Family medicine practice performance and knowledge management

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Background: Knowledge management (KM) is the process by which people in organizations find, share, and develop knowledge for action. KM affects performance by influencing work relationships to enhance learning and decision making.
Purpose: To identify how family medicine practices exhibit KM.
Methodology: A model and a template of KM concepts were derived from a comprehensive organizational literature review. Two higher and two lower performing family medicine practices were purposefully selected from existing comparative case studies based on prevention delivery rates and innovation. Interviews, fieldnotes of operations, and clinical encounters were coded independently using the template. Face-to-face discussions resolved coding differences.
Findings: All practices had processes and tools for finding, sharing, and developing knowledge; however, KM overall was limited despite implementation of expensive technologies like an electronic medical record. Where present, KM processes and tools were used by individuals but not integrated throughout the organization. Loss of information was prominent, and finding knowledge was underdeveloped. The use of technical tools and developing knowledge by reconfiguration and measurement were particularly limited. Socially related tools, such as face-to-face-communication for sharing and developing knowledge, were more developed. As in other organizations, tool use was tailored for specific outcomes and leveraged by other organizational capacities.
Practice Implications: Differences in KM occur within family practices and between family practices and other organizations and may have implications for improving practice performance. Understanding interaction patterns of work relationships and KM may explain why costly technical or externally imposed ''one size fits all'' practice organizational interventions have had mixed results and limited sustainability.

Key words: family practice, knowledge management, practice management, quality care

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Organizational characteristics (e.g., leadership and communication) are examined increasingly in pursuit of better health outcomes (Edmondson, 2003; Nelson et al., 2002; Shortell et al., 2005). Conceptualizing family medicine practices as complex adaptive systems, our research team has examined organizational characteristics, especially the quality of work relationships, associated with enhanced performance (Cohen et al., 2004; Orzano, Tallia, Nutting, Scott-Cawiezell, & Crabtree, 2006). A complexity perspective suggests that practice performance, whether quality of care, productivity, or workplace satisfaction, relates not only to the characteristics of individuals (e.g., provider) but also to the quality of work relationships and is mediated through individual and organizational learning, and decision making or sense making (Tallia, Lanham, McDaniel, & Crabtree, 2006). Although there are a variety of ways to influence work relationships (e.g., financial incentives, exercise of power), how information or knowledge is 'managed' provides another mechanism. Knowledge management (KM) relates to information management or practices' ability to access and use information to build knowledge; however, it is much more (Orzano, Ohman-Strickland, et al., 2007; Orzano, Tallia, McInerney, McDaniel, & Crabtree, 2007).

KM emerged from organizational sciences and reflected a response to failed efforts of reengineering and naïve reliance on information technology. Two KM dimensions exist, one focusing on management of information tools and resources, emphasizing the role of technology (Zack, 1999), and the other on creating and maintaining a conducive environment, emphasizing human factors such as trust, risk taking, learning ability, and sharing of information (Huotari & Iivonen, 2004). Increasingly, KM has been described along an integrated framework espousing knowledge "process" management within contexts of knowledge creation and sharing (McInerney, 2002). This framework accommodates distinctions between knowledge and information and knowledge and information management. Knowledge is recognized as having both an explicit and tacit component (i.e., expertise and assumptions that individuals develop and may never have been recorded or spoken) (McInerney, 2002). Information management or what some would call first-generation knowledge management in a primary care setting would relate to acquiring the best clinical and operational information or explicit knowledge, distributing it, and utilizing it at the point of service (McElroy, 2000b). Although information management is important for family medicine practice performance, it is not sufficient. Knowledge is built on information. The synthesis and integration of information is necessary for real knowledge building.

Not unlike business organizations decades ago, family medicine practices are faced with a rapidly changing health care environment and the need to innovate. Managing change requires an organization to learn. KM can be seen as a toolkit for learning. KM has been applied in other settings to explain performance differences among organizations and improve outcomes (Davenport & Prusak, 1998; Nonaka & Takeuchi, 1995; Pfeffer, 2000). Although KM has been mentioned within primary care, empirical studies have been confined to evidenced-based clinical decision making during clinical encounters (Gabbay & le May, 2004) or organizational level "thought pieces" (Sandars, 2004) more directed toward health informatics.

Understanding practice organizational performance and the role of knowledge management is important not only to health services researchers but also to managers of practices and to health policy makers. Family medicine practices are often organizational units of hospital and insurance health systems, and shared management arrangements have met with varying degrees of success (Tallia et al., 2003). Already challenged by shrinking reimbursement to increase patient throughput by enhanced office efficiency, managers are increasingly facing pay-for-performance arrangements requiring service quality. These challenges must be managed in the context of a workplace environment with sinking morale. Solutions suggested include investments in sophisticated information systems and office redesign (Future of Family Medicine Project Leadership Committee, 2004), solutions similar to those previously found lacking in other organizational settings, thereby fostering the emergence of KM. Therefore, establishing relevance of KM in family medicine practices is vitally important.

Building on our previous research, we answer the following question: Do family medicine practices exhibit KM, and if so, how? We propose a model of KM, operationalize key elements, and provide illustrations of KM using qualitative data from a multimethod study examining the organizational context for prevention delivery. In the discussion, we suggest model implications for understanding practice performance and informing interventions to improve quality of care.

Methods

This secondary analysis utilizes data from the Prevention and Competing Demands in Primary Care Study that examined organizational dimensions of 18 Midwestern family medicine practices. Sampling, data collected, and collection details are available elsewhere (Crabtree et al., 2005). Institutional Review Board approved the study. For the current analysis, two practices, higher performing I and higher performing II (HP-I and HP-II), were selected based on good prevention rates and "innovation" "Higher performing" practices were first selected because literature in other organizational settings suggested better opportunity of observing the most developed and varied

KM in these practices. Prevention rates were derived from patient charts and exit cards and included screening (cholesterol, Pap, mammogram), counseling for smoking cessation, and immunizations for children and adults. Innovation was defined as the capacity to learn and change, and it operationalized as technology use (e.g., electronic medical record [EMR]), incorporation of diverse health professionals (e.g., patient educator), and response to changing environments through new business and clinical strategies (e.g., arrangements with health system participants). Secondary selection criteria included variation in size (three vs. eight clinicians), location (rural vs. suburban), type of medical record (EMR vs. paper), and practice ownership. Subsequently, two "lower performing" practices (LP-I and LP-II), based on lower prevention rates and less evidence of "innovation," were selected in order to assess variation of KM in family practices and to improve suggestions of links with enablers and performance.

Analysis involved several iterative steps. First, the research team developed a preliminary conceptual framework. Although emphasizing certain authors (Blair, 2002; Brown & Duguid, 2000; Cook & Brown, 1999; Crossan, 1999; Davenport & Prusak, 1998; Huotari & Iivonen, 2004; McElroy, 2000a; McInerney, 2002; Wenger, McDermott, & Snyder, 2002), the framework remains informed by a synthesis of an extensive literature search of diverse disciplines including management, communication, and information science. Informed by this model, tables were constructed, identifying KM-associated processes and tools. Field notes and other practice-specific data were reviewed, and examples from each practice were identified (Addison, 1999). As examples were identified and discussed, tables were iteratively refined to reflect family medicine, as were initial model elements and relationships. Finally, the model was further refined by applying the template to two "lower performing" practices. Data were coded independently using the tables as a template (Crabtree & Miller, 1999). Coding differences were resolved by face-to-face discussions among the research team (two information scientists, one with KM content and qualitative methods expertise, two family physicians with organizational assessment and qualitative methods experience). A medical anthropologist provided independent periodic methodologic review.

Results

Conceptualization of KM

In our preliminary conceptualization based on the comprehensive literature review, KM is defined as the process by which people in organizations find, share, and develop information or knowledge for action. Setting aside nuanced differences between knowledge and information, this definition implies that (1) knowledge artifacts (e.g., protocols) are insufficient for effective knowledge use by organizations, (2) a number of interdependent processes are necessary to manage knowledge, (3) there are social and technical dimensions to these processes as a result of knowledge as tacit (e.g., apprenticeship) and explicit (e.g., book), and (4) action emanates from the tacit dimension of knowledge and KM processes engaged in pursuit of an organization's mission.

Operationalization of the KM Definition

Processes associated with *finding information or knowledge* include codification (recording) and dissemination/imitation, and utilize technical and socially directed tools in order to connect individuals with existing knowledge sources. "Losing" knowledge arises from gaps or misuse of technical tools, and when people leave (Table 1).

Processes associated with *sharing knowledge or information* include teaching/training and transfer/diffusion. Social tools, such as apprenticeship interactions and cross-functional teams, prevail over more technical-oriented ones and may extend beyond specific organizational units.

Processes and tools associated with *developing information or knowledge* include recombining existing knowledge through categorizing and sorting, as in database use (combination); internalizing individual's experiences in the form of shared mental models and technical know-how, as in manual use or oral stories (internalization); acquiring new mental models and technical skills from others, as in interactions with customers and on-the-job training (socialization); and, articulating tacit knowledge into more explicit forms of metaphors, analogies, concepts, hypotheses, as in collective reflection and evaluation (externalization). The term "tools" in this context implies not only technical systems (e.g., databases) but also practices (e.g., meetings) that assist in organizational knowledge integration. This process also implies "unlearning" or relinquishing existing knowledge in order to develop new knowledge.

Family Medicine Practice KM Model

A refined but still preliminary KM model emerged from the practice data (Figure 1). Most initial model elements and relationships based on the literature review representing other organizational settings were confirmed, but there were some surprises among all the practices, even those that were higher performing. Finding, sharing, and developing knowledge, although interdependent processes, appeared less integrated between work groups. In addition, tools were highly overlapping among the three KM processes and limited especially in the case of technical tools, in some cases despite the implementation

Table 1

KM processes and tools

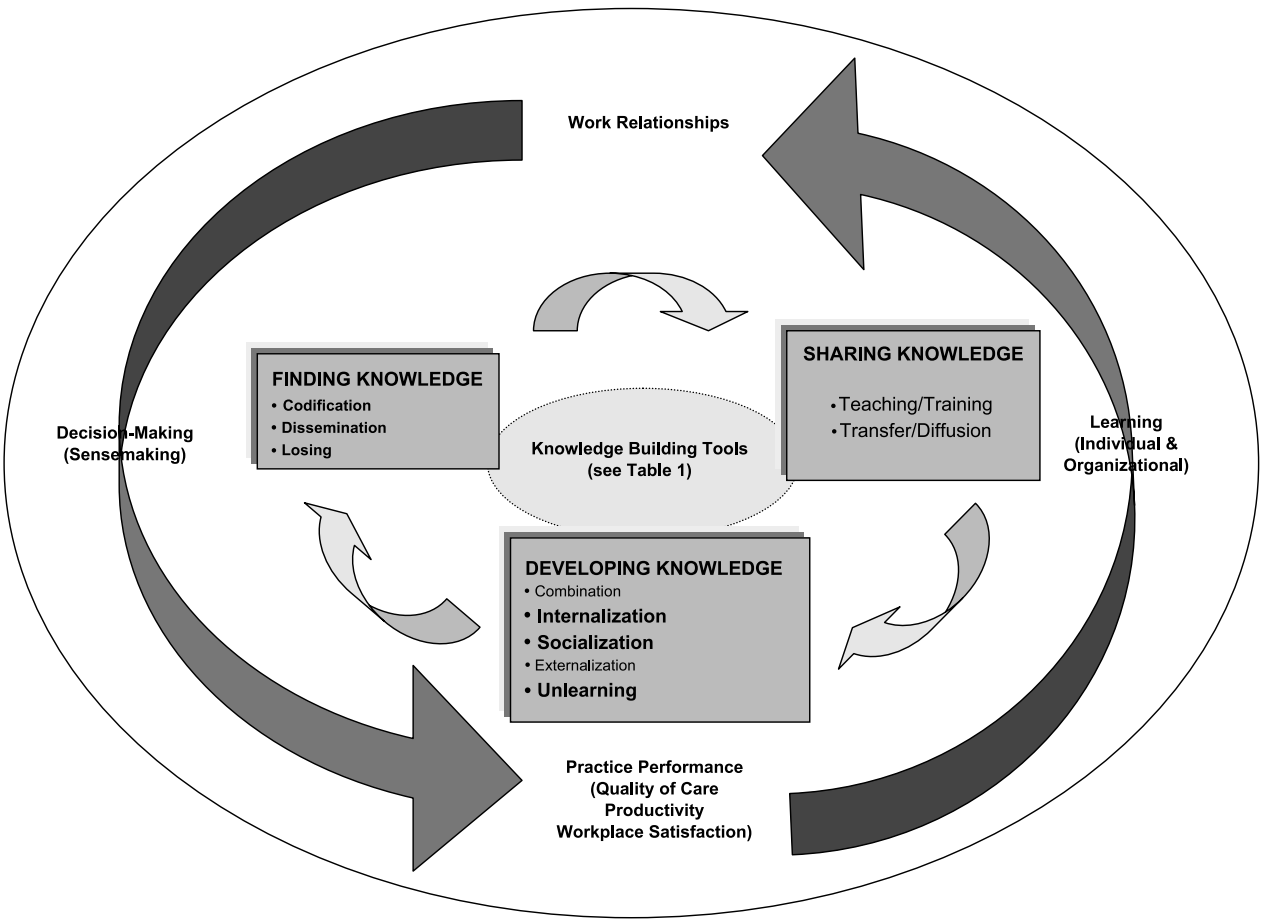
KM processes	KM tools
Finding/losing knowledge or information	
Codification (records, forms, or map into clinical, operational, or financial processes)	Databases (sort, add, categorize) Decision support Indexing/retrieval system Repositories (best practices, reports, documents, meeting minutes, manuals)
Dissemination/Imitation	Training Repositories Decision support Databases
Losing (tacit and explicit knowledge sources)	Personnel Routines
Sharing knowledge or information	
Teaching/Training	Lectures Apprenticeship
Sharing/Transfer/Diffusion	Cross functional teams Communities of practice Storytelling Knowledge artifacts Communication channels (e-mail, telephone, written, face-to-face) Expert knowledge base
Developing knowledge or information	
Combination (explicit to explicit: reconfiguration of existing information; opportunities for individual learning)	Databases (sort, add, combine, categorize} Formal education/training Individuals exchange/combine knowledge through such media as documents, meetings, telephone conversations, communication networks Middle managers break down and operationalize corporate visions, business, products, service concepts
Internalization (explicit to tacit: ''learn by doing'' internalized in individual, then group in shared mental models or technical know-how)	Helps if knowledge is verbalized or diagrammed into documents, manuals, or oral stories
Socialization (tacit to tacit: sharing experiences, and thereby creating tacit knowledge such as shared mental models and technical skills	Opportunities to share experiences; not have to use language Observation, imitation, practice; apprenticeship Interaction with customers
Externalization (tacit to explicit: articulating tacit knowledge into explicit concepts; takes the shape of metaphors, analogies, concepts, hypotheses, or models)	Dialogue/collective reflection Validation by trial periods, evaluation, measurement
Unlearning (retaining maladaptive rules, models, and operational, clinical processes)	Challenging and relinquishing status quo Taking advantage of tension

Note: KM = knowledge management.

of expensive technologies like an EMR. Although all three KM processes were limited relative to other settings, finding knowledge was particularly limited and is reflected in Figure 1 as a smaller rectangle relative to sharing and developing knowledge. Another difference of practices relative to other organizations was the extent of loss of information and knowledge. Technologically supported tools were also limited throughout all KM processes in practices relative to other organizations as evident in processes associated with finding and developing knowledge through combination (reconfigure) and externalization (measurement). Somewhat compensating was the presence of social-related tools as face-to-face communication and observation for sharing and developing

Figure 1

Knowledge management processes in family medicine practices



knowledge. The figure reflects these changes through font sizes by emphasizing socialization and internalization (developing knowledge) and sharing knowledge relative to combination and externalization (developing knowledge) and finding knowledge. Moreover, as the literature in other organizational settings predicted, lower performing practices demonstrated fewer and less effective processes and tools, both technical and social, and these practices demonstrated less integration of KM processes.

KM appears to have consequences for practice performance by influencing work relationships for learning and decision making. More importantly, there are opportunities for KM's enhancement by paying attention to interactions among processes, tailoring tools to specific outcomes, and enhancing enabling characteristics. Below are examples drawn from the data used in the analysis. The names represent aliases and enclosed in parenthesis are page and line numbers.

Examples of KM in Family Medicine Practices

Finding knowledge. Whereas LP-I relied solely on observation for training and ongoing support of personnel, HP-I supplemented observation with manuals for finding knowledge.

HP-I (Higher Performing Practice I) Repositories/Manuals: Finding Knowledge

> Neci showed me a procedure manual at the nurses' station. . .there are detailed instructions how to set up for procedures. For example, there are directions for a vasectomy and colposcopy. Neci said that that manual came in handy with Diella, who has worked about 6 months. She was to set up for a vasectomy and she had no clue where to begin, so she got that manual out and it took her through step-by-step. (P112;L5138)

Absence of repositories such as manuals and written procedures resulted in instances in LP-I of incomplete learning manifested by miscues in preparing patients for procedures and handling patient requests. In addition, repositories demonstrate the overlapping nature of KM tools in practices. Repositories are used not only in processes associated with finding knowledge but also in sharing knowledge (teaching/sharing) and developing knowledge (combination and internalization.

Sharing knowledge. Using cross-functional teams is an example of social tools related to transfer and diffusion processes. In practice HP-II, a permanent nonrotating team relationship between a physician assistant (PA) and nurse appeared to facilitate participatory decision making and sharing knowledge about patients and prevention. An interesting finding was that this "provider team" had differentially higher prevention rates in comparison to other practice B providers.

HP-II (Higher Performing Practice II) Cross-Functional Team: Sharing Knowledge

I was surprised at how much the PA's nurse is involved with patient care. At the end of the encounter, Matrika gives the patient the routing slip, or medication samples. She seemed to be very involved, more so than any of the other nurses. I asked the PA about that. . .she makes sure immunizations are caught up and recorded. . .she's responsible for getting all the information filled out for physicals. . .she really does a lot of educating. The other thing that she does on a routine basis that the other nurses don't do. She always asks the patient when she's weighing them if they smoke and writes that in every patient's chart. (P234;L10725)

This example also demonstrates the lack of integration of knowledge processes throughout the practice. Despite being a higher performing practice, and despite the presence of a seemingly effective process and tool for organizing the work relationship for the PA and nurse, the sharing of knowledge was underdeveloped in the other eight provider/nurse work relationships.

Developing knowledge. Developing knowledge relied more on social tools. Externalization or articulating tacit knowledge into explicit concepts, an extremely important knowledge creation process, was manifested through dialogue and collective reflection. Once disseminated and assimilated, this simple but powerful metaphor of a guardian angel could quite literally "save the clinic financially."

HP-I (Higher Performing Practice I) Guardian Angel Metaphor: Externalization in Developing Knowledge)

They don't care much for Dagna because she's the one who tells the assistants or doctor that they forgot to code something on the pink sheet. Well, Neci realizes that neither assistants nor doctors like to be told that they've done something wrong. So she's tried to change the focus on how they view Dagna. Now they try to think of her as a guardian angel instead of a critical person who's trying to find things wrong. She's trying to make sure the pink sheet is accurate and the patient gets charged. The clinic then is reimbursed and that helps everyone's wages. (P99;L4525)

Interactions, tailoring, and enabling KM processes. Interactions among the KM processes themselves demonstrated tradeoffs and/or effects among tools. In HP-II, reliance on codification limited potential diffusion, as in the patient educator organizing educational tools primarily for her own use. Not only did this seem to limit diffusion to those not directly in contact with the educator (field researcher observation), but also, coupled with additional data showing that a number of the doctors developed their own material, contributed to an inconsistent prevention practice mind-set and the potential for mixed messages to patients.

The practices also showed examples of tool tailoring for specific outcomes resulting in unintended consequences. To improve prevention, practice HP-I chose to implement an EMR, whereas practice HP-II chose team integration of a patient educator. Both tools appeared to influence the pattern of relationships around prevention. However, the EMR appeared to differentially impact identification, whereas the educator impacted counseling. Although both practices had similar average prevention rates, there was much greater variation among providers in practice HP-II. As reported in fieldnotes, many patients never got to the educator because of inconsistent identification by clinicians.

In addition to leveraging external resources, KM tools can be limited or enhanced through leveraging existing internal organizational capacities. For example, leadership can cultivate an enabling environment by encouraging time and space for reflection as was seen in both practices by providing for break rooms and by encouraging a culture that values trust and risk taking.

HP-II (Higher Performing Practice II) Trust: KM Enabling Organizational Capacities

Keegan (Office Manager) gives the appointment staff permission to fit in patients as they can even when a physician is totally booked-up. He says the appointment staff know the patients; they know the doctors; they know how fast the doctors work. They can figure out if something is going to work. (P282;L12926)

Discussion

We found that although examples of KM occur in family medicine practices, there are differences not only in comparison with other organizational settings but also

among practices. The strength of our findings relate to the depth of information from various sources that provide triangulation; limitations reflect team viewpoints, small sample, and the secondary nature of the data. However, the existence and variation of KM in and between practices has a number of implications, both for understanding practice and informing interventions to improve performance.

At first glance any differences between practices and other organizations might be attributed to deficiencies in resources and/or professional management and leadership development. However, differences between the higher and lower performing practices were not explained by differences in resources or available management and may relate to more fundamental practice characteristics. This finding echoes KM findings in small business organizations such as the use of social capital principles (Davenport, Graham, Kennedy, & Taylor, 2003) and is consistent with our previous research, which argues for adapting conceptualizations of organizational attributes such as leadership for family medicine practices rather than simply directly translating them from larger organizations (Orzano et al., 2006). Exploring these differences may not relate to simply the number or effectiveness of tools, but how KM interacts with such characteristics as motivation of key practice stakeholders, outside motivators (e.g., reimbursement structures) (Cohen et al., 2004), presence of practice champions (Crabtree et al., 2005), and compensation incentives (Shortell et al., 2005). These findings are consistent with characteristics such as interdependences among agents associated with complex adaptive systems. More importantly, these differences provide avenues for future exploration. Whatever these differences and how they can be explained, KM is occurring and we need to pay attention to KM in practices.

Our findings suggest that to excel at delivering care, creation and sharing of knowledge may need to occur not only between doctor and patient but also throughout the practice and possibly between the practice and other health system participants. These processes also require facilitation. Take for example interventions to improve prevention. The use of continuing medical education, clinician and patient reminders, EMR, and continuous quality improvement have all been used in the quest for better prevention delivery (Davis & Taylor-Vaisey, 1997; Grol & Jones, 2000; Solberg, et al., 2000). They could be operationalized as different ways to influence or manage relationships to improve prevention by enhancing decision making and learning. KM further suggests that they cannot be used haphazardly and must fit into an integrative framework that "fits" the practice (Stange, 1996). Although KM provides a salient framework for organizational learning within the context of primary care practices as complex adaptive systems, KM can also accommodate various practice organizational change models (Future of Family Medicine Project Leadership Committee, 2004; Glasgow, Orleans, & Wagner, 2001; Nelson et al., 2002).

Practitioners, management consultants, and managers, alike, can garner valuable lessons and a framework toward evaluating and implementing current redesign solutions (Future of Family Medicine Project Leadership Committee, 2004). Expensive technologies such as EMR do not guarantee a way to overcome practice difficulty in finding, losing, and sharing knowledge among different groups (e.g., nurses and clerical staff). However, by tailoring the tool to specific outcomes sought, practices can be successful in increasing KM. Again, the issue of practice "fit" is important. Consideration needs to be given to the choice of a KM tool to leverage other existing organizational capacities. For example, hiring a patient educator may be an appropriate fit in a practice's attempt to increase desirable patient outcomes. However, because KM is a shared process, attention also should be given to how such a hire will affect existing relationships within the practice. This finding should be anticipated by managers who recognize that complex adaptive systems manifest interdependencies and nonlinear characteristics where effects are neither proportionate nor predicable (Miller, Crabtree, McDaniel & Stange, 1998).

Overall, KM can be enhanced not only in leadership's cultivation of an encouraging environment but also by not inadvertently eliminating enablers that have worked. The "kitchen" that now becomes a storage area and stifles spontaneous conversation represents an example. Understanding interactions between the patterns of relationships and KM may provide an explanation of why costly technical and/or externally imposed "one size fits all" organizational interventions have demonstrated mixed results and limited sustainability. Future work is needed to further refine a social and technical conceptualization of KM and to develop measures of KM relevant to practice improvement interventions.

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