Assessing the Implementation of the Chronic Care Model in Quality Improvement Collaboratives

*Marjorie L. Pearson, Shinyi Wu, Judith Schaefer,
Amy E. Bonomi, Stephen M. Shortell, Peter J. Mendel,
Jill A. Marsteller, Thomas A. Louis, Mayde Rosen,
and Emmett B. Keeler*

Objective. To measure organizations' implementation of Chronic Care Model (CCM) interventions for chronic care quality improvement (QI).

Data Sources/Study Setting. Monthly reports submitted by 42 organizations participating in three QI collaboratives to improve care for congestive heart failure, diabetes, depression, and asthma, and telephone interviews with key informants in the organizations.

Study Design. We qualitatively analyzed the implementation activities of intervention organizations as part of a larger effectiveness evaluation of yearlong collaboratives. Key study variables included measures of implementation *intensity* (quantity and depth of implementation activities) as well as *fidelity* to the CCM.

Data Collection/Extraction Methods. We developed a CCM-based scheme to code sites' intervention activities and criteria to rate their depth or likelihood of impact.

Principal Findings. The sites averaged more than 30 different change efforts each to implement the CCM. The depth ratings for these changes, however, were more modest, ranging from 17 percent to 76 percent of the highest rating possible. The participating organizations significantly differed in the intensity of their implementation efforts ($p < .001$ in both quantity and depth ratings). Fidelity to the CCM was high.

Conclusions. Collaborative participants were able, with some important variation, to implement large numbers of diverse QI change strategies, with high CCM fidelity and modest depth of implementation. QI collaboratives are a useful method to foster change in real world settings.

Key Words. Quality improvement, implementation evaluation, chronic care model, organizational change, quality improvement collaboratives

The Institute of Medicine's report, *Crossing the Quality Chasm: A New Health System for the 21st Century* (IOM 2001), has challenged health care practitioners, administrators, and policymakers to implement major reforms to reinvent the nation's health care delivery system. Chronic care quality improvement (QI) collaboratives offer one set of comprehensive strategies for restructuring chronic care delivery systems. The collaboratives combine rapid-cycle change methods with multiple change strategies suggested by the Chronic Care Model (CCM) to facilitate improvements in processes and outcomes of care for people with chronic illness (ICIC 2003a, 2003b; IHI 2003). The CCM recommends organizational change in six areas: delivery system redesign, patient self-management support, decision support, information support, community linkages, and health system support. While change strategies have been implemented with success in each of the six areas (Wagner, Austin, and Von Korff 1996; Von Korff et al. 1997), little is known about how implementation in all six areas affects processes and outcomes of care (Bodenheimer, Wagner, and Grumbach 2002a, 2002b).

The RAND/Berkeley Improving Chronic Illness Care Evaluation (ICICE) team was charged with assessing the implementation and impact of the chronic care collaboratives. Key objectives were to evaluate (1) the success of the chronic care collaboratives in inducing the changes needed to implement the CCM and (2) the effects on costs, processes, and outcomes of care in organizations which were successful in varying degrees in implementing CCM (Cretin, Shortell, and Keeler 2004). This paper focuses on the first objective by addressing the following question: Did the participating organizations succeed in making CCM changes to their care delivery systems?

METHODS

Setting

The data are derived from three chronic care collaboratives conducted between 1999 and 2002. The QI collaborative process, developed by the

Address correspondence to Marjorie L. Pearson, Ph.D., M.S.H.S., RAND Corporation, 1776 Main Street, P. O. Box 2138, Santa Monica, CA 90407. Shinyi Wu, Ph.D., Peter J. Mendel, Ph.D., Mayde Rosen, R.N., B.S.N., and Emmett B. Keeler, Ph.D., are all with the RAND Corporation. Judith Schaefer, M.P.H. and Amy E. Bonomi, Ph.D., M.P.H., are with the MacColl Institute for Health Care Innovation, Center for Health Studies, Group Health Cooperative, Puget Sound, Seattle, WA. Stephen M. Shortell, Ph.D., M.P.H., is with the School of Public Health, University of California, Berkeley, Berkeley, CA. Jill A. Marsteller, Ph.D., M.P.P., and Thomas A. Louis, Ph.D., are with the John Hopkins Bloomberg School of Public Health, Baltimore, MD.

Institute for Healthcare Improvement (IHI), brings together teams from 20 or more health care organizations in three learning sessions to work together to improve performance in a specific clinical or operational area. In between learning sessions, the teams focus on small, rapid cycle changes to implement the change concepts in their practices. A faculty comprised of national experts provides clinical and technical guidance throughout the collaborative (IHI 2003).

Two of the study collaboratives were organized on a nationwide basis by Improving Chronic Illness Care (ICIC) and IHI; one focused on diabetes and congestive heart failure and the other on depression and asthma. (While each collaborative addressed two chronic conditions, all of the participating organizations chose only one of the conditions to address.) The remaining collaborative was the regional Washington State Diabetes Collaborative II, cosponsored by Qualis and the Washington State Health Department. Forty-two of 74 health care organizations agreed to take part in the evaluation. (Participation in the evaluation involved patient surveys, medical chart review, and staff surveys in addition to the staff interviews needed for the analyses in this paper [Cretin, Shortell, and Keeler 2004]. Organizations that declined to participate generally cited the added burden of patient data collection as their reason for refusal.)

Method Development

Since QI evaluation research currently lacks well-defined methods for measuring implementation, we needed to define methodology appropriate for our task. To do so, we developed a conceptual framework for characterizing intervention activities, identified sources of data on change activities, developed and pretested coding procedures, created interview protocols, developed a rating system for variable construction, and applied this methodology to data from the collaboratives. These steps are summarized below. (For greater detail, see technical appendix on <http://www.rand.org/publications/WR/WR217>.)

Conceptual Framework

Implementation evaluations may target numerous different aspects of implementation for study (Rossi, Freeman, and Lipsey 1999). Given our research question, we identified the *fidelity* and the *intensity* of the change activities as the aspects of greatest interest for this research.

Fidelity (Moncher and Prinz 1991; McGrew et al. 1994; McHugo et al. 1999; Bond et al. 2000) is defined in terms of alignment of the change activities with the different elements of the CCM. To identify the CCM elements and intervention activities congruent with them, we reviewed literature on the CCM and chronic care QI interventions, as well as IHI materials on suggested change concepts. We organized these change concepts hierarchically, starting with the six main CCM elements (delivery system redesign, self-management support, decision support, information systems, community linkages, and health system support) and branching into three levels of detail. This categorization scheme formed the basis for assessing the alignment of intervention change activities with CCM elements.

To assess implementation *intensity* (Shortell et al. 1995; Wickizer et al. 1998; Montori et al. 2002), we examined the *quantity* and the *depth* of the intervention activities. Operationalization of these concepts will be described under Implementation Intensity Measures below.

Data Sources for Coding

Our primary sources of data were organization documents and interviews. As part of their collaborative participation, sites submitted monthly progress reports to the collaborative facilitators for review and feedback. These documents were reviewed by the organizations' senior leaders and included brief descriptions of the small rapid cycle changes implemented each month. While their internal and external scrutiny lent credibility to these reports as sources of valid information on the organizations' change actions, we verified the information through interviewing each organization's team leader(s). We also supplemented these report and interview data with materials the sites presented at the final session of the collaborative. We coded all senior leader reports (up to 13 per organization) submitted by participants in the regional and one national collaborative. To conserve resources, only the summary senior leader report and subsequent reports were coded for the other national collaborative. See the technical appendix at <http://www.rand.org/publications/WR/WR217> for a comparison of these two approaches.

Coding Protocol

Each reported change activity was assigned two codes. The first code designated what CCM category the change targeted (at the lowest level of the categorization scheme). Figure 1 illustrates a coding path for an intervention activity identified at the first and most general level as redesign of the delivery

Figure 1: Coding Path

system. At level 2, a determination was made of the aspect of the delivery system targeted by the particular change activity (care management roles, team practice, care coordination, proactive follow-up, planned visits, or the visit system itself). Level 3 allowed for further characterization of that particular aspect. As the example in Figure 1 shows, a delivery system redesign change that targeted the visit system could be further identified as one that relocated a service, streamlined the appointment process, coordinated scheduling with other providers, facilitated back-to-back scheduling, provided home visits, provided phone visits, or provided group visits. The second code designated whether the activity appeared to be an *active change*, a *plan or preparation* for such change, or a *repeated* report of an earlier entry.

The coding protocols were pilot-tested and iteratively revised. Two researchers independently coded all reports and discussed discrepancies. Inter-coder reliability was assessed on a sample of senior leader reports.

The text of the monthly report change descriptions and the assigned codes were entered into *NVivo*, a qualitative research software program, along with any additional activities mentioned by the sites at their final collaborative session. We used *NVivo* to generate a draft log of all CCM change activities for each site. Questions that could not be resolved by coders at this stage were entered into the log for follow-up during subsequent telephone interviews.

Exit Interview Protocol

We conducted exit interviews with each organization's team leader(s) to verify our understanding of that site's intervention activities. Prior to each interview, we sent the site a copy of our draft log of their change activities with a cover letter asking the team leader to review it for possible omissions and misinterpretations and to be prepared to answer the site-specific questions. The new information was used to update that site's *NVivo* log.

Implementation Intensity Measures

Since our focus is on the CCM changes implemented, and not the decision-making process leading up to these changes, we limited these analyses to the reported activities that constituted actual changes in systems or practices. We created two indicators of CCM implementation intensity at each of the second levels of the CCM coding tree: (1) the total count of the organization's change activities in that CCM category and (2) a qualitative rating of the depth of the change on a 0–2 scale (see Figure 1). Both can be aggregated to create

summary variables for each of the six main CCM elements and for a CCM characterization as a whole.

To create the implementation depth variables, we rated the site's change activities as one of three levels of depth: 2 = change activity likely to have an impact according to CCM theory, 1 = change activity not likely to have an impact, or 0 = no change activity in that CCM area. The depth assignment of 2 was made according to predefined criteria, grounded in CCM theory and specific to the CCM element addressed. We developed these depth criteria based on materials distributed to collaborative participants, our notes from collaborative sessions, review of the CCM literature, and input from researchers and QI facilitators with extensive CCM expertise. These criteria are included in Table A1 of the technical appendix on <http://www.rand.org/publications/WR/WR217>.

The depth ratings are presented as percents of the maximum rating possible in each category. The maximum ratings possible reflected the number of second-level categories assigned to each of the CCM elements in our coding scheme. Since the rating for each of the 23 second-level subcategory ranges from 0 to 2, a site could get as many as 46 points overall.

Assessment of Chronic Illness Care (ACIC) Data

We compared the implementation intensity measures with data from sites' own assessments of the degree to which their current practices were congruent with the CCM. As part of their collaborative participation, sites were asked to complete the ACIC survey instrument (Bonomi et al. 2002; ICIC 2003c), once at the beginning of the collaborative (baseline) to identify areas for improvement and again towards the end of the collaborative (follow-up) to assess their progress. Baseline and follow-up ACIC scores were derived and the difference of the two scores was computed for each CCM element for each site.

Analysis

Descriptive statistics were used to examine variations in implementation intensity. Additionally, one sample *t*-test and an approximate *F*-test were used to evaluate whether the counts and the depth ratings were statistically the same for all 42 sites. Pearson correlation coefficients were used to study the relationships (1) between the two implementation intensity measures and (2) between the implementation measures and the ACIC scores.

RESULTS

Inter-Coder Reliability

After the coding protocols were revised based on the pilot tests, assessment of reliability showed an initial agreement of 82 percent and final agreement (following discussion) of 100 percent.

CCM Fidelity

Site fidelity to the major elements of the CCM was high. Forty-one of the 42 organizations (98 percent) made changes in at least five of six CCM elements and 34 (81 percent) did so in all six elements. Every organization implemented at least one intervention to improve both self-management support and information support. Six sites did not implement community linkage changes.

A multi-component emphasis is similarly reflected in the data on change activities at the second level of our CCM tree (not shown). While no site reported change efforts in all 23 of the second-level categories, the sites worked on interventions in 15 of the different categories, on average. The number of categories with changes ranged from 8 to 22 among the sites.

Intensity of Change Efforts

Table 1 presents descriptive statistics on the quantity and depth of change efforts implemented in each of the six major CCM elements and their second level subcategories.

Quantity. The collaboratives generated a large number of change activities across the 42 study sites to align delivery systems for better chronic illness care. Those with full coding reported 48 changes on average per site ($SD = 23.2$), and those with summary coding 33 changes on average per site ($SD = 14.8$). To give some example of the activities counted, the delivery system changes reported by one clinic working to improve depression care included the following five: they hired a nurse depression care manager, integrated a team approach to depression care (physician and/or nurse practitioner, nurse, care manager, and social worker), moved a social worker into the primary care area to improve coordination, initiated phone follow-up with patients, and implemented social worker home visits and walk-in appointments. A medical center implemented five registry changes to improve diabetes care: they identified diabetes patients for their initial

Table 1: Descriptive Statistics of Implementation Intensity

	Quantity				Depth	
	Sites with Full Coding* (n = 24)		Sites with Summary Coding† (n = 18)		All Sites (n = 42)	
	Mean	%	Mean	%	Mean	% Max. Possible
1. Delivery system redesign	8.6	18	6.1	18	5.5	46
A. Care management roles	1.0		1.4		1.1	
B. Team practice	0.4		0.3		0.3	
C. Care delivery/coordination	1.4		1.3		1.1	
D. Proactive follow-up	3.1		2.1		1.4	
E. Planned visit	1.2		0.4		0.7	
F. Visit system change	1.6		0.5		0.9	
2. Self-management support strategies	9.1	19	7.4	23	5.8	49
A. Patient education	3.0		3.4		1.4	
B. Patient activation/psychosocial support	0.8		0.7		0.7	
C. Self-management assessment	1.0		0.5		0.8	
D. Self-management resources and tools	2.3		1.8		1.5	
E. Collaborative decision making with pts.	1.6		0.8		0.8	
F. Guidelines available to patients	0.4		0.3		0.7	
3. Decision support	7.9	17	6.6	20	3.0	50
A. Guideline institutionalization and prompts	4.4		3.4		1.2	
B. Provider education	3.3		2.5		1.3	
C. Expert consultation support	0.3		0.7		0.5	
4. Information support	11.1	23	5.6	17	3.7	62
A. Patient registry system	4.8		2.5		1.3	
B. Use of information for care management	4.5		2.2		1.3	
C. Feedback of performance data	1.8		0.9		1.1	
5. Community linkages	3.6	8	2.5	8	1.8	44
A. For patients	2.3		0.5		0.8	
B. For community	1.3		2.0		0.9	
6. Health systems support	7.5	16	4.8	14	3.0	50
A. Leadership support	2.5		2.6		1.4	
B. Provider participation	1.6		0.2		0.5	
C. Coherent system improvement and spread	3.4		1.9		1.2	
CCM overall	47.8	100	33.0	100	22.8	50

*All senior leader reports were coded for evaluation organizations from the IHI Chronic Care Collaborative II and the Washington State Diabetes Collaborative II. These data are presented under the column heading "Sites with Full Coding."

†Only the summary senior leader reports and subsequent reports were coded for evaluation organizations from IHI Chronic Care Collaborative III. These data are under the column heading "Sites with Summary Coding."

CCM, chronic care model.

registry, hired a registry manager, tested the *Access* database for their registry, added laboratory information to the registry, and developed a laboratory interface.

Depth. Table 1 also shows the mean implementation depth ratings assigned to the intervention activities and the percents those ratings represent of the maximum ratings possible for each category. On average, the organizations achieved an overall depth rating of 22.8 or 50 percent of the maximum rating of 46 (SD = 6.6). This average rating of 1 (some changes) implies that greater depth in some second-level categories was balanced by no changes in others.

Information system changes were implemented in the greatest quantity and depth. The organizations on average devoted 21 percent of their total change efforts to improving information support for chronic illness care, with a depth rating averaging 62 percent of the maximum possible (Table 1). They made a similar proportion of changes (21 percent) to improve self-management support, but with less depth of effort (49 percent of the maximum possible). Sites overall placed least emphasis on community linkages (8 percent of the total quantity and 44 percent of the maximum depth).

At the second level of the CCM framework, changes in proactive follow-up, patient education, self-management resources and tools, provider education, patient registries, capacity to support care management decisions, and leadership support received the greatest focus in terms of both quantity and depth. Changes to engage practice teams, make guidelines available to patients, and provide expert consultation were implemented with the least intensity.

Site Variation

While every site did something to bring their chronic care more in line with CCM, some did considerably more than others. Statistical tests (one sample *t*-test and approximate *F*-test respectively) of site variation in counts and depth ratings indicate that the sites differed significantly in the intensity of their implementation efforts ($p < .001$). The number of active changes tested ranged from 10 to 130 per site (mean 48) among organizations with full coding and 8 to 56 per site (mean 33) among organizations with summary coding. The depth of the reported changes ranged from 17 percent to 76 percent of the maximum rating possible.

Relationship between Quantity and Depth Measures

Counts and depth ratings are significantly correlated overall ($r=0.80$, $p<.001$) and at each of the six element levels ($r=0.67$ to 0.70 ; $p<.0001$). The sites that tested the most changes tended also to have exerted the greatest depth of implementation effort, and the sites that conducted the least changes tended to be rated the lowest. Additionally, the correlations among major CCM categories of depth ratings suggest that, if a site was likely to report deeper changes in one CCM element, it was likely to do so in all other elements except community linkages.

Relationship between Implementation Depth Measure and ACIC Scores

Table 2 shows the correlation between the ACIC scores and our implementation depth ratings for each of the six major CCM elements as well as for the aggregated CCM characterization as a whole. The third column gives the correlation with the difference between the teams' ACIC scores at baseline and at the end of the collaborative, a measure of their self-assessed improvement in CCM care. In general, the depth of the change efforts was negatively correlated with the site's self-assessment prior to the intervention (ACIC baseline scores) and positively correlated with the site's self-assessed progress after the intervention (ACIC follow-up scores), although most of these relationships were not statistically significant. These results suggest that sites tried

Table 2: Correlations between Intervention Depth Ratings and Assessment of Chronic Illness Care (ACIC) Scores

CCM Element	Pearson Correlation Coefficients		
	Depth Rating and Baseline ACIC	Depth Rating and Follow-up ACIC	Depth Rating and the Difference between ACIC Baseline and Follow-up [†]
Delivery system redesign	− 0.25	0.08	0.35*
Self-management support	− 0.11	0.01	0.28
Decision support	− 0.02	0.39*	0.37*
Information support	0.03	0.46**	0.38*
Community linkages	− 0.31	0.11	0.35*
Health systems support	− 0.33*	− 0.05	0.36*
CCM as a whole	− 0.19	0.27	0.44*

*Correlation is significant at the 0.05 level (2-tailed).

**Correlation is significant at the 0.01 level (2-tailed).

[†]Baseline and follow-up ACIC scores were available for 33 of the study sites.
CCM, chronic care model.

more intensive interventions in areas where team members thought the site's performance was weak and, at follow-up, thought they had improved in those areas.

Significant, positive relationships were found between the implementation depth variable and the pre-post differences in the self-reported ACIC scores. The depth ratings were most strongly correlated with self-reported improvements in CCM characterization across CCM as a whole ($r = 0.44$, $p < .05$). The ratings also were significantly correlated with the sites' own assessments of their CCM improvement for five of the six CCM elements ($r \geq 0.35$, $p < .05$).

DISCUSSION

Our evaluation found that most organizations were able to make substantial changes to their systems of chronic care. With collaborative help and encouragement, they made multiple, diverse changes to more closely align their systems with all six major CCM elements. However, the findings also suggest that it is difficult to improve all elements of the CCM at a substantial level of intensity in one year. No organization came close to the maximum depth rating possible in our scheme for rating implementation intensity.

As might be expected with a diverse group of sites, the organizations varied significantly in the intensity of their implementation efforts. Their own assessments of their CCM improvements were correlated with the depth of their implementation activities.

Our findings of high fidelity to the CCM agree with Wagner et al.'s (2001a, 2001b) report of the comprehensiveness across CCM elements of collaborative participants' change efforts. They also suggest that collaborative participants attempted more diverse intervention foci than do most current disease management programs (Weingarten et al. 2002) or physician organizations (Casalino et al. 2003). Over four-fifths of the organizations implemented some interventions in all six CCM elements. Change implementation was not equally divided across CCM elements, however. The organizations worked most intensely on improving information support (24 percent of all their efforts, on average, and 62 percent of the maximum in depth) and least intensely on developing community linkages (8 percent of their efforts and 44 percent in depth).

Within the CCM elements, the organizations' implementation efforts were not equally divided across subcategories either. In implementing

changes to redesign the delivery system, the organizations worked most intensely on proactive follow-up. Similarly, within the larger CCM area of self-management support, the organizations emphasized patient education and self-management resources and tools. CCM sub-areas that received the least implementation emphasis were team practice, guideline availability for patients, and expert consultation support.

While other *QI* strategists have focused on changing provider behavior (Solberg 2000a; Solberg et al. 2000b), the collaborative faculty, in teaching the CCM, encouraged organizations to target their systems of care as well (Cretin, Shortell, and Keeler 2004). Recognizing that limited time and information overload limit physicians' ability to change care processes, systemic supports in the form of increased roles of nonphysician staff and information systems capable of providing reminders, checks, and other decision support were encouraged. The intensive implementation of information system changes suggests that the collaborative teams took seriously this advice to target their systems. Previous research would suggest that targeting systems for change increases the probability of effect on processes and outcomes of care (Lobach and Hammond 1997; Aubert et al. 1998; Renders et al. 2001; Stone et al. 2002; Gilbody et al. 2003).

The organizations varied widely in the effort they put into making changes. At the extremes, the number of changes made by the highest performer was seven times that of the lowest performer, and the ratings for depth of implementation ranged from 17 percent to 76 percent of the maximum possible. The few studies that report on the degree that interventions are implemented, also report wide variation in implementation intensity. Lichtman et al. (2001) reported organizational differences in implementation processes. Rubenstein et al. (1999) found major across-site differences in adherence to intervention protocol activities in six managed care organizations. Site differences, for example, ranged from 42 percent to 88 percent of clinicians trained. Our finding of wide variation in the sites' implementation is not surprising. If implementation varies in structured demonstration trials, we should expect even greater variation in real world *QI* situations, and particularly in collaboratives, which are structured to allow organizations wide latitude in implementation decisions.

The degree of implementation has been found to influence interventions' effectiveness (Shortell et al. 1995; Lipsey and Wilson 2001). Our finding of significant variation in organizations' implementation performance leads us to expect wide variation in intervention effects on processes and outcomes of care. Our current findings suggest a relationship between implementation performance and pre-post differences in the organizations' self-reported

assessments of their performance. As shown in the last column of Table 2, there is significant overall correlation ($r = 0.44$, $p < .05$) between our measure of depth of organizations' intervention efforts and the sites' reported improvement in their chronic care. At the element level, the ratings of the depth of their efforts are positively and significantly associated with increases in their assessments of their systems' performance in all but one of the CCM elements. Increased effort paid off, at least in the teams' view.

Our finding that organizations significantly varied in implementation performance raises the question of cause. The literature suggests that various organizational attributes, including culture, leadership commitment to quality improvement, climate, and motivation, may help explain such differences (Vroom 1964; Naylor, Pritchard, and Ilgen 1980; Quinn and Rohrbaugh 1983; O'Brien et al. 1995; Shortell et al. 1995; Boerstler et al. 1996; Zammuto and Krakower 1999; Shortell et al. 2000; Shortell et al. 2001; Casalino et al. 2003). Other ICICE analyses suggest that perceived team effectiveness is associated with greater implementation (Shortell et al. 2004).

Limitations

While innovative and informative, our assessment methodology has several limitations. First, we only take into account actions taken during the course of the collaborative. If an organization had implemented some CCM element in full prior to the intervention and therefore implemented no changes in this element during the intervention, they would score poorly on our implementation intensity measures. However, this situation was unusual. The ACIC baseline assessments suggested that the participating organizations perceived their preintervention systems as being deficient across CCM areas.

The self-reported nature of our data is a second limitation. The implementation quantity measure in particular is subject to a reporting style bias. Some organizations reported many detailed little steps or PDSA cycles, while other organizations more concisely reported steps at a bigger or more aggregated level. We developed our implementation depth measure, in part, to offset this quantity measure limitation and found that the two measures are significantly and positively correlated. Additionally, we used multiple data sources (monthly reports, collaborative materials, and exit interviews with key informants) to minimize this bias.

Our method of giving a single code to each reported change activity also might be considered a limitation. There is some overlap among CCM elements, due in part to the integrated nature of the CCM concepts. Since one

use of the codes was to count change activities, we needed to keep to one code per activity. We used decision rules to code according to the main or first purpose indicated by the wording in the monthly progress report.

The decision to code only the summary and subsequent monthly reports for one collaborative limits our ability to precisely report the number of changes implemented in that collaborative. Fortunately, the resulting undercount biases our findings in a conservative direction. The similarity of the summary coded sites to the fully coded sites in the relative emphases placed on the different CCM elements suggests that the summary method may provide a viable approach to understanding CCM fidelity.

We developed 23 ratings for depth of implementation, one for each of the second-level components of CCM, which were weighted equally. A first-level CCM element is associated with 2 to 6 ratings, with a resulting maximum score ranging from 4 to 12. Whether these second-level components are equally important could be argued, as could the number of components associated with each CCM element. Our methodology has been reviewed by researchers and QI facilitators with extensive CCM expertise and is similar to that used in the ACIC (Bonomi et al. 2002), but empirical testing has just begun. Subsequent results may suggest the need for reweighting and additional refinements.

While 42 is a large number of organizations, it is still only 57 percent of the eligible collaborative organizations. We would have expected the participation rate to be much higher if this analysis were the only objective of the evaluation, as the additional burden of our team leader interviews is minimal compared to that of patient surveys and medical chart review. While the response rate of 57 percent among eligible collaborative organizations may present a potential limitation for the representativeness of the study sites, there is no evidence of response bias in CCM implementation by the participating organizations compared to nonparticipating organizations. A comparison of the collaborative faculty's assessments of the organizations that participated in the evaluation to their assessments of the organizations that did not participate, for example, found only small differences that were not statistically significant.

CONCLUSION

Based on the concepts of intensity and fidelity, we have proposed a coding scheme for assessing QI implementation. Our findings suggest that the health care organizations participating in the study collaborative were able, with

some important variation, to implement large numbers of QI change strategies, with high CCM fidelity and modest depth of intensity. These changes are correlated with pre-post self-assessment scores of progress achieved. Implementation details, however, are only of real importance if they successfully lead to the targeted changes in processes and outcomes of care and if they are understood sufficiently to be replicable by other practitioners in other settings. Future ICICE analyses will examine the relationship between these measures of implementation performance and changes in processes and outcomes of care, as well as the organizational correlates of change. We hope these findings will substantially add to the body of QI evidence needed to successfully close the quality chasm.

ACKNOWLEDGMENTS

The authors would like to thank Shan Cretin for her wise counsel throughout the project; Arnab Mukherji for data analysis assistance; Patricia Williams for her assistance in preparing the manuscript; and Lillian Anguiano and Danielle Letourneau for their assistance with data extraction and management. This work was made possible through the following grants from The Robert Wood Johnson Foundation: #034984 and #035678.

REFERENCES

- Aubert, R. E., W. H. Herman, J. Waters, W. Moore, D. Sutton, B. L. Peterson, C. M. Bailey, and J. P. Koplan. 1998. "Nurse Case Management to Improve Glycemic Control in Diabetic Patients in a Health Maintenance Organization." *Annals of Internal Medicine* 129 (8): 605–12.
- Bodenheimer, T., E. H. Wagner, and K. Grumbach. 2002a. "Improving Primary Care for Patients with Chronic Illness." *Journal of the American Medical Association* 288 (14): 1775–9.
- . 2002b. "Improving Primary Care for Patients with Chronic Illness, The Chronic Care Model, Part 2." *Journal of the American Medical Association* 288 (15): 1909–14.
- Boerstler, H., R. W. Foster, E. J. O'Connor, J. L. O'Brien, S. M. Shortell, J. M. Carman, and E. F. Hughes. 1996. "Implementation of Total Quality Management: Conventional Wisdom versus Reality." *Hospital and Health Services Administration* 41 (2): 143–59.
- Bond, G. R., L. Evans, M. P. Salyers, J. Williams, and H. W. Kim. 2000. "Measurement of Fidelity in Psychiatric Rehabilitation." *Mental Health Services Research* 2 (2): 75–87.

- Bonomi, A. E., E. H. Wagner, R. E. Glasgow, and M. Von Korff. 2002. "Assessment of Chronic Illness Care (ACIC): A Practical Tool to Measure Quality Improvement." *Health Services Research* 37 (3): 791-820.
- Casalino, L., R. R. Gillies, S. M. Shortell, J. A. Schmittdiel, T. Bodenheimer, J. C. Robinson, T. Rundall, N. Oswald, H. Schauffler, and M. C. Wang. 2003. "External Incentives, Information Technology, and Organized Processes to Improve Health Care Quality for Patients with Chronic Diseases." *Journal of the American Medical Association* 289 (4): 434-41.
- Cretin, S., S. M. Shortell, and E. B. Keeler. 2004. "An Evaluation of Collaborative Interventions to Improve Chronic Illness Care: Framework and Study Design." *Evaluation Review* 28 (1): 28-51.
- Gilbody, S., P. Whitty, J. Grimshaw, and R. Thomas. 2003. "Educational and Organizational Interventions to Improve the Management of Depression in Primary Care." *Journal of the American Medical Association* 289 (23): 3145-51.
- Improving Chronic Illness Care (ICIC). 2003a. "Collaboratives to Date" [accessed on February 12, 2003]. Available at: <http://www.improvingchroniccare.org/improvement/collaboratives/reg-todate.html>
- Improving Chronic Illness Care (ICIC). 2003b. "Model Components: Overview of the Chronic Care Model" [accessed on February 12, 2003]. Available at: <http://www.improvingchroniccare.org/change/model/components.html>
- Improving Chronic Illness Care (ICIC). 2003c. "The Assessment of Chronic Illness Care (ACIC)" [accessed on February 12, 2003]. Available at: <http://www.improvingchroniccare.org/tools/acic.html>
- Institute for Healthcare Improvement (IHI). 2003. "Breakthrough Series Collaboratives" [accessed February 12, 2003]. Available at: <http://www.ihl.org/collaboratives/>
- Institute of Medicine, Committee on Quality of Health Care in America (IOM). 2001. *Crossing the Quality Chasm: A New Health System for the 21st Century*. Washington, DC: National Academy Press.
- Lichtman, J. H., S. Roumanis, M. Radford, M. Riedinger, S. Weingarten, and H. Krumholz. 2001. "Can Practice Guidelines Be Transported Effectively to Different Settings?" *Journal on Quality Improvement* 27 (1): 42-53.
- Lipsey, M. W., and D. B. Wilson. 2001. "The Way in Which Intervention Studies Have 'Personality' and Why It Is Important to Meta-Analysis." *Evaluation & The Health Professions* 24 (3): 236-54.
- Lobach, D. F., and W. E. Hammond. 1997. "Computerized Decision Support Based on a Clinical Practice Guideline Improves Compliance with Care Standards." *American Journal of Medicine* 102 (1): 89-98.
- McGrew, J. H., G. R. Bond, L. Dietzen, and M. Salyers. 1994. "Measuring the Fidelity of Implementation of a Mental Health Program Model." *Journal of Consulting and Clinical Psychology* 62 (4): 670-8.
- McHugo, G. J., R. E. Drake, G. B. Teague, and H. Xie. 1999. "Fidelity to Assertive Community Treatment and Client Outcomes in the New Hampshire Dual Disorders Study." *Psychiatric Services* 50 (6): 818-24.
- Moncher, F. J., and R. J. Prinz. 1991. "Treatment Fidelity in Outcome Studies." *Clinical Psychology Review* 11: 247-66.

- Montori, V. M., S. F. Dinneen, C. A. Gorman, B. R. Zimmerman, R. A. Rizza, and S. S. Bjornsen. 2002. "The Impact of Planned Care and a Diabetes Electronic Management System on Community-Based Diabetes Care: The Mayo Health System Diabetes Translation Project." *Diabetes Care* 25 (11): 1952-7.
- Naylor, J. C., R. D. Pritchard, and D. R. Ilgen. 1980. *A Theory of Behavior in Organizations*. New York: Academic Press.
- O'Brien, J. L., S. M. Shortell, E. F. X. Hughes, R. W. Foster, J. M. Carman, H. Boerstler, and E. J. O'Connor, 1995. "An Integrative Model for Organization-Wide Quality Improvement: Lessons from the Field." *Quality Management in Health Care* 3 (4): 19-30.
- Quinn, R. E., and J. Rohrbaugh. 1983. "A Spatial Model of Effectiveness Criteria: Towards a Competing Values Approach to Organizational Analysis." *Management Science* 29 (3): 363-77.
- Renders, C. M., G. D. Valk, S. J. Griffin, E. H. Wagner, J. T. van Eijk, and W. J. J. Assendelft. 2001. "Interventions to Improve the Management of Diabetes in Primary Care, Outpatient, and Community Settings." *Diabetes Care* 24 (10): 1821-33.
- Rossi, P. H., H. E. Freeman, and M. W. Lipsey. 1999. *Evaluation: A Systematic Approach*. 6th edn. Thousand Oaks, CA: Sage Publications Inc.
- Rubenstein, L. V., M. Jackson-Triche, J. Unutzer, J. Miranda, K. Minnium, M. L. Pearson, and K. B. Wells. 1999. "Evidence-Based Care for Depression in Managed Primary Care Practices." *Health Affairs* 18 (5): 89-105.
- Shortell, S. M., J. L. O'Brien, J. M. Carman, R. W. Foster, E. F. Hughes, H. Boerstler, and E. J. O'Connor. 1995. "Assessing the Impact of Continuous Quality Improvement/Total Quality Management: Concept versus Implementation." *Health Services Research* 30 (2): 377-401.
- Shortell, S. M., R. H. Jones, A. W. Rademaker, R. R. Gilles, D. S. Dranove, E. F. X. Hughes, P. P. Budetti, K. S. E. Reynolds, and C.-F. Huang. 2000. "Assessing the Impact of Total Quality Management and Organization Culture on Multiple Outcomes of Care for Coronary Artery Bypass Graft Surgery Patients." *Medical Care* 38 (2): 207-17.
- Shortell, S. M., J. A. Marsteller, M. Lin, M. L. Pearson, S. Wu, P. Mendel, S. Cretin, and M. Rosen. 2004. "The Role of Perceived Team Effectiveness in Improving Chronic Illness Care." *Medical Care* 42 (11): 1040-8.
- Shortell, S. M., J. L. Zazzali, L. R. Burns, J. A. Alexander, R. R. Gillies, P. P. Budetti, T. M. Waters, and H. S. Zuckerman. 2001. "Implementing Evidence-Based Medicine: The Role of Market Pressures, Compensation Incentives, and Culture in Physician Organizations." *Medical Care* 39 (7, suppl. 1): 162-78.
- Solberg, L. I. 2000a. "Guideline Implementation: What the Literature Doesn't Tell Us." *Joint Commission Journal on Quality Improvement* 26 (9): 525-37.
- Solberg, L. I., M. L. Brekke, C. J. Fazio, J. Fowles, D. N. Jacobsen, T. E. Kottke, G. Mosser, P. J. O'Connor, K. A. Ohnsorg, and S. J. Rolnick. 2000b. "Lessons from Experienced Guideline Implementers: Attend to Many Factors and Use Multiple Strategies." *Journal of Quality Improvement* 26 (4): 171-88.
- Stone, E. G., S. C. Morton, M. E. Hulscher, M. A. Maglione, E. A. Roth, J. M. Grims-haw, B. S. Mittman, L. V. Rubenstein, L. Z. Rubenstein, and P. G. Shekelle.

2002. "Interventions That Increase Use of Adult Immunization and Cancer Screening Services: A Meta-Analysis." *Annals of Internal Medicine* 126 (9): 641-51.
- Von Korff, M., J. Gruman, J. Schaefer, S. J. Curry, and E. H. Wagner. 1997. "Collaborative Management of Chronic Illness." *Annals of Internal Medicine* 127: 1097-102.
- Vroom, V. H. 1964. *Work and Motivation*. New York: John Wiley & Son.
- Wagner, E. H., B. T. Austin, C. Davis, M. Hindmarsh, J. Schaefer, and A. Bonomi. 2001a. "Improving Chronic Illness Care: Translating Evidence into Action." *Health Affairs* 20 (6): 64-78.
- Wagner, E. H., B. T. Austin, and M. Von Korff. 1996. "Organizing Care for Patients with Chronic Illness." *The Milbank Quarterly* 74 (4): 511-44.
- Wagner, E. H., R. E. Glasgow, C. Davis, A. E. Bonomi, L. Provost, D. McCulloch, P. Carver, and C. Sixta. 2001b. "Quality Improvement in Chronic Illness Care: A Collaborative Approach." *Journal on Quality Improvement* 27 (2): 63-80.
- Weingarten, S. R., J. M. Henning, E. Badamgarav, K. Knight, V. Hasselblad, A. Gano Jr., and J. J. Ofman. 2002. "Interventions Used in Disease Management Programmes for Patients with Chronic Illness—Which Ones Work? Meta-Analysis of Published Reports." *British Medical Journal* 325: 925-42.
- Wickizer, T. M., E. Wagner, A. Cheadle, D. Pearson, W. Beery, J. Maeser, B. Psaty, M. Von Korff, T. Koepsell, P. Diehr, and E. B. Perrin. 1998. "Implementation of the Henry J. Kaiser Family Foundation's Community Health Promotion Grant Program: A Process Evaluation." *The Milbank Quarterly* 76 (1): 121-47.
- Zammuto, R. F., and J. Y. Krakower. 1999. "Quantitative and Qualitative Studies of Organizational Culture." In *Research in Organizational Change and Development*, Vol. 5, ed. W. A. Pasmore and R. W. Woodman, pp. 83-114. Greenwich, CT: JAI Press.