://www.esac.ua.ac.be/main.aspx?c=*ESAC2&n=50006 (last accessed Jan. 19, 2010).
4. European Surveillance: *Special Issues on Antimicrobial Resistance* (press release). Nov. 13, 2008. http://www.eurosurveillance.org/Public/

PressReleases/ViewPressRelease.aspx?PressReleaseId=11 (last accessed Jan. 19, 2010).
5. Ball P., et al.: Antibiotic therapy of community respiratory tract infections: Strategies for optimal outcomes and minimized resistance emergence. *J Antimicrob Chemother* 49:31–40, Jan. 2002.
6. Gonzales R., et al.: Excessive antibiotic use for acute respiratory infections in the United States. *Clin Infect Dis* 33:757–762, Sep. 15, 2001. Epub Aug. 21, 2001.
7. Cabana M.D., et al.: Why don't physicians follow clinical practice guidelines? A framework for improvement. *JAMA* 282:1458–1465, Oct. 20, 1999.
8. Avorn J., Solomon D.H.: Cultural and economic factors that (mis)shape antibiotic use: The nonpharmacologic basis of therapeutics. *Ann Intern Med* 133:128–135, Jul. 18, 2000.
9. Steinman M.A., et al.: Improving antibiotic selection: A systematic review and quantitative analysis of quality improvement strategies. *Med Care* 44:617–628, Jul. 2006.
10. Avorn J., et al.: Information and education as determinants of antibiotic use: Report of Task Force 5. *Rev Infect Dis* 9(suppl. 3):S286–S296, May 1987.
11. Arnold S.R., Straus S.E.: Interventions to improve antibiotic prescribing practices in ambulatory care. *Cochrane Database Syst Rev* CD003539 (4), 2005.
12. Gonzales R., Corbett K.: The culture of antibiotics. *Am J Med* 107:525–526, Nov. 1999.
13. Gonzales R., Sande M.: What will it take to stop physicians from prescribing antibiotics in acute bronchitis? *Lancet* 345(8951):665–666, Mar. 18, 1995.
14. Davis D.A., et al.: Changing physician performance: A systematic review of the effect of continuing medical education strategies. *JAMA* 274:700–705, Sep. 6, 1995.
15. Grimshaw J.M., et al.: Changing provider behavior: An overview of systematic reviews of interventions. *Med Care* 39(suppl. 2):II2–II45, Aug. 2001.
16. Belongia E.A., et al.: A community intervention trial to promote judicious antibiotic use and reduce penicillin-resistant *Streptococcus pneumoniae* carriage in children. *Pediatrics* 108:575–583, Sep. 2001.
17. Finch R.G., et al.: Educational interventions to improve antibiotic use in the community: Report from the International Forum on Antibiotic Resistance (IFAR) colloquium, 2002. *Lancet Infect Dis* 4:44–53, Jan. 2004.
18. Finkelstein J.A., et al.: Reducing antibiotic use in children: A randomized trial in 12 practices. *Pediatrics* 108:1–7, Jul. 2001.
19. Foy R., et al.: Attributes of clinical recommendations that influence change in practice following audit and feedback. *J Clin Epidemiol* 55:717–722, Jul. 2002.
20. Perz J.F., et al.: Changes in antibiotic prescribing for children after a community-wide campaign. *JAMA* 287:3103–3109, Jun. 19, 2002.
21. Metlay J.P., et al.: Cluster-randomized trial to improve antibiotic use for adults with acute respiratory infections treated in emergency departments. *Ann Emerg Med* 50:221–230, Sep. 2007. Epub May 23, 2007.
22. Metlay J.P., et al.: Assessing the suitability of intervention sites for quality improvement studies in emergency departments. *Acad Emerg Med* 12:667–670, Jul. 2005.
23. Bodenheimer T., et al.: What are the facilitators and barriers in physician organizations' use of care management processes? *Jt Comm J Qual Saf* 30:505–514, Sep. 2004.
24. Clarke V.A., Frankish C.J., Green L.W.: Understanding suicide among indigenous adolescents: A review using the PRECEDE model. *Inj Prev* 3:126–134, Jun. 1997.
25. Green L.W., Costagliola D., Chwalow A.J.: Educational diagnosis and evaluation of educational strategies (PRECEDE Model): Practical methodology for inducing changes in behavior and health status [article in French]. *Journ Annu Diabetol Hotel Dieu* pp. 227–240, 1991.
26. Green L.W.: What can we generalize from research on patient education and clinical health promotion to physician counseling on diet? *Eur J Clin Nutr* 53(suppl. 2):S9–S18, May 1999.
27. Lukas C.V., et al.: Implementation of a clinical innovation: The case of advanced clinic access in the Department of Veterans Affairs. *J Ambul Care Manage* 31:94–108, Apr. 2008.
28. MacDonald M.A., Green L.W.: Reconciling concept and context: The dilemma of implementation in school-based health promotion. *Health Educ Behav* 28:749–768, Dec. 2001.
29. Sjöström M., et al.: A four week residential program for primary health care patients to control obesity and related heart risk factors: Effective application of principles of learning and lifestyle change. *Eur J Clin Nutr* 53(suppl. 2):S72–S77, May 1999.
30. Berwick D.M.: A user's manual for the IOM's "Quality Chasm" report. *Health Aff (Millwood)* 21:80–90, May 2002.
31. Ferlie E.B., Shortell S.M.: Improving the quality of health care in the United Kingdom and the United States: A framework for change. *Milbank Q* 79(2):281–315, 2001.
32. Dijkstra R., et al.: The relationship between organisational characteristics and the effects of clinical guidelines on medical performance in hospitals, a meta-analysis. *BMC Health Serv Res* 6:53, Apr. 28, 2003.
33. Gonzales R., et al.: Decreasing antibiotic use in ambulatory practice: Impact of a multidimensional intervention on the treatment of uncomplicated acute bronchitis in adults. *JAMA* 281:1512–1519, Apr. 28, 1999.
34. Gonzales R., Steiner J.F., Sande M.A.: Antibiotic prescribing for adults with colds, upper respiratory tract infections, and bronchitis by ambulatory care physicians. *JAMA* 278:901–904, Sep. 17, 1997.
35. Sofaer S.: Qualitative methods: What are they and why use them? *Health Serv Res* 34(5 pt. 2):1101–1118, Dec. 1999.
36. Green J., Thorogood N.: *Qualitative Methods for Health Research*. London: Sage Publications; 2004.
37. Ragin C.C.: Using qualitative comparative analysis to study causal complexity. *Health Serv Res* 34(5 pt. 2):1225–1239, Dec. 1999.
38. Improving care for acute myocardial infarction: Experience from the Cooperative Cardiovascular Project. The Cooperative Cardiovascular Project Best Practices Working Group. *Jt Comm J Qual Improv* 24:480–490, Sep. 1998.
39. Crabtree B.F., et al.: Delivery of clinical preventive services in family medicine offices. *Ann Fam Med* 3:430–435, Sep.–Oct. 2005.
41. Ellerbeck E.F., Bhimaraj A., Hall S.: Impact of organizational infrastructure on beta-blocker and aspirin therapy for acute myocardial infarction. *Am Heart J* 152:579–584, Sep. 2006.
41. Ballard D.J., et al.: Improving delivery of clinical preventive services: A multi-year journey. *Am J Prev Med* 33:492–497, Dec. 2007.
42. Fleming J.H., Coffman C., Harter J.K.: Manage your human sigma. *Harv Bus Rev* 83:106–114, 192, Jul. 2005.
43. Hess D.R.: How to initiate a noninvasive ventilation program: Bringing the evidence to the bedside. *Respir Care* 54:232–243, Feb. 2009.
44. Lipshutz A.K., et al.: Strategies for success: A PDSA analysis of three QI initiatives in critical care. *Jt Comm J Qual Patient Saf* 34:435–444, Aug. 2008.
45. Lu T.Y., et al.: A champion-driven pathway towards quality improvement in the medical management of osteoporotic fractures. *Med J Aust* 185:341–342, Sep. 18, 2006.
46. Ouslander J.G.: Quality improvement initiatives for urinary incontinence in nursing homes. *J Am Med Dir Assoc* 8(3 suppl.):S6–S11, Mar. 2007.
47. Wolfson D., et al.: Quality improvement in small office settings: An examination of successful practices. *BMC Fam Pract* 10:14, Feb. 9, 2009.
48. Howell J.M., Higgins C.A.: Champions of change: Identifying, understanding and supporting champions of technological innovations. *Organizational Dynamics* 18:40–55, Summer 1990.
49. Redfern S.J., Norman I.J.: Measuring the quality of nursing care: A consideration of different approaches. *J Adv Nurs* 15:1260–1271, Nov. 1990.
50. Spoon B.D., et al.: The CQI paradigm: A pathway to nurse empowerment in a community hospital. *Health Care Superv* 14:11–18, Dec. 1995.
51. Solberg L.I., et al.: Large multispecialty group practices and quality improvement: What is needed to transform care? *J Ambul Care Manage* 30:9–17, Jan. 2007.
52. Ong S., et al.: Antibiotic use for emergency department patients with upper respiratory infections: Prescribing practices, patient expectations, and patient satisfaction. *Ann Emerg Med* 50:213–220, Sep. 2007.