WORKING
PAPER

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

Methods Appendix

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Method Development

To measure implementation of the Chronic Care Model (CCM) interventions, we developed a conceptual framework for characterizing intervention activities, identified sources of data on change activities, developed and pretested coding procedures, created interview protocols, and developed a rating system for variable construction. We then applied this methodology to data from the chronic care collaboratives and analyzed variations in CCM implementation as well as the relationship of our implementation measures to sites' pre- and post-intervention assessments of their practices' congruence with CCM. Each of these steps is discussed below.

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. We conceptualized *change* activities as actions that alter current practice in a particular CCM area. Change activities thus are distinguished from activities taken before practice is actually altered, i.e., assessments, plans, or preparations.

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 each of 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 activities hierarchically, starting with

the six main CCM elements and branching into three levels of detail. The six main CCM elements (ICIC 2003a) include:

- delivery system redesign (changes in the organization of care delivery),
- self-management support strategies (efforts to increase patients involvement in their own care),
- decision support (guidelines, education, and expertise to inform care decisions),
- information systems (changes to facilitate use of information about patients, their care, and their outcomes),
- community linkages (activities increasing community involvement), and
- health system support (leadership, practitioner, and financial support).

This categorization scheme, presented in the left-hand column of Table A1, formed the basis for assessing the alignment of intervention change activities with CCM elements.

The intensity of implementation is emerging as a concept in QI intervention evaluation (Montori et al, 2002; Wickizer et al. 1998; Shortell et al. 1995). To assess implementation intensity, we considered both the *quantity* and the *depth* of the intervention activities. Quantity is measured as simple counts of activities. What constituted an activity could vary from one organization's report to another's, however, so some measure of the likelihood of the impact of the changes or their leverage towards improving chronic care was sought. We termed this concept the "depth" and operationalized it through qualitative rating criteria that will be described further under Implementation Intensity Measures below. Figure 1 illustrates that each change activity or action is conceptualized as related to the CCM via three levels of detail and to implementation intensity through its contribution to the quantity of changes and through the rating of the depth of change it represents.

Data Sources for Coding

Our primary sources of data on intervention change activities were organization documents and interviews. As part of their collaborative participation, sites submitted monthly reports to the collaborative facilitators for review and feedback. Called "Senior Leader" reports, these documents were reviewed by the organizations' senior leaders and included brief descriptions of the small rapid cycle changes implemented each month. While their external and internal scrutiny lent credibility to these reports as sources of valid information on the organizations' change actions, we verified much of 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 National Congress (the concluding session of the collaborative).

The total number of monthly progress reports actually submitted by organizations varied. The organizers of all three collaboratives asked organizations to submit monthly monthly progress reports, including one summary report toward the end of the collaborative, in which organizations listed all change activities undertaken to date. We coded all monthly progress reports (up to 13 per organization) submitted by participants in the one regional and one national collaborative. To conserve resources, only the summary monthly progress report and subsequent reports were coded for the other national collaborative. We examined the comparability of these two approaches by independently coding reports from 14 sites using both methods and utilizing regression analysis to test their relationship. We found that the results from the two methods were linearly related. (Number of change activities identified from full coding = 15.982 + 0.995 (number of change activities identified from summary coding).) Given this undercount of change activities identified by the summary coding method, we report the quantity of change activities separately for the two methods.

Coding Protocol

Each reported change activity was assigned two codes. The first code designated the CCM category the change targeted (at the lowest level of the categorization scheme presented in Table A1). Figure 1 illustrates a coding path for an intervention activity identified at the first and most general level as redesign of the delivery 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. Each reported activity then received a second code indicating whether it appeared to represent an *active change*, a *plan or preparation* for such change, or a *repeated* report of an earlier entry.

Two members of the evaluation team (MP, SW) worked together to pilot-test coding the descriptions of improvement cycles in an initial subset of monthly progress reports (n = 28) using the coding tree. We iteratively revised the coding tree during this pilot period to better reflect the improvement activities and resolve coding discrepancies. To increase the validity and reliability of the coding process, we next distributed copies of the coding tree and a randomly selected 10% sample of monthly progress reports to two members of ICIC (JS, AB), as well as to the two evaluation team members. These four coders independently coded the activity descriptions in these reports and subsequently met to discuss coding discrepancies. A simplified coding tree and an initial set of coding decision rules resulted. The same four individuals then

coded another 10% sample of reports to pilot the simplified coding tree and the decision rules. The four coders agreed 60% of the time on the first level of coding prior to discussion. Agreement on lower levels was higher, but limited to those activities that were uniformly coded at the first level. Agreement exceeded 90% following discussion. The coding tree was revised and the decision rules expanded as we resolved discrepancies.

To maximize reliability, the two-member evaluation team decided to have two individuals individually code all monthly progress reports and discuss all discrepancies. A research assistant was trained to participate in the coding (along with MP and SW) and decision rules were clarified. A subsequent reliability check found agreement to be greater than 80% before discussion and 100% following discussion.

The text from the monthly progress reports describing the change activities and the assigned codes were entered into Nvivo, a qualitative research software program. We reviewed the materials the sites presented at their final collaborative session for any mention of activities not included in the monthly progress reports. Such activities were coded and entered in NVivo with the Monthly progress report coding.

NVivo was used to generate a draft log of all CCM change activities for each site. Two members of the evaluation team members reviewed each log for the coding consistency and accuracy. All problems were discussed and corrections agreed upon by the two members. Questions that could not be resolved by coders at this stage were compiled for follow-up during subsequent telephone interviews with team leaders at each site.

Exit Interview Protocol

We conducted exit interviews with each organization's team leader(s) to clarify and 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. This log included all active change activities we had identified for that site, any planned activities for which we had been unable to identify a subsequent action, and our questions about that organization's intervention efforts. The cover letter accompanying this log asked the team leader to review the log of activities for possible omissions and misinterpretations and to be prepared to answer the site-specific questions.

At least two RAND researchers participated in all phone interviews. In each, we addressed the site-specific questions listed on that site's log and asked about any possible omissions or misinterpretations of their intervention activities. We additionally asked general questions about the 1) major successes of their collaborative effort, 2) major barriers or resistance in implementing the CCM efforts and how these were addressed, 3) continuation and spread of the CCM efforts, and 4) site procedures for writing and reviewing the monthly progress reports.

Data Management and Reduction

Immediately following the interview, we incorporated the new data into that site's NVivo log of change activities. Depending on their content, the interview data were attached to a specific change activity or included in an overview section at the end of the log. When necessary, change activities were recoded based on the clarification provided in the interview. (Most recoding involved the classification of activities as planned or active changes.) Logs of the intervention activities, presented in self-reported text and categorized within the CCM coding tree, thus were completed for each organization. To facilitate review and analysis, these data were summarized across sites in tabular form as well.

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 and excluded planning activities that did not culminate in change during the collaborative (e.g., discussion of alternative patient education materials that did not result in new materials being made available to patients). 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. Both can be aggregated to create summary change count and depth variables at the first levels of the coding tree (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 impact according to CCM theory, 1 = some change activity (but not characterized as likely to have 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 the participants in the chronic care collaboratives, our notes from collaborative sessions, review of the CCM literature, and input from researchers and QI facilitators with extensive CCM expertise. These criteria, presented in the right-hand column of Table A1, specify characteristics of change activities that the CCM posits as likely to have impact on practice and outcome for each CCM element.

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 Assessment of Chronic Illness Care (ACIC) survey instrument (Bonomi et al. 2002; ICIC 2003b), 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. The ACIC was designed to help organizations evaluate how well they were providing care for chronic conditions in each of the areas of the CCM. Baseline and follow-up ACIC scores were derived and the difference of the two scores was computed for each CCM element for each site. Two ACIC items were moved to a different category in the analyses to better correspond to the ICICE categorization.[1] These baseline and follow-up ACIC scores were available for 33 (79%) of the study sites.

Analysis

Descriptive statistics were used to examine variations in implementation intensity within CCM categories and among sites. Additionally, one sample t-test and an approximate F-test[2] 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.

NOTES

1. The items on patient treatment plans and informing patients about guidelines were moved to the Self-Management Strategies category.

2. The following analytic method was used to compare depth ratings:

Background
There are $K = 17$ groups (practices) and a total of 23 outcome measures, each scored 0, 1, or 2. These are structured into $J = 6$ sets and each set has I_j items (for example, $I_1 = 6$). We want to evaluate whether the items responses are statistically the same for all groups.

Notation
P_{vijk} = the probability of obtaining outcome v (= 0, 1 or 2) for item i in set j, group k.
Z_{vijk} = indicate the score obtained v (= 0, 1 or 2) for item i in set j, group k. For each (i, j, k) only one of $Z_{0ijk}, Z_{1ijk}, Z_{2ijk}$ takes the value 1; the others are 0.
$S_{ijk} = Z_{1ijk} + 2 \times Z_{2ijk}$ is the score from item (ijk).
S_{+jk} = The total score for set j in group k.
$S_{++k} = T_k$, the total score for group k.

Assess the variance of the T_k
We want to compare the sample variance of T_k to that predicted from the null hypothesis that the probabilities do not depend on group (on k):

$$H_0 : p_{vijk} \equiv p_{vij} \text{ for all } k$$

Compute the sample variance of the T_k:

$$\hat{V} = \frac{1}{K-1}\sum_k \left(T_k - \overline{T}\right)^2 ,$$

where $\overline{T}$ is the sample mean of the T_k.
Compute the estimated probabilities under H_0:

$$\hat{p}_{vij} = \frac{Z_{vij+}}{K}$$

Compute the variance of T_k under H_0:

$$V_{H_0} = \sum_{ij}\left[\hat{p}_{1ij}\left(1-\hat{p}_{1ij}\right) - 4\hat{p}_{1ij}\hat{p}_{2ij} + 4\hat{p}_{2ij}\left(1-\hat{p}_{2ij}\right)\right] \quad (1)$$

Compare the estimated and predicted variance:

$$Ratio = \frac{\hat{V}}{V_{H_0}} \quad (2)$$

Perform statistical test

Use an approximate test to compare (2) to an $F_{(K-1),(dendf)}$ critical value, where the denominator *dendf* = (*K-2)*(23) = 15 *x* 23 = 345.

Table A1. CCM Implementation Measurement

CCM Elements	Criteria for Implementation Depth Rating of 2*
I. Delivery system redesign	
A. Care management roles: 1. Increase physicians' role for care management 2. Increase non-physician's role for care management. 3. Increase existing care managers' role. 4. Specify a new role of care management to a non-physician. 5. Other	A. Substantial system change to support care management (e.g., new care manager role, standing order for non-physicians).
B. Team practice: 1. Specify practice team. 2. Specify practice team activities 3. Other	B. A practice team change – i.e., a change to make patients' care delivered through a team process.
C. Care delivery/coordination: 1. Coordinate care/communication among providers and/or across settings. 2. Delegate care from physician to non-physician. 3. Other	C. Improved continuity of care delivery through systematic communication, standardization, or coordination.
D. Proactive follow-up: 1. Follow-up with patients for scheduling, reassessment, or treatment. 2. Coordinate/consult with other providers. 3. Other	D. Follow-up appears to include self-management support processes and/or be ongoing over an extended period of time.
E. Planned visit 1. Plan/structure processes to be performed during visit 2. Prepare for the visit in advance (e.g., soliciting tests, reviewing data)	E. Systematized preparation for planned patient visit (e.g., made patient data available in advance, structured processes through forms, etc.)

F. Visit system change 1. Provide group visit. 2. Provide phone visit. 3. Provide home visit. 4. Provide back-to-back scheduling 5. Coordination/schedule appointments with other providers. 6. Streamline appointment system. 7. Relocate service. 8. Other	Facilitated patients seeing multiple providers in a single visit (e.g., group visits, back-to-back scheduling) and visits included some clinical process; or added/expanded home visits.
II. Self-management strategies	
A. Patient education 1. Education materials provided. 2. Person-to-person education provided (including in-person, telephone, group classes). 3. Referral provided. 4. Other	A. Expansion of person-to-person education (sustained over a period of time, i.e., not just 1 or 2 sessions).
B. Patient activation/psychosocial support 1. Use motivational interviewing techniques 2. Prepare patient for clinical visit (e.g., questions or preview of issues). 3. Apply other specific behavior change strategies to assist self-management. 4. Provide psychosocial support (include support group) 5. Tailor self-management strategies to individual patients. 6. Other	B. Application of specific activation strategy (e.g., support group, motivational interviewing, preparing patient for visit).
C. Self-management assessment 1. Assess readiness to self-manage 2. Assess self-management skills and needs	C. Regular or comprehensive assessment and documentation of self-management readiness and/or needs.

D. Self-management support 1. Offer self-management guidance (e.g., cooking classes, label reading). 2. Provide self-management tool (e.g., weight log, weight scale, CHF calendar, reminder). 3. Collaborate with other provider resources to provide self-management support. 4. Offer patient incentives to improve care and adhere to guidelines. 5. Other	D. Offered multiple self-management resources (tools, exercise program, or financial help with meds).
E. Collaborative decision making with patients 1. Forms/prompts/tools for collaboration provided (to provider and/or patient). 2. Patient participates in defining problems. 3. Patient preferences for treatment solicited. 4. Patient participates in planning (action plan, targets, priorities, contracts) over and above stating treatment preferences. 5. Patient participates in evaluating progress and goals. 6. Other	E. Effort to institutionalize patients having a central role in determining their care (e.g., through flow sheets or prompts).
F. Guidelines available to patients 1. On routine basis (e.g., through patient education materials or in organization publications) 2. On patient request.	F. Appears likely that guidelines include recommendations for provider care as well as patient care.
III. Decision support and expert system	
A. Institutionalization of guidelines, protocols, or prompts 1. Guide clinical decisions (e.g., diagnostics, therapy). 2. Guide self-management support (e.g., patient activation, education). 3. Guide individualized care planning. 4. Guide other care management activities (e.g., planned visit, follow-up). 5. Guide coordination of care.	A. Computerized or linked to registry to enhance use of guidelines/prompts at the point of decision.

6. Other	
B. Provider education 1. Education materials provided. 2. Lectures, in-services, seminars, CME courses 3. Academic detailing, individual visits. Promotion by opinion leaders. 4. Other	B. Provided interactive learning/teaching to various roles of providers to increase their skills in delivering chronic care, or used academic detailing or opinion leaders.
C. Expert consultation support 1. Facilitate specialty/expert consultation on individual cases 2. Facilitate practice consultation by experts	C. Linkages with specialists to make expert support and consultation readily available to primary care clinician decision-making.
IV. Information support	
A. Patient registry system 1. Primarily for identification of patient population. 2. Fuller registry system (includes additional data, e.g., on risk, treatment, or outcomes). 3. Other	A. Develop processes for use of the registry, including designating personnel for data entry and registry maintenance or linking to other existing information systems.
B. Use of information for care management 1. Implement/improve data support for planned visit, care planning, management, and/or reassessment. 2. Provide data collection tools. 3. Share data and or care plan with other providers. 4. Provide reminders for care planning and management. 5. Other	B. Provided additional information support for individual patient care management, e.g., pre-visit data, reminders.
C. Provision of performance data 1. Feedback of provider-specific data 2. Provide group/organization-specific data for QI monitoring (e.g., outcome measures).	C. Major effort to institutionalize feedback and use of performance data to improve chronic care.

V. Community linkages	
A. For patients 1. Provide information on or refer to community resources to support patient needs. 2. Seek community resources or collaborate with community to meet patient/population needs. 3. Provide services or program for members at community level. 4. Other	A. Obtained resources or services for patients through community.
B. For community 1. Provide services or program for community. 2. Collaborate with community to meet community needs. 3. Other	B. Linkage helped make available additional resources or services (over and above education).
VI. Health systems support	
A. Leadership support 1. Acquire leadership support for chronic care improvement. **2. Acquire resources for chronic care changes.** 3. Other	A. Acquired financial resources for chronic care changes.
B. Provider participation 1. Offer incentives to providers to improve care and adhere to guidelines. 2. Acquire/increase providers' participation to support chronic care changes (e.g., marketing/buy-in). 3. Other	B. Offered incentives to providers to improve patient care and adhere to guidelines.
C. Coherent system improvement (including spread) 1. Coordinate chronic care improvement with formal QI efforts. 2. Participate in IHI-type QI efforts. 3. Coordinate/communicate among subsystems. 4. Spread QI successes. 5. Other	C. Extensive spread within the larger health system or integration of collaborative models into the QI program.

*Change activities within the CCM element had to meet this definition to receive a depth rating of 2.

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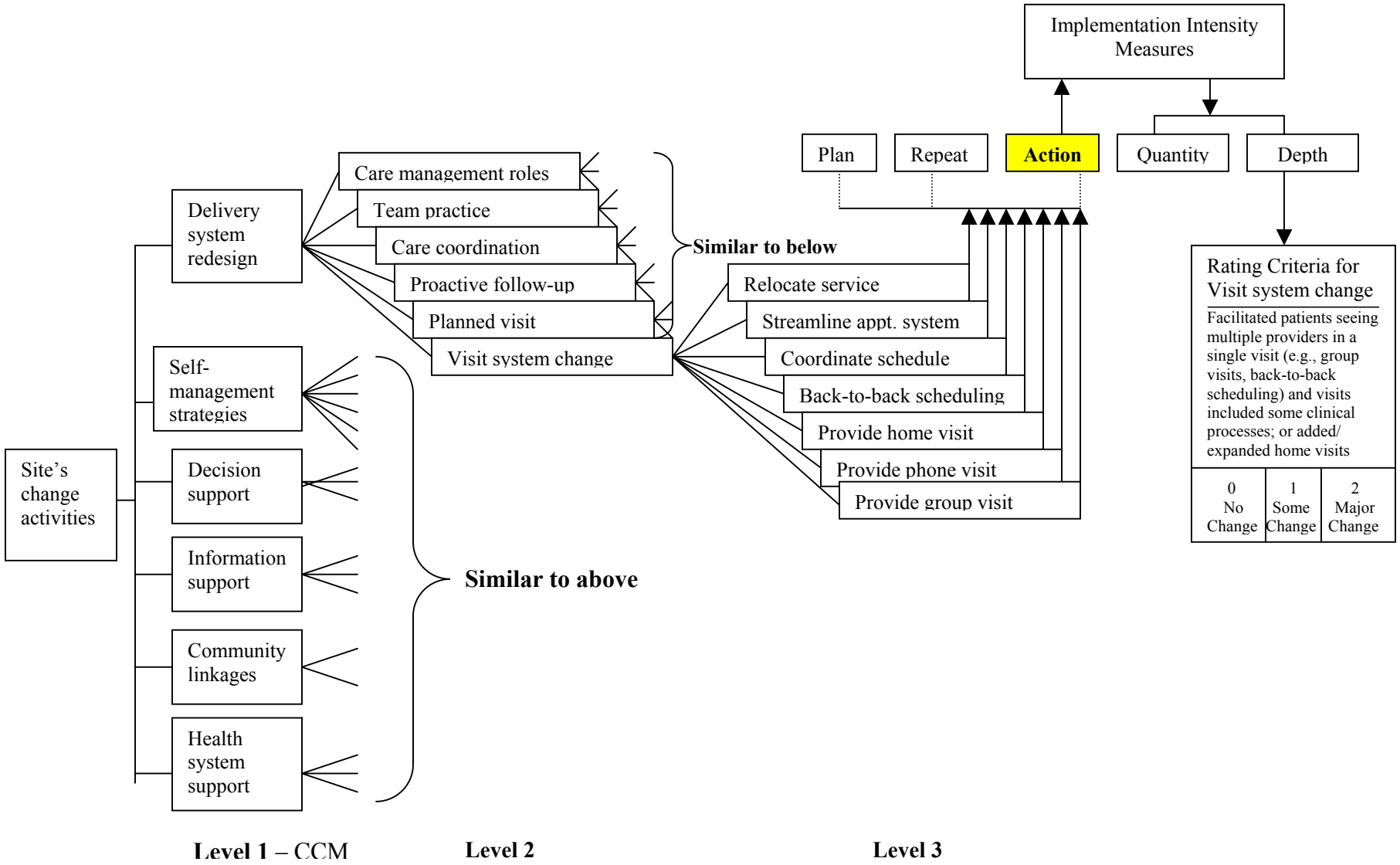
Figure 1. Coding Path