

# A Knowledge Management Model: Implications for Enhancing Quality in Health Care

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**Improving health care delivery is a pressing societal goal, and information scientists have a role in effecting change. Information science research has led to understanding theories and practices of information use within the informing professions, but information science and one of its subspecialties, Knowledge Management (KM), also have the potential to influence and enhance other professional disciplines. This concept paper makes the argument that KM is a beneficial framework to help health care clinicians manage their practices and ultimately administer quality care to their patients. The central argument is predicated on the assumption that medicine is a knowledge-based profession and that finding, sharing, and developing clinicians' knowledge is necessary for effective primary health care practice. The authors make the case that in an environment of a burgeoning body of health care research and the adoption of technology tools, physicians can benefit from understanding effective KM practice. The model as presented here borrows from recent information science scholarship in KM and is intended to inform intervention protocols for effective KM to improve quality of care.**

## Introduction

Despite increasing evidence of the health-promoting influence of primary health care to populations and health systems (Starfield, Shi, & Macinko, 2005), a stark reality confronts primary care—a gap remains between the possible and the

actual. Over two decades of interventions designed to translate scientific advances into effective action in practice have met with mixed results or limited sustainability (Grol & Jones, 2000). Utilizing a variety of strategies, interventions have targeted the clinician (Davis, Thomson, Oxman, & Haynes, 1995), the patient (Glasgow, Bull, Gillette, Klesges, & Dzewaltowski, 2002), practice (Solberg et al., 2000), the community (Dietrich, O'Connor, Keller, Carney, Levy, & Whaley, 1992), and the health system (Doran et al., 2006). Taken individually, the behavioral, social, economic, technological, and organizational solutions intended to “redesign the work and the workplaces of primary care clinicians” may have merit in closing the gap in translating evidence into practice; however, implementation and evaluation could be enhanced by having an overarching framework (Doran et al., 2006; Future of Family Medicine Project Leadership Committee, 2004).

## Statement of the Problem

Organizational characteristics are coming under increased scrutiny to provide better health results (Edmondson, 2003b; Nelson et al., 2002). Our research team and collaborators have aimed to identify organizational characteristics associated with enhanced performance through studies based in primary care practices (Cohen et al., 2004; Orzano, Tallia, Nutting, Scott-Cawiezell, & Crabtree, 2006; Tallia, Lanham, McDaniel, & Crabtree, 2006). The quality of work relationships has been noted as a factor that influences performance differences, but another less developed organizational characteristic is related to the potential to access and use information as fundamental to building knowledge (Orzano et al., 2006).

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Merely acquiring, disseminating, and utilizing the best clinical and operational information are no longer enough to achieve success (McElroy, 2005; Sandars, 2004). A time of dramatic change and uncertainty as well as an immense body of health care research demands that the workplace encourage creativity in order to develop new knowledge (Doran et al., 2006; Future of Family Medicine Project Leadership Committee, 2004). Knowledge Management (KM) is a concept that has been applied in other settings to explain performance differences among organizations and improve outcomes (Davenport & Prusak, 1998; Pfeffer, 2000). Evolved from practice associated with the reengineering and quality movements (Berwick, 1991; Hamer & Champy, 1993), yet grounded in theory from the social sciences, we propose knowledge management as a framework for positioning primary care practice to meet the challenges of a rapidly changing health care system in the 21st century.

Our specific purpose in this article is to build on information science research and adapt KM as an important concept for empirical research and theory building in primary health care. To accomplish this goal, we will propose a sociotechnical model of KM emergent from a synthesis of diverse disciplines and discourses, explicate certain elements adapted to the context of primary care practice, and will apply the model to a primary care practice scenario. A discussion will explore the relevance of the model to practitioners, researchers, and policy makers and the implications of KM in enhancing quality in primary health care practice. The significance of the model and its description, even in its preliminary application here, is that the intellectual labor involved in the analysis and the templates developed may aid in future KM research and in ongoing research related to KM and health care. A new model derived from a synthesis of current KM frameworks is necessary to align with the context of primary care practice and because applying KM techniques to health care in the United States and in other countries is a new strategy that has the potential to improve quality of care and reduce costs.

## Research Methods

Our analysis progresses from a review of the literature through identification of data from various fields of inquiry relevant to defining the critical attributes of the KM concept, enabling features, and outcomes (Rodgers, 2000). A primary care practice scenario was developed to illustrate the concept through the application of KM processes and tools. The scenario is hypothetical, but it is based on real life practices extracted from observational and interview transcript data from a study related to preventative health care (Crabtree et al., 2005).

The utilization of multiple databases, independent searchers with diverse content and methodological expertise, and independent search strategies, maximized capturing the breadth of the subject. This effort was particularly important because the KM discourse has drawn from multiple disciplines, and has been recorded in academic and nonacademic

sources. The main query terms included knowledge management and information management. Additional terms included information mastery, information, communication, information dissemination, organizational learning, information transfer, knowledge, and library. Although the majority of references date from the 1990s forward, references from as early as 1916 are represented.

In addition to the review and analysis of the literature, the researchers conducted a qualitative analysis of transcriptions from observational and interview data collected in four U.S. Midwestern family care practices. Two higher and two lower performing practices were purposely selected from existing comparative case studies based on prevention delivery rates and innovation. Practice level and individual clinician rates of preventive services delivery (e.g., tobacco counseling, immunizations, mammography screening) were derived from patient chart audits. Innovation was described as the capacity to learn and change, and measured as technology utilization (e.g., electronic medical record), 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). The researchers developed and utilized the taxonomy of key KM themes, KM processes, and KM tools listed in Tables A1, A2, and A3, presented in the Appendix to identify instances of knowledge discovery, knowledge sharing, and dissemination that were observed in the health care practices. The scenario presented here was created from the KM processes found in the data from rural and urban health care practices. This data comprised approximately 1,200 pages of single-spaced transcriptions. In the following section, we provide background on the development of our conceptual model.

## Origins of Knowledge Management

Reflecting the overlap consistent with any multidisciplinary discourse, Tables A1 and A2 summarize key KM concepts and pertinent disciplines and contributors. Although academic management science and business consultancy practice have heavily contributed and popularized KM, other fields of inquiry have also participated and published. Among an eclectic group, these fields include Communication, Philosophy, Sociology, Psychology, Library and Information Science, Education, Engineering and Computer Science, Economics and Informatics. Related discourses and practices, such as organizational knowledge, organizational learning, and the learning organization, have been intertwined with KM (Argyris & Schon, 1978; Nonaka & Takeuchi, 1995; Senge, 1990).

Knowledge management as a practice, emerged in the 1990s as a practitioner-based response to social and economic trends, and catapulted into prominence with popular books by Nonaka and Takeuchi (Nonaka & Takeuchi, 1995) and Davenport and Prusak (Davenport & Prusak, 1998). Prominent among trends that led to KM were globalization, success of computing, and knowledge-centric view of the

firm (Prusak, 2001). Through globalization's fostering of a frenetic environment for firms to introduce new products and services, organizations were compelled to ask, "what do we know, who knows it, what do we not know that we should know?" (Prusak, 2001). In addition, as workers increasingly had access to an overabundance of information through computing, the value of less reproducible skills like knowledge and those now ascribed under the rubric of "emotional intelligence" ascended in value (Goleman, 1998). Rather than simply moving data and documents around, KM grew out of an understanding of the critical value of knowledge and the clear need to devise ways to support and benefit from them. Reinforcing this evolving distinction between information, data, and knowledge (Buckland, 1991), the emerging knowledge-centric view of the firm (Drucker, 1993), i.e., "organizations that know how to do things," (Prusak, 2001, p. 1002) represented another trend. As Reich pointed out in *The Work of Nations*, the 21st century would see an increase in well-paying jobs where workers applied their symbolic analytic skills, such as those employed by lawyers, computer programmers, consultants, and teachers to create wealth (Reich, 1991). One could also place physicians in this category as the need for acquiring new knowledge related to medical practices, new pharmaceutical products, and the utilization of technology tools, such as electronic medical records, became necessary for effective management of care.

Knowledge management as a concept evolved from information science, organizational science, and other social sciences as a natural evolution following attempts to improve quality, reengineer the way work is structured, and adopt the habit of large capital investments in new technology, especially Information Technology (IT; Stewart, 2001). Although at times KM has been described as an integrated framework espousing knowledge "process" management within the context of knowledge sharing (KS), two competing views continue (Davenport & Cronin, 2000; Hall, 2001; Heaton & Taylor, 2002; McInerney, 2002; von Krogh, 2003b). One view focuses on the management of information tools and resources, emphasizing the role of technology (Zack, 1999); the other view focuses on creating and maintaining a conducive environment, emphasizing human factors such as people's trust, learning ability, sharing of information (Brown & Duguid, 2000). In the next section, we describe the KM model in the context of the seeming paradox of managing knowledge or knowledge objects through both technical and social processes.

## Model Development

Now equipped with an understanding of KM from multiple perspectives, it becomes necessary to consider KM in the health care domain; as E. Davenport suggests, "when context changes, new paradigms of KM may be expected" (Davenport & Cronin, 2000, p. 4). Previous paradigms have either emphasized certain aspects of KM and/or targeted specific environments. For example, Nonaka and Takeuchi's

KM model emphasizes knowledge creation in an R & D section for a large corporation (Nonaka & Takeuchi, 1995) or McElroy's model relegates managing knowledge objects to "first generation KM" (McElroy, 2000b). Alavi's model emphasizes IT tools to facilitate KM (Alavi & Leidner, 2001), whereas Hedlund's N-Form corporation model concentrates on what others might consider "enablers" rather than critical or essential KM attributes (Hedlund, 1994). Wenger's model of "communities of practice" focuses on knowledge sharing (Wenger, 1998). Even the scarce KM models intended for a health care context restrict their scope to the clinician as learner and ignore the organizational context (De Lusignan, Pritchard, & Chan, 2002).

Our current conceptualization of KM (see Figure 1) reflects an integrated framework focusing on effective knowledge process management to impact performance and work relationship in ways that enhance learning and decision-making. Although for the ease of depiction, the relationships among the model elements appear to represent linear relationships, a fair number of interdependences exist. A working definition informed by the model suggests *KM as the process by which people in organizations find, share, and develop knowledge for action*. This definition implies that (a) a knowledge artifact, that is, codified knowledge is in a format that is insufficient for fully effective knowledge use by practices (e.g., digital medical records); (b) a number of interdependent processes are necessary to manage knowledge; (c) there are social and technical dimensions to these processes as a result of knowledge being tacit (e.g., that knowledge conveyed in apprenticeships relationships) and being explicit (e.g., objects such as procedure manuals); and (d) action emanates from the tacit dimension of knowledge and KM processes engaged in pursuit of an organization's mission.

The model consists of KM enablers, critical processes, and the consequences of effective KM programs. In the next section we will define these elements in detail and then apply them to primary health care practices.

### *Enablers of Knowledge Management*

Those who describe KM as managing or creating an environment would argue that the enablers depicted in the model (see Figure 1) actually encompass KM; however, we argue as do others (Holsapple & Joshi, 2004; Lee, 2003) that these variables are enablers of KM and not its essence. Whereas KM processes such as finding, sharing, and developing knowledge represent basic operations, enablers provide the foundation necessary for the organization to increase its effectiveness in KM. Mindfulness, or openness to new ideas and perspectives, and heedful interrelating, or awareness of how one's work affects another, are examples of relationship characteristics that support KM (Weick, 2002; Weick & Roberts, 1993). In work situations where those involved "know what they are doing, being knowledgeable involves complying with the norms of interaction and presentation that characterize a work context" (Davenport, 2002, p. 1038). Communication that is accurate,

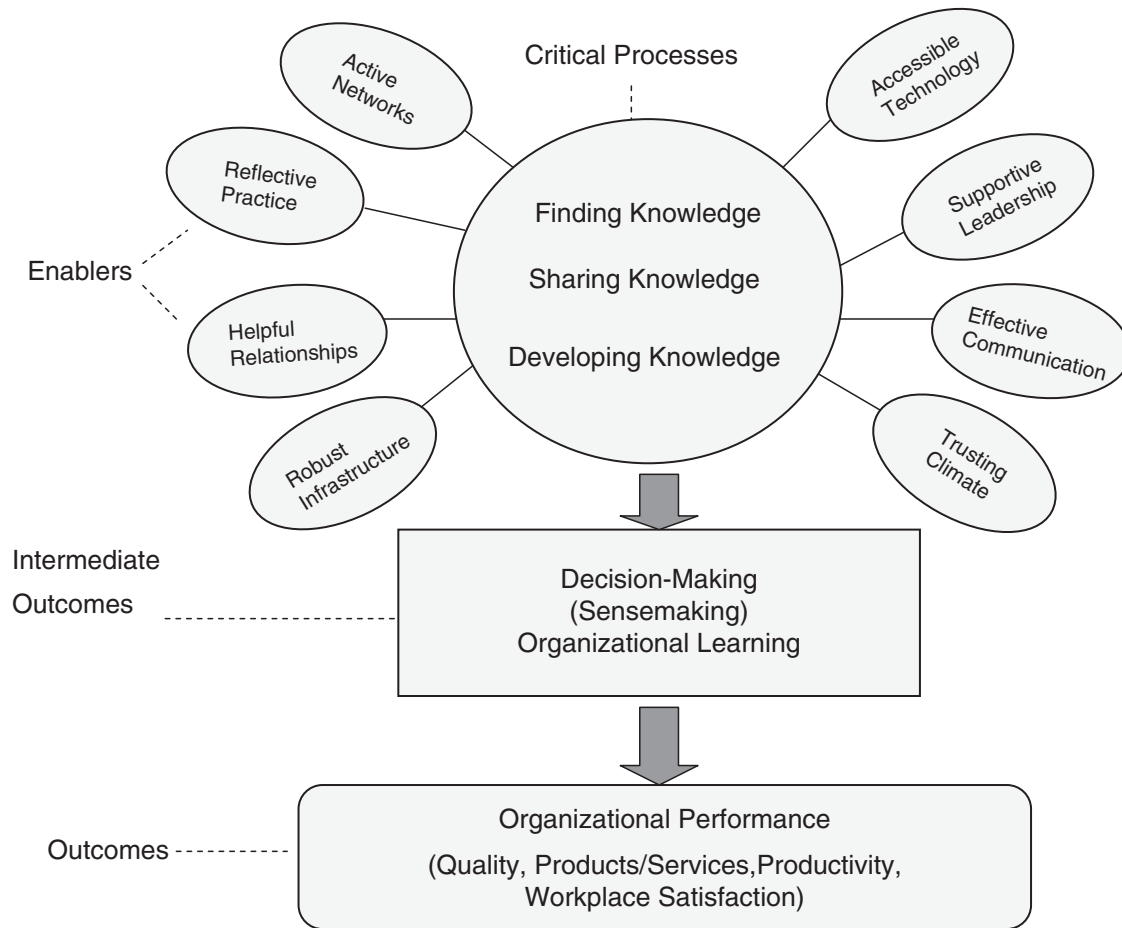


FIG. 1. Knowledge management model.

timely, accommodates conflict, and facilitates feedback represents another enabler (Elliott & O'Dell, 1999). In addition, the leadership enabler speaks to a commitment to KM processes by creating the space and encouraging the time for knowledge sharing (Davenport, Long, & Beers, 1998). This commitment extends to encouraging external connections or networks by allowing for networking outside the organization itself, as described in Wenger's "communities of practice" model (Wenger, 1998). Leadership is also important in deciding on priorities. An organizational climate that rewards sharing and collaboration and allows risk taking, can effectively enhance KM processes (Horak, 2001). Trust or the mutual confidence that no party to an exchange will exploit another's vulnerabilities, is a particularly important enabler, especially in the current competitive environment where one's special knowledge could be misused, or worse, employed to undermine one's position (McInerney, 2005). A reflective practice where individuals and groups reflect on past learning, analyze current processes, and evaluate /measure actions, represents another enabler (Schon, 1983). Finally, an infrastructure that competently deploys resources such as technology, office systems, or human resource functions can be important for online learning, communication, and sharing of knowledge (Sandars, 2004).

### Critical Processes

Key words and concepts associated with KM appear repeatedly across disciplines. These critical processes include processes for finding, sharing, and developing knowledge.

*Finding knowledge.* Finding or uncovering knowledge entails processes that allow organizations to make sense of and use data, information, and knowledge objects that may be present, but are not codified, analyzed, nor accessible to members. These processes concentrate mainly on technical tools, but also can be found in socially directed tools employed to connect individuals with existing knowledge sources, either other individuals or objects. Knowledge objects are entities that represent knowledge existing within organizational members (McInerney, 2002). Taking an evolutionary view of KM, some might describe these technical processes and associated tools as representing first-generation KM (McElroy, 2000b). It could be viewed as a partial solution to inadequate knowledge sharing. Groupware, knowledge repositories, data warehousing, and document management are examples of KM tools (Duffy, 2001). All are seen as superior to serendipity and manual efforts when it comes to dispersing knowledge from one part of the

organization to another. They represent ways to access the collective knowledge that the organization holds. Often described as glorified information/data management, and most apparent in this KM process, KM both attempts to translate lessons learned from information/data management as well as to make aware its diminishing returns (McElroy, 2000b; Wilson, 2002). Finally, finding processes also imply the possibility of “losing” knowledge as well, not only in gaps or misuse of technical tools, but also in avoiding loss of knowledge when people leave the organization (Long & Davenport, 2003).

*Sharing knowledge.* Sharing or the transfer and diffusion of knowledge includes processes to improve the willingness and ability of knowledgeable organizational members to share what they know to help others expand their own learning and knowing. Sharing knowledge is necessary both for the creation of new organizational knowledge as well as its distribution within the organization (von Krogh, 2003a). Although some technical tools have been utilized to facilitate knowledge transfer such as groupware, e-mail, etc., the sharing practices involve more social ones directed at encouraging organizational members to talk about things they already know. In fact, the social tools extend beyond the specific organizational unit to other units and even outside the organization as in communities of practice (Wenger, McDermott, & Snyder, 2002). Even when technical tools such as intranets are utilized for sharing, Hall (2001) emphasizes the importance of motivating factors as explicit rewards. Sharing knowledge, then arises from viewing knowledge less as a thing and more as a process (McInerney, 2002). Because tacit knowledge tends to be more difficult to codify, interaction or socialization tools are critical (Davenport & Prusak, 1998; von Krogh, 2003b). In addition, sharing knowledge contributes to creation of new knowledge by also validating new knowledge before it’s codified or further distributed (McElroy, 2000b; Nonaka & Takeuchi, 1995).

*Developing knowledge.* Developing or creating knowledge describes processes that allow organizational members to create new understandings, innovations, and a synthesis of what is known already. When organizations innovate, they do not simply process information from the outside in to solve existing problems and adapt to a changing environment. They actually create new knowledge and information, from the inside out, to redefine both problems and solutions (Davenport & Prusak, 1998; Nonaka & Takeuchi, 1995). Developing new knowledge derives from the distinction between tacit and explicit knowledge, and involves the mobilization and conversion of tacit knowledge (Broadbent, 1998; Nonaka & Takeuchi, 1995). To articulate intuitions and insights, heavy reliance is placed on figurative language and symbolism. Facilitating sharing of an individual’s personal knowledge with others, embracing ambiguity as a source of alternate meanings, remaining open to a fresh way of thinking about things, fostering redundancy, encouraging frequent

dialogue and communication, all are ways to establish a “common cognitive ground.”

Creating new knowledge also involves another distinction. Although one invokes the term *organizational knowledge creation*, the organization cannot create knowledge on its own without the initiative of the individual and the interaction that takes place within the group (Tsoukas & Mylonopoulos, 2004). This reliance on socialization is what differentiates KM from the classic views of the organization, of knowledge within the context of the history of information management. Knowledge management is an active process involving the creation of knowledge, the intentional elicitation of knowledge, and the ability to share knowledge across the organization (Davenport & Cronin, 2000; von Krogh, 1998).

### *Consequences of Knowledge Management*

Knowledge management facilitates individual and organizational decision-making or sensemaking and learning to achieve an organization’s mission and enhanced organizational performance.

*Decision making/sense making.* Decision making is roughly equivalent to the problem-solving process. This includes such concepts as “sensing, exploration and definition of problems or opportunities as well as generation, evaluation and selection of solutions” (Huber & McDaniel, 1986, p. 576). When issues are not especially clear because the data is voluminous, incomplete, or not very reliable, formalized decision making gives way to sensemaking or making meaning of situations (Weick, 1995). Collaborative working becomes extremely important as manifested in enhancing functionality of enterprise software (Scott & Kaindl, 2000), production process for pharmaceuticals (Bergquist, Ljungberg, & Lundh-Snis, 2001), and development of open source software (Lerner & Tirole, 2005). All three can be seen as examples of making collective “sense.” Organizational knowledge informs this process and KM processes encourage new knowledge production, sharing, and access for collective action.

*Organizational learning.* Although methods of decision-making may well influence learning processes, and vice versa, learning is to be distinguished from decision making (Argyris & Schon, 1978). Organizational learning increases organizational knowledge, and learning may, in fact, occur long before or long after action is taken (Miller, 1996). McGill, Slocum, and Lei (1992) define organizational learning as the ability of an organization to gain insight and understanding from experience through experimentation, observation, analysis, and a willingness to examine both successes and failures. Learning occurs at the individual and group level (Cook & Yanow, 1993). A sociotechnical model of KM that promotes education and innovation provides an implementation strategy not only for knowledge creation, but learning as well; it can be

considered a tool-kit of sorts for learning. Innovation in product and service delivery is an important outcome (Leonard-Barton, 1995; Malhotra, 2000). Finally, associated with learning is unlearning (Nonaka & Takeuchi, 1995). Through the process of knowledge creation and sharing, some knowledge may be discarded. Likewise, not only can knowledge be discarded, but there can be a “reuse” of knowledge for new purposes (Markus, 2001).

## The KM Model

Before applying the KM model to primary health care practices, it is necessary to indicate how the elements of the model will be described or measured. The KM definitional dimensions are described in Table 3 where the dimensions are matched with commonly employed KM tools.

Processes associated with finding information or knowledge include codification, identifying lessons learned and best practices, dissemination/imitation, and loss, and utilizing technical and socially directed tools to connect individuals with existing knowledge sources. “Losing” knowledge arises from gaps or misuse of technical tools, and when people leave.

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

Processes and tools associated with developing information or knowledge include recombining existing knowledge through categorizing and sorting, as in database utilization (combination); internalizing individual’s experiences in the form of shared mental models and technical know-how, as in manuals 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) (Nonaka & Takeuchi, 1995). This process also implies “unlearning” or relinquishing existing knowledge to develop new knowledge.

In the next section, we will apply the conceptual model of KM and the KM tools taxonomy by creating a primary health care practice scenario for the purpose of illustrating the model in a more concrete and understandable narrative. Although the practice scenario is hypothetical, the elements are drawn from an analysis of observational and interview data derived from researchers being on site in family care practices in a Midwestern setting in the United States. The researchers who compiled the data visited urban and rural practices where they interviewed clinicians and support staff and where they were allowed to observe physician–patient encounters. The data were transcribed and “scrubbed” to remove any identifying factors related to specific individuals or practices.

## *Family Practice Scenario for Possible Application*

The following hypothetical health care practice is a pattern of processes and best KM practices observed by the researchers in observational data from multiple real-life health care practices in the United States. The scenario describes application of the conceptual model (see Figure 1) and the taxonomies listed in the tables that appear in the Appendix.

Health Care Practice A can best be described as a dusty jewel amid the disordered health care landscape and represents a practice that has a high level of preventive services delivery. Disease prevention requires awareness of expert recommendations, followed by translating them into action by identifying patients at risk, providing immunizations and education, and tracking progress. The three physicians in Practice A share a vision to improve patient care and are motivated to provide KM processes and tools to enhance prevention. These include a patient registry (database) to identify and mail reminders to women due for mammographic screening, a well-organized medical record including a flowsheet (decision-support) to more easily prompt for immunizations during routine visits, and trained nurses to counsel lifestyle changes (cross-functional teams). In addition to communicating this shared prevention vision, other enabling factors for knowledge development and knowledge sharing include leadership that provides the time and space for reflection (formal group meetings) and informal meetings (lunch and breaks in the kitchen).

Although the practice has limited financial resources for investment in technology and personnel, the practice leverages resources by participating with other family practices in an arrangement providing administrative support through a Professional Hospital-Clinician Organization (PHO), a type of community of practice. One of the nurse educators was particularly interested in extending the gains in prevention to improving care to patients with chronic diseases. At a group meeting, an opportunity presented itself. Despite repeated tinkering with the office scheduling system in attempts to minimize complaints from patients, staff, and clinicians about access to the office, schedule conflicts, and not enough visit time, the nagging problems erupted at a monthly staff meeting. The staff decided to do a rapid time study to see where the problems were—with doctors, with certain times or days, certain patients, or certain medical conditions.

At a subsequent meeting, the results of the time study were presented to the group. It suggested that patients with certain multiple diagnoses, especially those with diabetes, were causing the appointment logjam. Suggestions ranged from increasing visit length for certain patients to requesting patients return more often. The nurse educator suggested group visits, something that she had been briefly exposed to at a professional nurses meeting. The clinician at the meeting noted that she had read about group visits in a journal. The staff members were intrigued, but there were a number of issues raised—payment, acceptance by the doctors, and participation by patients.

After some reflection, a recommendation was brought to the practice leadership group with background information

to inform a decision. After staff training, group visits were implemented. A registry was constructed from the billing system to identify and enroll patients with diabetes. Training was supported by the Professional Hospital-Clinician Organization, and included didactic work, observation, followed by supervised participation. A manual was developed. Despite the enthusiasm and preparation work, some unexpected setbacks occurred. Some patients were reluctant to relinquish individual encounters. Equally surprising to the practice members actively engaged in the process was one of the clinician's reluctance to refer her patients for group visits. After sitting in on a session and witnessing the effect of the group visits on a patient that she had labeled as "noncompliant," she learned how the groups could function for knowledge building and became a staunch supporter. As a board member to the PHO, she would suggest that the PHO explore implementation in additional practices.

Knowledge finding, sharing, and especially creation were illustrated in the development and implementation of group visits in the practice studied. Facilitated by enabling factors, the practice went through a process of innovation in a new delivery care system that altered the mental model of care from individual to group and integrated financial, operational, and clinical components. There were elements of social and technical dimensions. Socially related tools included the meetings, training, and external connections. The registry, time study, and training manual were technical examples. Elements of tacit knowledge were evident in expression through the nurse educator and office manager at practice meetings. Explicit knowledge examples were given expression through the professional sponsored meetings and journals. There were elements of sharing and creating, often in nonlinear ways, through various levels of the organization, the small group, then leadership group, then the PHO, then back to the small group. There were steps toward validation along the way before wider dissemination. The consequences were evident through organizational discussion and learning. Learning was developed generatively through a willingness to examine alternatives, anticipate impediments, and adjust to unexpected reactions. One could expect potential application to other conditions and performance (workplace satisfaction, patient satisfaction, financial and patient outcome on diabetic care). Here we have put forth a hypothetical case based on observation and interview data gathered in high- and low-performing health care practices. In the following discussion, we develop the concept KM and relate the importance and potential of a KM model to the pursuit of health and healing in primary care practices.

### *Implications for Healthcare and Information Science*

While health care worldwide continues to search for improvements, health care in the United States is in profound crisis. The crisis includes problems with access, cost, and quality, and each of these has the potential of being helped by information science. Primary care practices (PCPs) are also in crisis, lacking integration with other parts of the health

care system, and suffering from poor organization, support, and functioning, yet PCPs have the potential of solving many of the problems in American health care. In every other health system around the world, well-functioning primary care is essential for quality health care. More than 90% of all Americans visit their primary care provider at least once each year (Benson & Marano, 1994). For the most part, primary care in the United States is delivered through a network of community based freestanding practices. Because of their central role in health care delivery, understanding and fixing the problems of PCPs is, therefore, essential to improving the health care of the nation's citizens.

We have found KM to be a helpful organizing framework to identify and solve problems facing PCPs, and in this article, we have presented a model for how KM informs our understanding of PCP's. Specifically, KM provides a practical framework for understanding how to improve the access to and quality of clinical care through enhancements to preventive services and early and effective management of chronic illnesses, factors that account for primary care's positive effects on a health system (Starfield et al., 2005). Knowledge management processes and tools can be thought of as ways to organize and influence learning and decision making within practices to achieve overall health.

Tremendous opportunity exists for information science to inform the better delivery of health care services. Primary care service delivery no longer exists solely as the province of the clinician, but rather with the practice as an organization. To excel at delivering primary care, the creation and sharing of knowledge must occur not only between the clinician and patient, but also throughout the practice, and between the practice and other health system participants. Knowledge management informs our understanding of this process, and its enhancement can improve communication and understanding of health conditions and facilitate effective treatments. Quality does not simply reside in an individual, but in the quality of the group and with the PCP's organizational attributes such as the quality of relationships (Tallia et al., 2006). Knowledge management can provide valuable lessons and a framework for practice redesign solutions (Doran et al., 2006; Future of Family Medicine Project Leadership Committee, 2004).

This understanding of KM in the "work and workplace" of primary care provides a theoretical framework for explaining the mixed results or lack of sustainability from previous interventions to enhance care. Knowledge management can inform current and future efforts toward quality care improvements. One example of the benefits of effective KM processes can be seen in interventions to improve chronic diseases and prevention. Continuing medical education, clinician and patient reminder systems, electronic health records to gain new knowledge about patients and the practice, continuous quality improvement, group visits and knowledge sharing, have all been implemented in the quest to improve diabetes care (Davis & Taylor-Vaisey, 1997; Grol & Jones, 2000; Solberg et al., 2000). These methods could be understood as different ways to influence or organize

relationships to improve diabetes care by enhancing decision making and learning. However, research in how KM is employed in organizations informs us that KM methods cannot be implemented haphazardly as they can interact to enhance or detract from desired outcomes (Huysman & de Witt, 2003, p. 27). Rather, KM explains why knowledge exchange and other knowledge building activities need to be tailored to specific outcomes as well as being implemented in an integrative framework. For example, if the intent is to improve patients' self-management of diabetes, working within group visits may be one way to influence the patient. Having multiple voices discuss the illness and strategies for dealing with it using the knowledge and experience acquired by the group, can inform and empower patients beyond what the advice of a single physician can offer.

Within the conceptual framework of KM it can be understood that if a practice population frequents the office mainly for acute visits, then group visits may not be the first step towards better diabetes control. Rather, employing a patient reminder system or a well-organized chart with clinician prompts to treat coexisting conditions would be a better deployment of limited practice resources. Knowledge management can provide this framework for organizational learning while accommodating the diversity of practice organizational models (Cohen et al., 2004; Future of Family Medicine Project Leadership Committee, 2004; Glasgow, Orleans, & Wagner, 2001; Nelson et al., 2002).

Knowledge management can also enhance practices by helping practice staff and clinicians to choose tools that leverage other existing organizational capacities. Knowledge management has utility not only in cultivating new interventions, but also by retaining enablers that have worked. For example, space in PCPs is at a premium, and it may be tempting to take a group space and transform it into an office. However, KM in practices informs us that converting the break room into an individual's private office can easily stifle opportunities for spontaneous conversation of benefit to sharing information of value to the practice.

Although our model of KM needs testing, refinement, and practice improvement relevant measure development, there is "much to offer and even more to hope" (Fry, 1966, p. 2). Understanding interactions between patterns of practice member relationships and KM may explain why some costly technical and/or externally imposed "one size fits all" organizational interventions have had mixed results and limited sustainability in PCP. So by helping to understand PCPs, KM has the potential to influence practice improvement efforts and improve the overall quality of primary care.

## Conclusion

Knowledge management is a relevant construct for the analysis of the organization and functional behavior in primary care practices. Drawing on a synthesis of the information sciences and health care organizational literature, we have presented a model of KM that provides a theoretical and practical framework to facilitate our understanding of

primary care practices' health-promoting influence. Because any intervention to improve knowledge development and knowledge sharing in health care practices must be based on a solid and persuasive theoretical foundation, it is hoped that the work presented here can serve as a reference and impetus for improving quality in the management of health care. Knowledge management also provides essential insights into understanding successful primary care practice improvement, and as a result, has the potential to influence favorably the overall improvement in the health of residents in the United States and around the world.

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## Appendix A

TABLE A.1. Summary of key knowledge management KM themes, relevant disciplines, and major contributors.

Discipline	Contributors	Key themes
Communication Philosophy	Heaton & Taylor, 2002; McInerney, 2002 Barnes, 1984; Polanyi, 1966	<ul style="list-style-type: none"> <li>—KM as “process” management</li> <li>—Nature of knowledge, information, &amp; data</li> <li>—Tacit &amp; explicit knowledge</li> <li>—Knowledge as relative, situated, &amp; socially constructed vs. objective reality</li> </ul>
Psychology	Argote, 1993; Argote, Ingram, Levine, & Moreland, 2000; Kolb, 1954; DeFillippi & Ormstein, 2003	<ul style="list-style-type: none"> <li>—Cognitive &amp; behavioral dimensions to knowledge &amp; learning. Cognitive: adjustment or change in way organizations or individuals process information, develop shared meaning, &amp; interpret events. Behaviorists assume learning has occurred if there has been a change in behavior or action even if not preceded by a change in thinking to motivate the new behavior:</li> <li>—Although focus on individual knowing &amp; learning, extended to small group/organizational level</li> <li>—Reasons for failing to act, not to learn, forgetting, ignoring</li> <li>—Impossible to think of knowledge in terms of mechanical transfer</li> </ul>
Sociology	Bell, 1999 reissue edition original 1973; Machlup, 1982 Durkheim, 1982 Lesser & Storck, 2001	<ul style="list-style-type: none"> <li>—Macro level: Knowledge-based society information; led &amp; service oriented</li> <li>—Grounded in “social facts,” observation of what people actually do, the circumstances that they share knowledge, &amp; apply, change or ignore what they learn from others</li> <li>—Social Capital: the collective value of all social networks &amp; the inclinations that arise from these networks to do things for each other</li> </ul>
Library and Information Science	Buckland, 1991 Marchand, 1983 Davenport & Cronin, 2000 Hall, 2001 Ponelis & Fairer–Wessels, 1998; Holsapple & Joshi, 2002 Marwick, 2001;	<ul style="list-style-type: none"> <li>—Distinctions between information, knowledge, data</li> <li>—Knowledge acquired through a process of “becoming informed”</li> <li>—KM as the 4th stage of information management;</li> <li>—KM triad framework information management by another name, management of “know–how,” optimization of conditions for adaptive co–evolution</li> <li>—Typology for knowledge sharing</li> <li>—Blend of business processes, people, information technology</li> <li>—Decision–supports</li> <li>—Utilization of technology in development of KM tools to facilitate tacit as well as explicit dimensions of knowledge</li> </ul>
Economics	Hislop, 2002b Koenig, 2000 von Krogh, 2002, 2003b Markus, 2001 Grant, 1996; Machlup, 1982; Levitt & March, 1988; March, 1991; Starbuck, 1992; Hayek, 1945; Penrose, 1959; Arrow, 1962	<ul style="list-style-type: none"> <li>—Difficulty of using technology for KM</li> <li>—Intellectual capital</li> <li>—Knowledge sharing and collective action, communal resource</li> <li>—Knowledge “reuse”</li> <li>—Knowledge as an inexhaustible resource; economic significance of knowledge</li> <li>—Knowledge–based theory of the firm</li> <li>—Organizational knowledge</li> <li>—Attention drawn to business &amp; economic outcomes expected from KM</li> <li>—The firm’s capacity to learn as an asset; organization could learn in ways that were independent of individual</li> <li>—Learning by doing</li> </ul>

(Continued)

TABLE A.1. (Continued)

Discipline	Contributors	Key themes
Education	Nelson & Winter, 1982; Winter, 1993 Dewey, 1916; Elkjaer, 2003 Petrides, 2002	<ul style="list-style-type: none"> <li>—“Tacit knowing” as basis for individual &amp; group competence</li> <li>—Firms as organizations that know how to do things</li> <li>—Expanded learning from individual to small group level</li> <li>—Activity of training has influenced KM practices</li> <li>—Idea of learning in activity or through experiences</li> <li>—KM role in education, organizational learning</li> </ul>
Engineering & Computer Science	Boisot & Cox, 1999; Damodaran & Olphert, 2000; Chae, Paradise, Koch, & Huy, 2005 Silver, 2000; Stenmark, 2000 Blair, 2002	<ul style="list-style-type: none"> <li>—Importance of human interface with software and hardware development and utilization has shaped the technical dimension of KM discourse</li> <li>—Exploration of “human factors” has influenced discussion of KM enablers such as organizational culture, communication, relationships, and trust</li> <li>—Technology support for KM, knowledge repositories, yellow pages</li> <li>—Distinguishes KM from Information Management. KM as management of supporting data &amp; information, &amp; management of individuals with specific abilities.</li> <li>—KM embedded not only in documents but routines, processes, practices</li> </ul>
Quality Movement Medicine, Nursing/Allied Health/Medical Informatics	Deming, 2000; Berwick, 1989 Abidi, 2001; Balas, Krishna, Kretschmer, Cheek, Lobach, & Boren, 2004; Cheah & Abidi, 1999; Montani & Bellazzi, 2002; Purves & Robinson, 2004; Stefanelli, 2004; Fitchett, 1998; Bali, Feng, Burstein, & Dwivedi, 2005; Gabbay & le May, 2004 Horak, 2001 Malone, 2001 Bohmer & Edmondson, 2001; Edmondson, 2003b; Pisano, Bohmer, & Edmondson, 2001 Rushmer, Kelly, Lough, Wilkinson, & Davies, 2004; Nutley & Davies, 2001 Plalice & Kitch, 2003; Sandars, 2004	<ul style="list-style-type: none"> <li>—Internal customers; overt processes; shared transparent goals; measurement</li> <li>—Technical dimensions reflected in EMR, repositories for best practices, and electronic facilitation of communication; decision supports</li> <li>—Tends to be more concentrated on individual medical decision-making</li> <li>—Human factors in health delivery: Risk taking, collaboration, sharing, leadership</li> <li>—KM initiatives in health care</li> <li>—Team learning; organizational learning in health settings</li> <li>—Learning organization to medical practice; Learning UK NHS</li> <li>—KM practices in UK health settings</li> </ul>

EMR = Electronic Medical Record; NHS = National Health Service.

Strategic Management

Grant, 1996; Spender & Grant, 1996; Hedlund, 1994;  
de Geus, 1988  
Nielsen, 2005

Stewart, 2001  
Prahalad & Hamel, 1990

Kogut & Zander, 1992

Hislop, 2002a; Soliman & Spooner, 2000; Swart &  
Kinnie, 2003

Human Resource Management

Organizational Science

Nonaka, 1991; Nonaka, 1994; Nonaka & Takeuchi, 1995

Nonaka, 1994; Nonaka & Takeuchi Davenport &  
Prusak; Prusak, 2001

Pfeffer, 2000; Sveiby, 1997

Drucker, 1993; Drucker, 1999

cheini, 189 1

Bratsumi, 172 1  
I, 199; MintzbeOra &, 200;& imuni, 191;

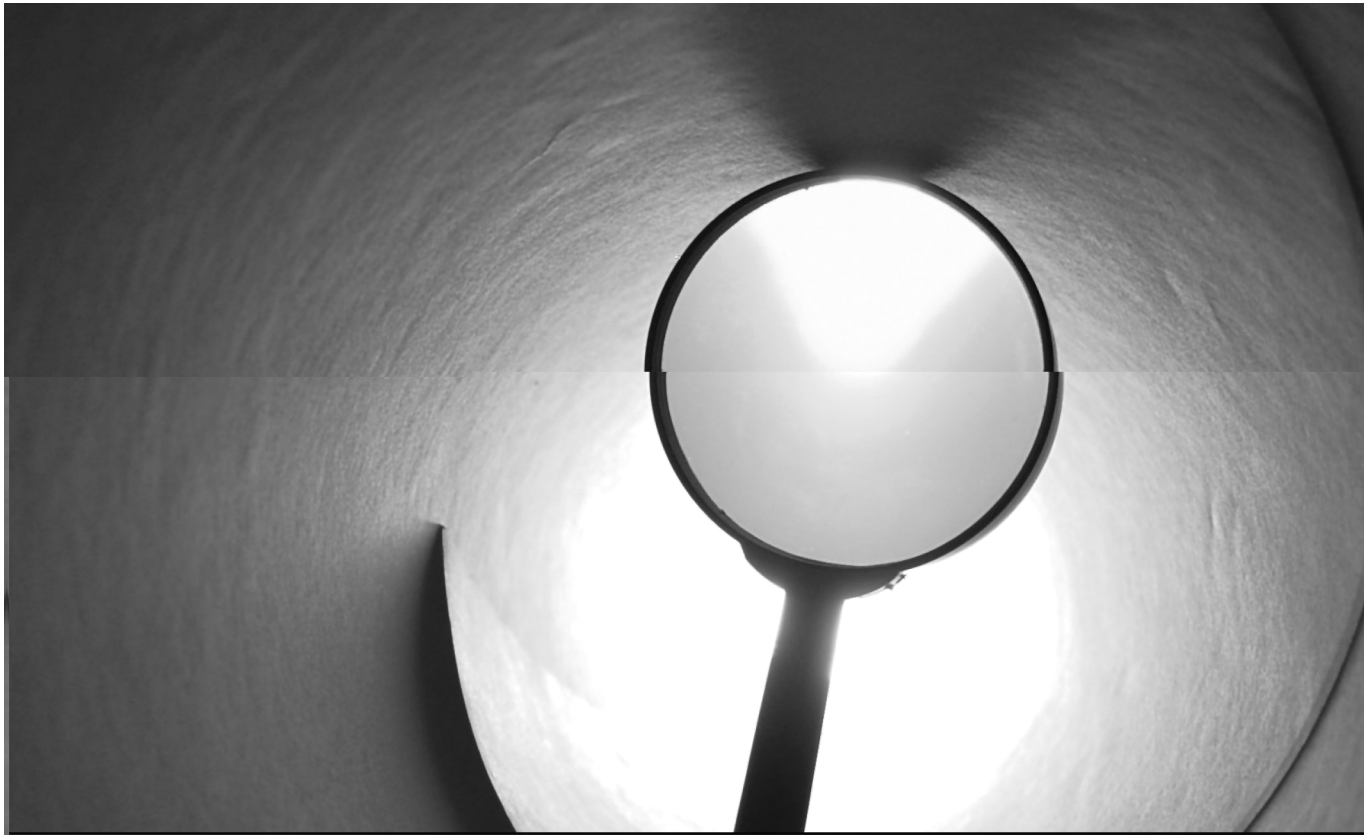
TABLE A2. (Continued)

Subdiscipline	Contributors	Key KM themes
	Weick, 1995; Daft & Weick, 1984; Boje, 1991	—Sense making versus decision making: Learning begins with organizations making sense of their environment because of ambiguity and uncertainty never have enough information
	Cyert & March, 1963; March & Olsen, 1975; Cangelosi & Dril, 1965; Cook & Brown, 1999; Huber, 1991; Cohen & Levinthal, 1990; Fiol & Lyles, 1985; Hedberg, 1981; Nicolini & Mezner, 1995; Tsang, 1997; Duncan & Weiss, 1979; Shrivastava, 1983	—Organizations as interpretative systems; storytelling in organizations —Organizations learn as well as individuals —Differences between learning and knowing
	Starbuck, 1992; Barney & Hansen, 1994	—Knowledge-intensive firms learn by training, minimizing personnel turnover, developing organization, culture, building routines & social capital, trust
	Crossan, 1999	—Knowledge embedded in non-human repositories such as routines, systems. —Structure and strategy
	Edmondson, 2000.; Edmondson, 2002	—Empirical work in group/team dynamics & behavior in business/health organization —Structure & design of organizations, especially a more distributive orientation
	McElroy, 2000a; Tsoukas, 1998	—Complexity science connections with KM & organizational learning
	Probst, Raub, & Romhardt, 2001; Ahmed, Lim, & Zairi, 1999; Appleyard, 1996; Armistead & Meakins, 2002; Bassi & McMurrer, 2005; Bertler, Pavlopoulos, & Koutsouris, 2005; Chou & Tsai, 2004; Darroch, 2003; Darroch, 2003; de Gooijer, 2000; Edmondson, 2003a; Kakabadse, Kakabadse, & Kouzmin, 2003; Lehr & Rice, 2002; Mentzas, Apostolou, Young, & Abecker, 2001; Moffitt, McAdam, & Parkinson, 2003; Sveiby & Simons, 2002; Sveiby, 1997; Van Buren, 1999; Davenport et al., 1998; Davenport, Harris, Long, & Jacobson, 2001; Davenport & Beers, 1995	—KM implementation strategies —Measurement
	Beijerse, 1999; Wickert & Herschel, 2001	—Typology & measurement of KM in small businesses
	Gold, Malhotra, & Segars, 2001; Malhotra & Galletta, 2003; Gray, 2001	—Categorizations system for KM practices around organizational strategy vs. Nonaka's use of knowledge characteristics
	Lave & Wenger, 1991; Wenger, 1998	—The group as unit of analysis in exploring productive work
	Brown & Duguid, 1991, 2000; Inkpen & Tsang, 2005;	—Extended to networks & communities, "communities of practice"
	Inkpen & Crossan, 1995	—Knowledge not as simply socially constructed, but as co-creation of the group, & the group in relationship to the community
	Wilson, 2002; Alvesson, Kärreman, & Swan, 2002	—"Social School" of organizational theorists critique against KM initiatives technological focused and ignoring the social architecture of knowledge exchange;"
	Alavi & Leidner, 2001; Zack, 1999 Hansen, Nohria, & Tierney, 1999;	—Critique of KM —KM typologies
	Tierney, 1999;	—Codification of knowledge
	Garvin, 1993; Senge, 1990, 1994	—Utilization of technology in development of KM tools to facilitate tacit as well as explicit dimensions of knowledge
Consultancy Practice	Garvin, 1993; Senge, 1990, 1994	Learning organization: personal mastery, mental models, teams, shared vision, systems thinking



TABLE A3. Knowledge management (KM) processes and tools.

KM processes	KM tools
Finding/losing knowledge or information	
Codification (records, forms or maps into clinical, operational or financial processes)	<ul style="list-style-type: none"> <li>—Databases (sort, add, categorize)</li> <li>—Decision support</li> <li>—Indexing/Retrieval system</li> <li>—Repositories (best practices, reports, documents, meeting minutes, manuals)</li> </ul>
Dissemination/imitation	<ul style="list-style-type: none"> <li>—Training</li> <li>—Repositories</li> <li>—Decision support</li> <li>—Databases</li> </ul>
Losing (tacit and explicit knowledge sources)	<ul style="list-style-type: none"> <li>—Personnel</li> <li>—Routines</li> </ul>
Sharing knowledge or information	
Teaching/training	<ul style="list-style-type: none"> <li>—Lectures</li> <li>—Apprenticeship</li> </ul>
Sharing/transfer/diffusion	<ul style="list-style-type: none"> <li>—Cross Functional teams</li> <li>—Communities of Practice</li> <li>—Story Telling</li> <li>—Knowledge Artifacts</li> <li>—Communication Channels (E-mail, phone, written, face-to-face)</li> <li>—Expert knowledge base</li> </ul>
Developing knowledge or information	
Combination (explicit to explicit: reconfiguration of existing information; opportunities for individual learning)	<ul style="list-style-type: none"> <li>—Databases (sort, add, combine, categorize}</li> <li>—Formal education/training</li> <li>—Individuals exchange/combine knowledge through such media as documents, meetings, phone conversations, communication networks</li> <li>—Middle managers break down and translate corporate visions, business, products, service concepts</li> </ul>
Internalization (explicit to tacit: “learn by doing” internalized in individual, then group in shared mental models or technical know-how)	<ul style="list-style-type: none"> <li>—Helps if knowledge is verbalized or diagrammed into documents, manuals, or oral stories</li> </ul>
Socialization (tacit to tacit: sharing experiences, and thereby creating tacit knowledge such as shared mental models and technical skills)	<ul style="list-style-type: none"> <li>—Opportunities to share experiences; not have to employ language</li> <li>—Observation, imitation, practice; apprenticeship</li> <li>—Interaction with customers</li> </ul>
Externalization (tacit to explicit: articulating tacit knowledge into explicit concepts; takes the shape of metaphors, analogies, concepts, hypotheses, or models)	<ul style="list-style-type: none"> <li>—Dialogue/collective reflection</li> <li>—Validation by trial periods, evaluation, measurement</li> </ul>
Unlearning (retaining maladaptive rules, models, and operational, clinical processes)	<ul style="list-style-type: none"> <li>—Challenging and relinquishing status quo</li> <li>—Taking advantage of tension</li> </ul>



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