INNOVATIONS IN EDUCATION AND CLINICAL PRACTICE

Continuous Quality Improvement for Patients with Back Pain

Richard A. Deyo, MD, MPH, Marie Schall, MA, Donald M. Berwick, MD, Tom Nolan, PhD, Penny Carver, MEd

Recent evidence has changed traditional approaches to low back pain, suggesting minimal bed rest, highly selective imaging, and early return to normal activities. However, there are wide geographical variations in care, and substantial gaps between practice and evidence.

This project sought to merge scientific evidence about back pain and knowledge about behavior change to help organizations improve care for back pain. Participating insurance plans, HMOs, and group practices focused on problems they themselves identified. The year-long program included quarterly meetings, coaching for rapid cycles of change, a menu of potential interventions, and recommendations for monitoring outcomes. Participants interacted through meetings, e-mail, and conference calls.

Of the 22 participating organizations, 6 (27%) made major progress. Typical changes were reduced imaging, bed rest, and work loss, and increased patient education and satisfaction. Specific examples were a 30% decrease in plain x-rays, a 100% increase in use of patient education materials, and an 81% drop in prescribed bed rest.

Despite the complexity of care for back pain, rapid improvements appear feasible. Several organizations had major improvements, and most experienced at least modest improvements. Key elements of successful programs included focus on a small number of clinical goals, frequent measurement of outcomes among small samples of patients, vigilance in maintaining gains; involvement of office staffs as well as physicians, and changes in standard protocols for imaging, physical therapy, and referral.

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Recent research has changed traditional approaches to low back problems. Sound evidence indicates that bed rest is generally ineffective, imaging tests should be highly selective, and early return to normal activities is an

optimal recommendation. This evidence is summarized in the guideline for acute low back problems sponsored by the Agency for Health Care Policy and Research (AHCPR),¹ similar British guidelines² and recent reviews.³

Despite this consensus, there is a substantial gap between scientific evidence regarding back pain and actual practice. Up to 60% of imaging tests for low back pain may be inappropriate,^{4,5} and lengthy bed rest continues to be widely prescribed.^{6,7} Back surgery rates vary widely among developed countries, and physicians report different approaches to standardized back pain scenarios.⁷ Purely educational approaches targeted at physicians or at patients have had minimal effects in changing behavior.⁸⁻¹⁰

Thus, the problem of back pain is ripe for applying newer strategies for provider change and the concepts of continuous quality improvement. These techniques include setting specific goals, monitoring progress, and instituting rapid changes followed by refinement, extension, and wider dissemination.¹¹ Rather than identifying "bad apples," the intent is to improve the performance of all providers in a system.¹²

This project sought to merge scientific knowledge about back pain with knowledge of continuous quality improvement and provider change strategies. Our goal was to facilitate improvements in care for back pain in large organizations, focusing on problems they themselves identified. This report summarizes the strategies used and examples of improvements that were achieved.

METHODS

Program Organization

This effort was sponsored by the Institute for Healthcare Improvement (IHI), an independent nonprofit organization that identifies and disseminates innovations for improving health care quality. As part of IHI's "Breakthrough Series,"^{13,14} this program involved organizations committed to achieving rapid, substantial improvements in back pain care. The process began by identifying a scientific leader (RAD) and a multidisciplinary planning group. This expert group included 2 orthopaedic surgeons, a physical therapist, a chiropractor, 2 general internists, a family physician, an emergency physician, a radiologist, and a research

Received from the Center for Cost and Outcomes Research, Department of Medicine, and Department of Health Services, University of Washington, Seattle, Wash (RAD), and the Institute for Healthcare Improvement, Boston, Mass (MS, DMB, TN, PC).

Address correspondence and reprint requests to Dr. Deyo: University of Washington, Center for Cost and Outcomes Research, 146 N. Canal St., Suite 300, Seattle, WA 98103-8652.

epidemiologist. These individuals represented academia, HMO practices, and workers' compensation agencies. The group met to identify and summarize scientific knowledge regarding back pain (Table 1), and to identify key change strategies for organizations (Table 2).

Participants

Organizations volunteered and paid a fee to IHI to support program costs. Among the 22 participating organizations were 3 Blue Cross or Blue Shield plans, 3 HMO systems, an academic medical center, a chiropractic college, a multicenter and multidisciplinary spine specialty group, an organization focused on occupational back problems, and 12 large hospital-based practices, multispecialty groups, or independent practice associations. Thus, some participants were third-party payers, while others were provider organizations. Each organization identified three team members to attend collaborative meetings. Organizations were encouraged to choose teams carefully, generally including a physician champion, a clinic administrator, and someone representing quality management or senior administration. Teams were encouraged to seek high-level administrative support to facilitate problem-solving and organizational change.

Program Content

The program was organized around 3 "learning sessions" and a final "national congress" to publicize and disseminate findings. These sessions occurred over approximately 1 year. The first learning session introduced modern concepts of care for low back pain, emphasizing the principles in Table 1. This session included workshops on aspects of care such as imaging, referral patterns, and patient education. A "menu" of key changes for improving care was introduced (Table 2), but we anticipated that no organization would try to implement all of them. Organizations were also encouraged to identify other innovations for reducing variations in care and changing provider behavior. Concepts of rapid change were introduced, including experimentation with changes on a small scale, refinement, and then extension to wider implementation.¹⁵ The

need for frequent team meetings and rapid change was emphasized to maintain momentum.

Brief outcome measures for quantifying the impact of changes were introduced at this learning session (Table 3).¹⁶ These questions were chosen by the planning committee to be feasible in routine care; include multiple dimensions of outcome (symptoms, daily activity, general well-being, work impact, and satisfaction); and be compatible with other widely used outcome measures for low back pain.¹⁶⁻¹⁸

The first learning session also included "coaching" by members of the planning group with each team, in part to develop specific quantitative goals and to plan initial steps. It was recognized that teams would have different clinical goals, market environments, organizational hurdles, and financial incentives.

At the second learning session, teams reported their experiences to each other. There was extensive exchange of ideas and joint problem solving. Breakout sessions addressed relationships with local employers and psychosocial issues. A highlight was instruction in measuring and reporting improvements, using the outcome questions in Table 3 as examples. Teams were encouraged to develop graphical presentations of their data and to perform continuous repeated measurements (e.g., weekly or monthly patient samples). Another feature was instruction in spreading changes, assuming that many teams had made progress on a small scale which was now ready for implementation in other clinics or groups.

At the third session, interaction among teams continued, as did individual team meetings and planning opportunities. A key feature was individual consultation for each team with leaders of the collaborative to offer individualized feedback, advice, and encouragement. At the final national congress, participating teams took the role of teachers, and shared their experience, knowledge, and results with an open audience.

Between learning sessions, there were conference calls involving interested teams and planning group members, and an e-mail listserve to permit ongoing interaction among the teams. There were also individual telephone contacts between collaborative leaders and participating teams and in some cases local visits, consultation, and lectures by planning group members.

Table 1. Principles of Scientific Back Care

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◆ Most low back problems can be managed in primary care because the overall prognosis is excellent; surgery is necessary in only a small minority.^{1-3,24} ◆ Radiographs and modern imaging have a limited role in part because many anatomic abnormalities are common in asymptomatic persons and appear to be purely incidental findings.²⁵⁻²⁸ ◆ Because of the weak association between symptoms and imaging results, diagnostic uncertainty is the norm. Key goals of early evaluation are to rule out systemic diseases (e.g., metastatic cancer, bone or epidural infection, inflammatory spondyloarthropathies); to identify the patients with neurologic impairments; and to identify factors which may delay recovery (e.g., depression, substance abuse, adversarial compensation proceedings).^{29,30} ◆ Bed rest does not help recovery; early return to normal activities is the optimal activity recommendation.³ ◆ Exercise is inadvisable in the face of acute pain, but is helpful for preventing recurrences after the acute episode subsides. It is also a cornerstone of care for chronic back pain.³¹⁻³³
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Table 2. Key Strategies for Improving Care for Low Back Pain***Preoffice Visit**

- ◆ Public service announcements, newsletters, or standardized educational material available to patients prior to acute episode to minimize expectations of x-rays, imaging, and bed rest (1)
- ◆ Dedicated phone number for access to triage nurse or other provider (6)
 - With patient agreement, an informative wait inserted before appointment is made
 - Recommended self-management techniques and symptom relief offered to patient
 - Patient provided with information on usual course of treatment prior to visit

At the Time of Care

- ◆ Physician uses patient history and brief physical examination to rule out serious underlying disease (9)
- ◆ Imaging and surgical referrals made only when appropriate:
 - Number of views for plain x-rays is limited by protocol (e.g., eliminating obliques and coned lateral) (4)
 - Informative wait before ordering tests or making referral (6)
 - Telephone consultations with surgical and nonsurgical specialists readily available to primary care physician (6)
 - Imaging and referral utilization data provided and reviewed with physician, including comparisons with peers or with guidelines (13)
 - New options to refer appropriate patients to nonsurgical specialists: spine center, physical therapist, physiatrist, support/educational group or other sources for patients who do not improve within 4-6 weeks, yet have no surgical indications (1)
- ◆ Patient interaction guides (script, checkoff list) and standardized patient educational material to counsel patient on recommended course of treatment and self-management techniques (6)
- ◆ "Outlier" rates of imaging or referral used to identify clinics or physicians for targeted intervention (1)
- ◆ Decision aids (laminated cards, computer reminders, check lists) to reinforce indications for imaging or surgical consultation (4)
- ◆ "Academic detailing" (1-on-1 advising with eye-catching handouts) to introduce key guidelines, provide rationale, and references (5)
- ◆ Influential peers involved in developing or adapting guidelines, decision aids, patient education materials, and detailing materials (11)
- ◆ Multidisciplinary review conference for planned surgical cases (1)

To Accelerate Return to Work**Providers and employers**

- ◆ Agree on standard treatment protocols, reporting forms, and return-to-work procedures (4)
- ◆ Consider detailing sheet to educate patients and employers (0)
- ◆ Identify key points of contact at both physician's office and corporate site (4)

Employers

- ◆ Institute transitional return-to-work policies and provide flexibility in job assignments (2)
- ◆ Provide time during day for recommended exercise and rehabilitation (0)
- ◆ Call patients to express concern, enthusiasm for early return to job (0)

Providers

- ◆ Reduce prescriptions for bed rest and time off (10)
- ◆ Avoid unnecessary x-rays and imaging (8)
- ◆ Prescribe return to normal activities, appropriate exercise (part of patient education efforts)
- ◆ Visit employers to build communication and provide education (1)

*Approximate number of plans attempting each strategy is shown in parentheses.

Aims for Improvement

Participating organizations focused on different problems depending on local situations. Examples were reducing unnecessary imaging, reducing bed rest prescriptions, and encouraging rapid return to work. Many teams set goals derived from the AHCPR guideline for low back problems, but they were encouraged to identify specific aspects to focus their efforts and to provide opportunities for monitoring improvements.

Analysis

Because each team had its own clinical goals, outcome measures, and data sources, results were not reported in a uniform fashion. Nonetheless, collaborative leaders encour-

aged some specific outcome measurement strategies. First, organizations were advised to use their administrative databases when useful, but not to delay implementing changes or monitoring impacts for anticipated refinements in the information system. Participants were urged to use the brief outcome questions in Table 3, and to obtain frequent patient samples, if only of small numbers. Thus, for example, a common strategy was to call a random sample of 10 or 20 patients at 6 weeks following an initial visit for back pain. The outcome questions were administered, and a new sample was contacted the following week or the following month. The measures in Table 3 were therefore used not primarily to track the outcomes of individual patients, but to provide an ongoing assessment of system performance.

Teams were then encouraged to prepare annotated time series graphical presentations of their results. Al-

Table 3. Proposed Core Outcome Measures

1. During the past week, how bothersome have each of the following symptoms been? (circle one number in each row)	Not at all bothersome	Slightly bothersome	Moderately bothersome	Very bothersome	Extremely bothersome
a. Low back pain	1	2	3	4	5
b. Leg pain (sciatica)	1	2	3	4	5
2. During the past week, how much pain did pain interfere with your normal work (including both work outside the home and housework)?	☐ Not at all	☐ A little bit	☐ Moderately	☐ Quite a bit	☐ Extremely
3. If you had to spend the rest of your life with the symptoms you have right now, how would you feel about it?	☐ Very dissatisfied	☐ Somewhat dissatisfied	☐ Neither satisfied nor dissatisfied	☐ Somewhat satisfied	☐ Very satisfied
4. During the past 4 weeks, about how many days did you cut down on the things you usually do for more than half the day because of back pain or leg pain (sciatica)? _____ Number of days					
5. During the past 4 weeks, how many days did low back pain or leg pain (sciatica) keep you from going to work or school? _____ Number of days					
6. Over the course of treatment for your low back pain or leg pain (sciatica), how satisfied were you with your overall medical care?	☐ Very dissatisfied	☐ Somewhat dissatisfied	☐ Neither satisfied nor dissatisfied	☐ Somewhat satisfied	☐ Very satisfied

though changes could not be implemented in the fashion of controlled trials in these routine-care settings, the time-series presentation helped identify changes and permitted better evaluation of the quality improvement efforts than is typical in most practices.

RESULTS

Goals

The most common goals were reduction in the use of imaging tests (8 teams); more appropriate use of referrals (6 teams); improvement in patient functional status or satisfaction (6 teams); reduction in use of bed rest (5 teams); and reducing work absenteeism (5 teams). Some focused on reducing specific types of imaging, such as oblique x-ray views or myelograms. Goals reported by fewer teams included reducing the use of high cost medicines, decreasing return visits to urgent care centers, and increasing physician satisfaction. One plan, which had previously identified an unusually high surgery rate among enrollees, sought to decrease surgery rates. Some plans sought to modify the

use of physical therapy, either by reducing early referrals, or facilitating early use of physical therapists for patient education, in part as a substitute for primary physician visits.

Strategies

Most of the strategies listed in Table 2 were employed by at least some of the groups, although the wide array of activities undertaken makes it impossible to report all interventions and results. System changes were often the most effective interventions, because they made desired behavior the "default." For example, the number of views obtained on a routine x-ray protocol, or the timing and content of initial physical therapy visits were modified by some participants. A more extensive example was a new spine clinic, staffed by a physiatrist, a nurse practitioner, and an exercise physiologist. This created a referral option for more comprehensive conservative care prior to surgical referral.

Many plans mailed guidelines to their physicians and developed continuing medical education (CME) programs. However, most successful teams emphasized personal

meetings with individual physicians ("academic detailing"), rather than relying strictly on written information. Several developed "detailing sheets" with attractive visuals and supporting documentation aimed at imaging practices or bedrest prescribing. Some teams noted the value of involving clinic staff as well as physicians in implementing changes and monitoring progress.

Many teams developed patient education materials. These varied in format, and included printed materials, videotapes, computer-based programs for waiting rooms, and educational classes. Some implemented a telephone follow-up system. Many participants created decision aids for physicians, including pocket reminders and special medical record forms. Several teams established ties with local industries in an effort to reduce work loss, though these were not sufficiently advanced during the 1-year program to test changes.

In general, the successful teams were those that implemented multiple interventions, usually 6 or more of the strategies listed in Table 2. Because most teams implemented multiple changes simultaneously and with varying degrees of rigor, we cannot be highly precise in identifying the most effective interventions. However, our impression was that system changes (e.g., to standard radiographic, physical therapy, and referral protocols) were often the most effective.

A variety of factors impeded the teams that made little or no progress. In some cases, improving back care never achieved a high administrative priority within the organization. Some teams were unsuccessful because they tried initially to implement changes throughout a large system rather than testing strategies on a small scale. Others never really functioned, because the right people were not involved or members were lost during the program. Some groups relied too heavily on simply distributing guidelines, and others (especially some insurance plans) had too little direct contact with physicians or other clinical staff.

Outcome Measures

Most teams employed at least some of the outcome measures in Table 3. Many added questions particular to their own situations and goals. For example, some asked whether bed rest was prescribed and how much. Several examined rates of imaging tests. One developed a novel ratio to assess the overall use of advanced imaging: the ratio of computed tomography scans, magnetic resonance imaging scans, and myelograms to the number of lumbar surgical procedures. Using the rationale that these tests should generally be reserved for patients who appear clinically to be surgical candidates, the team specified that this ratio should be low (less than 4:1).

Observed Quality Improvements

Participants self-rated quality improvements on a 5-point scale: 1 = nonstarter, 2 = activity (e.g., collecting

data) but no changes, 3 = modest improvement (anecdotal evidence, measurable local changes, early system-wide change), 4 = substantial progress (measurable change in several sites or at system level), and 5 = outstanding sustainable results (system-wide changes, results at national leading edge). These ratings were used to monitor progress and evaluate final results. The planning committee used these ratings and their own observations to rate each team on the same scale. Six teams' progress was rated as 4.0 or higher, another 6 were rated as 3.5, and the remainder were rated as 3.0 or less. Specific case reports illustrate the progress made by some of the more successful teams.

CASE 1

A medical group had 70 physicians in 18 practice sites. Two sites were seen as particularly receptive to quality improvement efforts. Key goals were to reduce bed rest, imaging, and physical therapy, and to increase the use of patient education materials. Interventions included new patient education materials, CME and academic detailing, new medical record forms, and feedback to physicians about their practice patterns. Although effects on bedrest prescribing were modest, 1 site showed substantial decreases in use of magnetic resonance imaging and physical therapy (from about 10% of patients to near zero for both) while increasing use of patient education materials (over 100%) and maintaining patient satisfaction (Figure 1).

CASE 2

An academic medical center identified its goals as reducing myelography, early physical therapy referrals, and lumbar spine films. Key strategies were to identify the highest utilizers of myelograms and to demonstrate that the test had little influence on clinical decisions; to insert an educational 20-minute visit with a physical therapist and schedule follow-up only if symptoms were unresolved in 6 weeks; to disseminate imaging guidelines; and to reduce the standard lumbar spine radiographic protocol from 5 views to 3.¹⁹⁻²³ Myelography use decreased 23%; early physical therapy fell by 30%; use of plain radiographs was reduced by 30%; and the standard institutional radiographic protocol was modified to reduce the number of routine views.

CASE 3

A large insurance company serving several cities focused on improving functional status and reducing work absenteeism. Strategies included mailing guidelines to primary care physicians, orthopaedists, and neurosurgeons; developing patient handouts for physicians' offices; CME programs for primary care physicians; meetings with major employers and unions; mailed reminders;

FIGURE 1. Selected measures of process and outcome in 1 intervention clinic. Data are plotted for 2 baseline months and 7 months of intervention. Data are based on recurrent samples of approximately 10 patients for each month.

modified medical record forms; and individual physician feedback on guideline compliance. There was an 81% decrease in bedrest prescriptions; reduced symptom severity; less reported interference of back pain with work; and improved satisfaction with care over a 10-month interval (Figure 2).

DISCUSSION

These experiences suggest that rapid improvements in care for back pain are difficult but feasible. Although only 27% of the participating organizations posted major

improvements, this can be seen as a substantial gain over the status quo. Furthermore, most organizations made at least minor progress in appropriate use of services, less use of bed rest, or reductions in work absenteeism. Several participants reported greater use of patient education and higher levels of patient satisfaction. In some circumstances, it was possible to improve practice simply by modifying standing protocols for radiographic studies or physical therapy. System changes that made it easy to “do the right thing” were often the most successful interventions.

The experience also suggested the importance of a local process and a specific focus in implementing guidelines. Although many organizations based their interventions on the AHCPR guidelines, these were usually adapted to local circumstances and resources. In the process, local physicians became involved and became advocates for the guidelines. Rather than attempting to implement every detail of a lengthy guideline, successful teams focused on specific decisions or features of the guideline and used multiple interventions to make appropriate changes. Several teams noted the importance of vigilance and ongoing intervention, as early gains were sometimes reversed after an initial intervention.

Quality improvements of this sort may be difficult to achieve in isolation, without the team interaction, encouragement, and coaching of the collaborative program. Nonetheless, we believe organizations undertaking such efforts may benefit from some of the resources and experiences described here. Key ingredients appear to be confidence in the scientific basis for changes, setting specific goals, rapidly testing changes on a small scale, monitoring impacts, and engaging both clinicians and administrators. These efforts require real resources—time, money, and commitment—that may be difficult to garner in some settings.

Although there is an important gap between research findings and practice for back pain, this condition has not been the focus of quality improvement efforts. This may be in part because of the diffuse nature of back pain care. Within a healthcare system, patients may present with back pain in the emergency room, primary care clinics, or specialty clinics. Each specialty has unique approaches, and inpatient care is infrequent. Patient expectations and demands probably drive much of current utilization. Thus, many would find this a difficult problem for which to improve quality and efficiency. The successes of some organizations in this collaborative, however, suggest that improvements can be achieved even for this vexing ambulatory symptom.

Furthermore, the full impacts of changes in primary care may only be realized after a substantial period of time. For example, patients who are better educated about the benign nature and favorable prognosis of back pain may be less likely to seek additional care or unnecessary tests. Reduced testing may in turn reduce ill-advised treatments. Thus, improvements in primary care may have favorable but slowly evolving cascade effects.

FIGURE 2. Selected process and outcome measures for a large insurance plan. Data are plotted for 1 baseline month and 7 months of intervention. Data are based on recurrent samples of 10 to 25 patients per month.

This report is limited by the absence of a comparison group without interventions, the absence of formal hypothesis testing, and the highly individualized nature of the interventions and evaluations. Furthermore, most of the evaluations were based on small samples of patients. However, these limitations reflect the nature of quality improvement efforts in general, and the necessity of highly tailored efforts.

We may hope that the strategies listed in Table 2 will evolve into a well-integrated image of optimal care for back pain, leading to systems performing at unprecedented levels. As demonstrated by some of our participants, such a system would make extensive use of patient education, reassurance, and self-care, and sparing use of diagnostic tests. As in the new spine clinic at one HMO, it would provide supervised exercise therapy to prevent recurrences and treat chronic back pain. Both providers and employers would encourage early return to normal activities and facilitate communication among the workplace, the health system, and the patient. Reminders and cues might bol-

ster primary physicians' confidence in evaluating patients and making optimal referrals. Such a system might help reverse the unnecessarily large impact of back pain on patients, health care costs, and employers.

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REFERENCES

1. Bigos S, Bowyer O, Braen G, Brown K, Deyo R, Haldeman S, Hart JL, Johnson EW, Keller R, Kido D, Liang MH, Nelson RM, Nordin M, Owen BD, Pope MH. Acute low back problems in adults. Clin Prac Guideline No. 14, AHCPR. Publication 1994;95-0643.
2. Deyo RA. Acute low back pain: a new paradigm for management. *BMJ*. 1996;313:1343.
3. Waddell G, Feder G, Lewis M. Systematic reviews of bed rest and advice to stay active for acute low back pain. *Br J Gen Pract*. 1997;47:647-52.
4. Schroth WS, Schectman JM, Elinsky EG, Panagides JC. Utilization of medical services for the treatment of acute low back pain:

- conformance with clinical guidelines. *J Gen Intern Med.* 1992;7:486-91.
5. Swedlow A, Johnson G, Smithline N, Milstein A. Increased costs and rates of use in the California workers' compensation system as a result of self-referral by physicians. *N Engl J Med.* 1992;327:1502-6.
 6. Volinn E. Between the idea and the reality: research on bed rest for uncomplicated acute low back pain and implications for clinical practice patterns. *Clin J Pain.* 1996;12:166-70.
 7. Cherkin DC, Deyo RA, Wheeler K, Ciol MA. Physician views about treating low back pain. The results of a national survey. *Spine.* 1995;20:1-9.
 8. Cherkin D, Deyo RA, Berg AO. Evaluation of a physician education intervention to improve primary care for low-back pain. II. Impact on patients. *Spine.* 1991;16:1173-8.
 9. Cherkin DC, Deyo RA, Berg AO, Bergman JJ, Lishner DM. Evaluation of a physician education intervention to improve primary care for low-back pain. I. Impact on physicians. *Spine.* 1991;16:1168-72.
 10. Cherkin DC, Deyo RA, Street JH, Hunt M, Barlow W. Pitfalls of patient education. Limited success of a program for back pain in primary care. *Spine.* 1996;21:345-55.
 11. Berwick DM, Nolan TW. Physicians as leaders in improving health care: a new series in *Annals of Internal Medicine*. *Ann Intern Med.* 1998;128:289-92.
 12. Berwick DM. Continuous improvement as an ideal in health care. *N Engl J Med.* 1989;320:53-6.
 13. Kilo CH. Improving care through collaboration. *Pediatrics.* 1999;103(suppl):384-93.
 14. Kilo CM. A framework for collaborative improvement: lessons from the Institute for Healthcare Improvement's Breakthrough Series. *Qual Manag Health Care.* 1998;6:1-13.
 15. Langley GJ, Nolan KM, Nolan TW, Norman CL, Provost LP. *The Improvement Guide: A Practical Approach to Enhancing Organizational Performance.* San Francisco, Calif: Jossey-Bass Publishers;1996.
 16. Deyo RA, Battie M, Beurskens AJHM, et al. Outcome measures for low back pain research: a proposal for standardized use. *Spine.* 1998;23:2003-13.
 17. Ware JE, Sherbourne C. The MOS 36-item short-form survey (SF-36). I. Conceptual framework and item selection. *Med Care.* 1992;30:473-83.
 18. Daltroy LH, Cats-Baril WL, Katz JN, Fossel AH, Liang MH. The North American Spine Society Lumbar Spine Outcome Assessment Instrument: reliability and validity tests. *Spine.* 1996;21:741-9.
 19. Eisenberg RL, Akin JR, Hedgcock MW. Single, well centered lateral view of lumbosacral spine: is coned view necessary? *Am J Radiol.* 1979;133:711-3.
 20. Rhea JT, DeLuca SA, Llewellyn HJ, Boyd RJ. The oblique view: an unnecessary component of the initial adult lumbar spine examination. *Radiology.* 1980;134:45-7.
 21. Scavone JG, Latshaw RF, Weidner WA. Anteroposterior and lateral radiographs: an adequate lumbar spine examination. *Am J Radiol.* 1981;136:715-7.
 22. Gehweiler JA, Daffner RH. Low back pain: the controversy of radiologic evaluation. *Am J Radiol.* 1983;140:109-12.
 23. Eisenberg RL, Hedgcock MW, Williams EA, et al. Optimum radiographic examination for consideration of compensation awards: II. Cervical and lumbar spines. *Am J Radiol.* 1980;135:1071-4.
 24. Waddell G. A new clinical model for the treatment of low-back pain. *Spine.* 1987;12:632-44.
 25. Boden SD, Davis DO, Dina TS, Patronas NJ, Wiesel SW. Abnormal magnetic-resonance scans of the lumbar spine in asymptomatic subjects: a prospective investigation. *J Bone Joint Surg.* 1990;72A:403-8.
 26. Wiesel SW, Tsourmas N, Feffer HL. A study of computer assisted tomography. I. Incidence of positive CAT scans in an asymptomatic group of patients. *Spine.* 1984;9:549-51.
 27. Stadnik TW, Lee RR, Coen HL, Neiryuck EC, Buisseret TS, Osteaux MJC. Annular tears and disk herniation: prevalence and contrast enhancement on MR images in the absence of low back pain or sciatica. *Radiology.* 1998;206:49-56.
 28. Jensen MC, Brant-Zawadzki MN, Obuchowski N, Modic MT, Malkasian D, Ross JS. Magnetic resonance imaging of the lumbar spine in people without back pain. *N Engl J Med.* 1994;331:69-73.
 29. Deyo RA, Rainville J, Kent DL. What can the history and physical examination tell us about low back pain? *JAMA.* 1992;268:760-5.
 30. Deyo RA. Early diagnostic evaluation of low back pain. *J Gen Intern Med.* 1986;1:328-38.
 31. Malmivaara A, Hakkinen U, Aro T, et al. The treatment of acute low back pain—bed rest, exercises, or ordinary activity? *N Engl J Med.* 1995;332:351-5.
 32. Lahad A, Malter AD, Berg AO, Deyo RA. The effectiveness of four interventions for the prevention of low back pain. *JAMA.* 1994;272:1286-91.
 33. Manniche C, Hesselsoe G, Bentzen L, Christenson I, Lundberg E. Clinical trial of intensive muscle training for chronic low back pain. *Lancet.* 1988;2:1473-6.

APPENDIX

Low Back Pain Collaborative Planning Group

Timothy Carey, MD
University of North Carolina at Chapel Hill
Chapel Hill, NC

Penny Carver
Institute for Healthcare Improvement
Boston, MA

Daniel Cherkin, Ph.D.
Group Health Cooperative of Puget Sound
Seattle, WA

Richard Deyo, MD, MPH
University of Washington
Seattle, WA

Alan Jette, PT, Ph.D.
Boston University
Boston, MA

Charles M. Kilo, MD, MPH
Institute for Healthcare Improvement
Boston, MA

Ferdy Massimino, MD, MPH
Kaiser Permanente Oakland
Oakland, CA

Barry Jay Miller, MD
Kaiser Santa Teresa Medical Center
San Jose, CA

Robert Mootz, DC
Washington Dept. of Labor & Industries
Olympia, WA

Thomas Nolan, Ph.D.
Associates in Process Improvement
Silver Spring, MD

Marie Schall, MA
Institute for Healthcare Improvement
Moorestown, NJ

Jeffrey Susman, MD
University of Nebraska Medical Center
Omaha, NE

John R. Thornbury, MD
Castle Rock, CO

James Weinstein, DO
Dartmouth Medical Center
Hanover, NH

Kaiser Permanente
Lakeville, CT

Kaiser Permanente Oakland
Oakland, CA

Lovelace Healthcare Innovations
Albuquerque, NM

Luther/Midelfort – Mayo Health System
Eau Claire, WI

Mayo Medical Center
Rochester, MN

Mercy Healthcare Sacramento/
Catholic Healthcare West
Sacramento, CA

OSF St. Francis Medical Center
Peoria, IL

Palmer Center for Chiropractic Research
Davenport, IA

Rochester Community Individual Practice Association
Rochester, NY

Texas Back Institute
Plano, TX

University of North Carolina Hospital
Chapel Hill, NC

University of Washington Medical Center
Seattle, WA

Wellmark, Inc.
Des Moines, IA

Wellpoint
Costa Mesa, CA

Low Back Pain Collaborative Participants

Blue Cross Blue Shield of Georgia
Atlanta, GA

Blue Cross Blue Shield of Kansas City
Kansas City, MO

Camcare Research Institute
Charleston, WV

Community Hospitals Indianapolis
Indianapolis, IN

Group Health Cooperative
Seattle, WA

Harvard Pilgrim Health Care
Brookline, MA

Health Care Network
Brookfield, WI

Health Care Plan
Amherst, NY