Knowledge Care

Using Technology to Seize the Knowledge Management Opportunity in Healthcare

DRAFT Position Paper

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Executive Snapshot

Few would deny that effectively managing knowledge is a key driver of quality outcomes and profits in healthcare delivery today. Yet the evidence (decision errors, skill shortages, slow transfer rates for best practices, high malpractice premiums, etc.) suggests our ability to create, use, share, and protect the knowledge needed for healthcare delivery may be nearing a point of failure. Some efforts – mainly in the form of clinical knowledge management – have made progress, but a new approach is required if we are to avoid a full-scale knowledge management failure in healthcare delivery. This paper presents an emerging approach calling for leadership from physician executives and for a keen focus on tackling issues across the spectrum of knowledge management (**c**reate, **u**se, **s**hare and **p**rotect knowledge or CUSP). The most urgent challenges for the physician executive in the next wave of knowledge management include implementing mechanisms for knowledge governance, improving cognitive fit between knowledge management systems and users and clarifying the links between knowledge, outcomes and economics (i.e. outcomenomics) in healthcare delivery. This paper introduces a simple but industrial-strength framework called knowledge care (for knowledge management in healthcare delivery), designed to tackle just these issues.

Knowledge Failure in Healthcare Delivery

There is something very wrong with the way we are managing knowledge in healthcare.

We cannot effectively apply the knowledge we have and yet the supply continues to explode in some areas while running dangerously low in others. Consider for example that fact that:

- New medical and healthcare-related knowledge doubles in less than four years (knowledge creation)[1]
- Practitioners receive a mountain of guidance (e.g. GPs in the UK receive 33 lbs of clinical guidelines per year) yet patients receive less than 50% of the recommended care in many disease states (knowledge use)[2]
- The upward spiral of malpractice premiums reflects the intense legal and economic risks practitioners and underwriters face in the everyday application of medical knowledge (knowledge use)
- Attempts to computerize decision assistance are met with strong clinician resistance and result in alert fatigue and "blow by" (knowledge use)
- It can take 17 years to translate new scientific discoveries into best health care practices (knowledge sharing or transfer)[3]
- There are well-documented shortfalls between the supply and demand for nurses and physicians in certain specialties. The 20-year forecast presents an alarming healthcare skill shortage (knowledge protection)[4]
- There is a growing number of patent applications being filed that claim innovative ways of using technology to deliver healthcare. Although not a factor today, these patents will create an invention or patent infringement risk for many providers in healthcare tomorrow (knowledge protection).[5]

A "perfect storm" is forming in healthcare around how we create, use, share and protect the knowledge needed to deliver cost-effective care. Some go so far as to call it a crisis. OpenClinical, a UK-based group of medical research and provider organizations, developed a white paper entitled "The Medical Knowledge Crises and Its Solution through Knowledge Management" that claims:

> "It in now humanly impossible for unaided healthcare professionals to possess all the knowledge needed to deliver medical care with efficacy and safety made possible by current scientific knowledge."

How are we to navigate this storm or come out of this medical knowledge crisis? We believe the physician executive is the natural leader. Further, we see technology as one of three key levers needed to manage the knowledge assets and risks that are inherent in healthcare delivery.

Finally, we believe that every knowledge-based problem we have in healthcare is also an opportunity and that the best way to solve the problem is to seize the opportunity. Therefore, we have prepared this white paper for the physician executive intent on using information technology (IT) to seize the knowledge management (KM) opportunity in healthcare delivery.

Knowledge Management Technology in Healthcare Delivery Today

To date much of the KM work in healthcare technology has been focused more on medicine than on the delivery of care and has been done in Europe rather than in the United States. In its most advanced form, KM in healthcare has produced the field of clinical knowledge management.[6] Technology has played a dominating role in improving how we manage clinical knowledge in two ways:

- *Computerizing knowledge*: making knowledge explicit by capturing, codifying, applying and maintaining complex data, rules and protocols in systems in order to support and improve clinical decision-making. The electronic medical record (EMR), computerized physician order entry (CPOE), clinical decision support (CDS), expert systems and repositories of evidence-based literature are all examples of using technology to computerize knowledge.

- *Leveraging tacit or people-based knowledge by*: improving communication, coordination and collaboration to improve access to and the synthesis of knowledge needed to deliver effective care. Telemedicine, virtual communities (e.g. web-based interactions for chronic care), the e-ICU (intensivists deliver remote ICU care via systems, cameras and mobile robots) and expert locators (software to help connect you with answers and experts) are all examples of how to manage tacit knowledge using IT

Clinical knowledge management has some history and has produced success. For example, the efforts of Partners Healthcare were highlighted in the prestigious Harvard Business Review in July 2002. The article focused on how Partners has "baked specialized knowledge" right into the workflows of healthcare delivery. Specifically it highlights their work in order entry.

Yet clinical knowledge management has not caught fire or scaled up. In some cases it fails to produce the desired economic and clinical improvements. It has not, at least in its current form, done much to abate the potential knowledge crisis in healthcare. Why not? We believe that part of the answer is that the IT aspects of these types of projects overwhelm the knowledge management considerations.

For example, when you are implementing an EMR, telemedicine system or some form of clinical decision support, the classic IT work of selecting or developing the software, customizing it, building the servers, setting up passwords, training end users and the like dominate the project. From a management standpoint such activities make up most of the work leaving few resources and little time to attend to the critical (and less well-defined) knowledge management aspects. As the IT aspects of the work overwhelm the KM we fail to produce the outcomes we seek. This has certainly been the case in other industries where experts claim that 70% of the KM technology systems disappoint or out right fail.[7]

From Clinical Knowledge Management to Knowledge Care

So how are we to avoid repeating the mistakes other industries have made in using technology for KM? The key is to bring a sharp focus and a disciplined approach to the other aspect of the work that is KM. Specifically, there are four critical factors that must be addressed for success on IT-based KM projects:

1. Knowledge governance: How will we validate or certify the knowledge that is used in the system? If a system contains knowledge such as a clinical rule or evidence-based guideline we must be sure that it reflects the best judgment of the healthcare system. For example, in a CPOE system will we allow users to override alerts? If so, which alerts? Will they be required to document their rationale? How will the overrides and rationales be captured in the legal medical record? Without a well-oiled knowledge governance machine it will take too long and cost too much to create the large bodies of computerized knowledge needed to profitably and safely meet the increasing demand for healthcare services.

2. Cognitive fit: How will we ensure the system's interface and associated workflows support or enhance how clinicians, patients, and administrators naturally organize information, make decisions and learn? A good fit between the system and the user's mental model is critical to acceptance, use and avoiding new types of errors. Later in this paper we will introduce an approach you can use to assess the cognitive fit of any IT system in terms of trust, emulation, load and learnability.

3. Knowledge engineering: How will we identify and capture the knowledge in a way that guarantees a robust and maintainable system? This involves converting raw data, unstructured text and human expertise into a computer usable format. In the case of converting human expertise, knowledge engineering involves working with experts in the area to document the rules, concepts and reasoning processes they use. This knowledge is then programmed into a computer.

For example, it takes considerable work to program the drug-drug interactions and dose rules and concepts needed for a decision support. Many knowledge-based systems fail to make it into wide use because they are geared towards simplified problems or are too costly to maintain. As the cost of knowledge engineering can be high, many health systems will not be able to afford to it. This could be the Achilles heel of KM in healthcare unless we find effective ways to create, sell and share it on a large-scale basis.

4. Knowledge value: How will we make sure that both quality outcomes and improved economics are achieved by the system? As knowledge (and therefore how we manage it) simultaneously drives quality and productivity we can expect that the creative use of KM systems will improve outcomes and economics. For example, an intensivist that uses Visicu's e-ICU can monitor more patients and improve the care the patient would otherwise have received. This would increase billings for the physician and potentially decrease the length of the patient's stay and therefore increase volumes at the hospital's ICU. Other vendors, for example Active Health Management, have created a large rule set (the CareEngine) of evidence-based guidelines that can identify patterns in a patient's medical claims and pharmacy benefit data suggesting the need to initiate or stop a treatment, or to perform a test that has not yet been done. No single provider is likely able to see these patterns and thus initiate the appropriate intervention. This creates an opportunity for a new fee-based service that improves the timeliness and effectiveness of patient care. Health IT vendors that provide these KM solutions are the most visible examples of how to improve economics and outcomes at the same time. These examples are compelling enough to spawn new businesses, and as KM in healthcare delivery matures, we expect to see successful group practice, hospital and health plan KM applications spinout into successful ventures. Right now though, the inability to see the link between knowledge and value is often a barrier to making the appropriate investment in KM to improve the "outcomenomics" of care.

Physician executives are uniquely positioned to bring focus and leadership energy to the critical factors of governance, cognitive fit, engineering and value in the next emerging wave of KM. For example, they have the organizational position and technical mastery needed to form and lead the committees and processes that are required for knowledge governance. Physicians, as users of the KM system and bearers of tacit knowledge, will be called upon to participate in interface design (cognitive fit) and knowledge engineering sessions. Further, with additional training physician executives make excellent lead knowledge engineers. Finally, physician executives can envision the operational, marketplace and overall economic opportunities made possible by using technology to improve how we create, use, share and protect healthcare knowledge.

Bringing a sharp focus to knowledge governance, fit, engineering and value is one thing we need to bring KM to life in healthcare delivery. Another is to broaden our understanding of what technology can do for managing different types of knowledge. We must think beyond clinical applications to consider how technology can be used to:

1. Manage the knowledge the patient requires to properly access and use healthcare. What knowledge is required to decide to seek medical help, follow the treatment plan or even change behaviors to avoid health risks? For example, the web is awash with health calculators, assessments, checklists and decision tools to help patients with these questions. There are literally thousands of virtual communities that have sprung up on the Internet, over 82,000 on Yahoo Health alone, where patients share knowledge, tips and experiences in managing a wide variety of conditions. Finally, there are popular sites (e.g. WebMD) that provide overviews, tutorials and reference material on nearly every health question or medical concern a patient could have. Hand-held devices for consumers with health content on them are beginning to appear. Most agree that the role of the patient in the healthcare delivery process must increase in sophistication and effectiveness. That requires knowledge and lots of it.

2. Manage the knowledge that leaders, administrators and support staff need to run operations well and compete effectively in the marketplace. What knowledge is required about competitors, workflows, patient's needs and emerging medical technologies to run the business of healthcare? Already business intelligence systems, workflow automation software and data mining are KM technologies at work in this area. For example, rules embedded in workflow software designed to complete and code charts faster means dropping bills sooner and better cash flows. Using neural networks (a type of KM technology that is developed by training the computer to recognize patterns in historical data on the problem) to more accurately predict healthcare costs means better plan underwriting and profitability. Expert systems that promote customer self-service lower operating costs and free staff to improve patient satisfaction in other ways. Using data mining techniques to discover new patterns in outcome studies or public health records can provide insights for developing new healthcare services or products. Administrative, HR, finance and other support areas are all knowledge intensive. Making them more effective means improving how we manage the knowledge that drives them.

The best opportunities for using KM to improve outcomes and economics need not always involve decision or collaboration support for clinicians. However, like the clinical applications of KM, the patient and business applications must also take into account governance, cognitive fit, engineering and value.

Consider for example, the health and economic implications of using KM to improve how patients engage in prevention and the self-care of chronic conditions. As much as 70% of our healthcare spending can be traced back to the otherwise avoidable health risks associated with ineffective diet, inadequate exercise, alcohol or drug use, poor sleep habits and negligence of personal safety.[8] Further, patients with diabetes, congestive heart failure and other chronic conditions often fail to follow treatment plans driving up the cost of care tremendously. This situation is somewhat perplexing given the amount of money and time that is spent by clinicians, public health officials, health plans and other agencies on educating patients. The results of these efforts are at best mixed indicating that there is a real problem with how we are managing consumer's knowledge when it comes to self-care. From a KM standpoint the problem is not the lack of knowledge, but rather how it is being delivered to the patient. There is a profound lack of fit between how patients think, organize information and make decisions and how the healthcare system is educating and sharing knowledge. Simply telling a patient that smoking is bad for them and sharing the facts about lung cancer are not enough. More emotionally effective and technologically sophisticated means of packaging and delivering knowledge just when it is needed are required. Online health reminders, daily inspirational health cards, professionally facilitated web-based group sessions, personal medical monitoring devices, computer-based behavioral protocols (e.g. neuro feedback) and even specially designed computer games to help patients to learn how to manage their disease are just a few examples of innovations in this area. The goal is to figure out how to package and deliver knowledge to produce and sustain health-related behavior change. We believe that improving the cognitive fit between patients and the systems and means used to educate them is one of the biggest opportunities for KM in healthcare today.

Knowledge as a Foundation for Patient Care

To seize the KM opportunity in healthcare we must begin to move beyond clinical knowledge management to the broader realm of what we call knowledge care. Knowledge care is just shorthand for knowledge management in healthcare delivery and can be defined as efforts aimed at

> *improving how we create, use, share and protect the knowledge needed to deliver quality outcomes and profits across the patient care continuum.*

Knowledge care is about managing knowledge to *simultaneously* improve patient care and the economics of the business. KM systems that properly combine clinical, patient and business knowledge will decrease the tension between the tradeoff of improving quality versus improving *margins* that seems haunt healthcare management.

Knowledge care is not about information per se. It is about knowledge. Knowledge includes information and data but it is active not static. Knowledge involves cognition or the use of data and information to perform some mental task such as making a treatment decision, interpreting a lab report or learning about a new drug. Simply put:

Knowledge = information + cognition

KM in healthcare is not about information management but it is about combining information with cognition. It is about making sure our information systems are designed to support or enhance the cognition (interpretation, decision making, problem solving) of clinicians, patients and administrators. As we will see, this goes far beyond the IT ambition of making sure the right information is available at the right place and time. Information access is the goal of information management not knowledge management.

Given the complexity of healthcare, cognition (social and mental processes that use knowledge to complete a task or reach a goal) plays a key role in nearly every step of patient care. For example:

- Nurses organizing findings using taxonomies based on anatomy (e.g. head-to-toe assessment)
- Physicians visually correlating trends in vitals and fluids I/O to medications given and nursing assessments to see cause and effect at-a-glance
- A resident learning recognition primed decision-making by mentally mapping the current case to similar cases in the past and using that to frame/guide analysis and treatment
- A surgeon triaging patients in a disaster situation based on survivability
- A therapist using heuristics (rules of thumb based on experience) to determine when to stop a treatment
- An ER physician following a structured decision tree (e.g. Goldman's chest pain algorithm).

The cognitive component of knowledge is often embodied in people. So the interface that links human cognition to information stored in the computer becomes the primary focus of knowledge care. In other cases the cognitive component of knowledge is done (fully or partially) in computers, (e.g. in a decision tree or rules engine) and the focus of KM is expanded to include the technical, organizational and governance processes needed for successful knowledge engineering.

Making the decision about where the cognitive component of knowledge is done sits at the heart of knowledge care and requires a keen understanding of how knowledge drives value.

For example, is it cost beneficial to encode the knowledge as rules in a computer? Can a physician's assistant or nurse make the treatment decision or does it require a physician? Can the clinician interact remotely with the patient to make the judgment? Is this a matter of self-care and best left to the skills and knowledge base of the patient? Such decisions (and the IT systems to support them) hold the potential for reconfiguring the delivery of care and dramatically improving outcomes and economics.

With clinical skill shortages and growing demand from an aging chronically ill population, now is the time to reconsider the locus of knowledge needed to deliver care. Further, as we invest in the US and around the world in large-scale health information networks a powerful new infrastructure for computerizing knowledge and leveraging tacit knowledge is emerging. Seizing this opportunity to create more effective health service delivery models requires not only the much discussed standardization to insure system interoperability, but even more fundamentally, a common approach to knowledge governance.

Knowledge Governance

Knowledge governance, within the scope of this paper, is concerned with the policies, guidelines and processes used to validate and maintain the quality of:

- the knowledge used in healthcare information systems (i.e. computerized knowledge). This includes objects (e.g. physician order sets), rules, decision trees, neural networks, computerized protocols (e.g. for implementing evidence-based guidelines), controlled vocabularies and any other data structure that contains conceptual or procedural clinical, patient or business knowledge.

- how technology is used to deliver, leverage or otherwise amplify tacit or people-based knowledge in the delivery of care.

In short, knowledge governance lays down the law for using technology to manage computerized and tacit knowledge in your healthcare system and ideally across healthcare systems in your region and ultimately nationally.

In principle, knowledge governance requires a board to create the policies and commission the committees needed to manage knowledge in your organization. The committees established by the board meet regularly to enforce the policies in a specified domain or application area. For example, some healthcare organizations have already formed committees with a knowledge governance flavor to deal with rules, alerts, order sets and clinical pathways.

Just as healthcare organizations have worked hard to establish medication and drug policies, nursing care standards, electronic and manual assessment standards and a host of other healthcare standards they must now develop standards for the creation, use and maintenance of computerized knowledge.

Policy questions a knowledge governance board must deal with include:

- How do we manage the moral consequences and legal liability of inaccurate computerized knowledge that causes harm?
- Do we require that all automated decision aids provide an explanation of the recommendations they make? Do these recommendations become part of the legal medical record?
- With limited resources, what are the high priority areas for implementing KM systems?
- Do we allow overrides of alerts? Which ones and by whom? Will the reason for the override be documented? Who is responsible for reviewing overrides and reasons? More generally, how will we handle disputes between human judgment and machine judgment?
- What knowledge engineering standards should our organization follow for the creation, maintenance and testing of computerized knowledge?
- How will we evaluate vendor (or other third party) supplied computerized knowledge?
- How do we validate KM systems that do not make their internal logic explicit (e.g. neural networks and machine learning applications)?
- How will uncertain knowledge and recommendations be communicated to the end-user? How can we ensure they understand the limitations?
- How will a committee (e.g. focused of validating clinical rules) resolve disputes between multiple experts in the same field?
- If we customize an evidence-based guideline do we conduct an outcome study to validate it?

There are also a host of policy questions that arise when you seek to use technology to leverage people-based knowledge. This is where people hold the cognition component of knowledge and technology is used (somewhat like an extender) to amplify the productivity of the expert's knowledge. A few examples:

- How much medicine can be done over the phone or computer network?
- How will we address the licensure issues to permit medical practice via computerized networks beyond state borders?
- What are the appropriate clinician-to-patient ratios for technology-mediated remote care?
- What guidelines will we follow for doing psychotherapy or other behavioral health treatments over the Internet?
- Can we give a second opinion based solely on a review of an EMR?

- Do we require a patient's permission before using the robot in grand rounds?
- How will patients react (what is their mental model) to a mobile robot or to interacting with a clinician over the Internet?

There are no easy or standard answers to these tough policy questions. Further these are not idle or academic questions. There is already a substantial amount of computerized knowledge in use in healthcare in the form of rules and objects in EMRs, CPOE, data mining, underwriting and various clinical expert systems. It is likely already in use in a hospital near you. Look for a neural network embedded in an image scanner that is interpreting mammograms, trending rules in patient monitoring devices or drug interaction rules in your pharmacy software or CPOE system. The need for knowledge governance is urgent. And the urgency is growing as the supply of vendor-provided medical knowledge embedded in devices and software continues to mount.

Ultimately, the issue of knowledge governance goes beyond any one healthcare organization and is a matter for the profession at large. This is especially clear when we look at knowledge governance issues presented by computerized protocols for the implementation of evidence-based medicine (EBM) and the opportunities for sharing computerized knowledge that the emerging national health information network presents. Lack of knowledge governance in these domains could stall or even thwart much of the potential that KM has to offer healthcare delivery.

As we seek standards to ensure interoperability between different EMR systems for the national health information network, we must establish a knowledge governance mechanism to anticipate the next step of sharing computerized knowledge and leveraging tacit knowledge over that very same infrastructure.

TELL: Assessing Cognitive Fit

Working out the governance mechanisms for technology-mediated knowledge (managing computerized and tacit knowledge using technology) is not enough. We must also engineer the human-computer interface in a way that enables, or better improves, the cognition of the user. Remember, knowledge management is not about information access or finding the information you need. That is the job of Information Management. In KM we worry about when and how the information is presented to support and improve cognition.

There are four main variables (TELL) to consider when evaluating the cognitive fit of a KM system:

1. **T**rust: Do users have high confidence in the system?
2. **E**mulation: How well do the screens map to the way users organize information and solve problems?
3. **L**oad: How much mental effort (cognitive load) is required to use the system?
4. **L**earnability: If the system does require a new way of thinking – how easy is it to learn and master?

Systems that offer low cognitive load, high trust and emulation and are learnable are designed to support or enhance cognition. Such systems have the highest level of user acceptance.

Let's take a look at each of the four variables of cognitive fit in more detail.

Trust

If I have high confidence with a system it is easier to work with. I move through screens faster and will be more likely to take the time to input data. I will also be less likely to get upset or distracted. Although it may seem soft, trust is a key factor in cognitive performance.

Specific questions to ask about the trust factor in KM systems include:

- Is the data accurate and consistent?
- Do I understand the logic that has been programmed into the system?
- Is it up to date?
- Are explanations for alerts and recommendations provided?

KM systems that improve patient safety (e.g. decision support applications designed to avoid adverse drug events) will necessarily challenge the judgment or actions of the user. Alerts, critiques or alternatives will be offered by the system. If these are not timely, constructive and relevant the user will quickly lose trust in the system. As with people, trust once lost is very hard to recover.

Emulation

User cognitive emulation means that the system flows and presents information just like users think about things. Quite literally, the system duplicates, as closely as practical, the process steps involved in the user's decision-making and presents information in the same language and order as users think about it.

To design for emulation – we must first understand the mental models (e.g. metaphors, taxonomies, scripts) and cognitive processes (e.g. heuristics, mental algorithms or workflow between the ears) of the users.

Specific questions to ask about the cognitive emulation of a KM system include:

- Do we understand the cognitive needs of the users?
- Have the layout of menus, lists and items in information displays and printouts been organized using a clinical taxonomy or classification system versus an alphabetic scheme or something developed by IT?
- Are meaningful metaphors used to guide the interactions with the system?
- How tuned are the screens in the system to supporting specific clinical decisions and events such as: shift change, patient transfer, developing a diagnosis or planning a treatment?
- Do we know how patients think about the role of technology in the delivery of health care (e.g. reaction to a robot or physician consulting a computer in the exam room)?

<u>Load</u>

Working memory can only hold seven plus or minus two pieces of information at any one time.[9] Systems that demand near (or over) that limit place a heavy mental load on users causing them to tire, make errors and have to write things down. On the other hand, low-load interfaces have clarity of display. They also provide context, do routine logic and calculation automatically and do not frustrate the user with low-relevance or repetitive prompts.

Specific questions to ask when assessing the cognitive load of your KM system:

- Are the screens and printouts complex requiring careful study or can users understand them at a glance?
- Do users need to look at multiple screens or report pages (and remember what they have seen) to get the required information?
- Does the application reveal trends and calculate totals?
- Does the system provide context sensitive help and explanations for recommendations?
- Can users customize (and save) the screen settings?
- Are the screens, printouts and hardware of the system aesthetically pleasing? The literature shows users are more relaxed and flexible in their approach to using devices that attend to aesthetics.
- Can users back-up in the system and change answers or provide different information?
- Are user prompts clear, context specific and only as frequent as needed?

These questions may seem basic, or even simplistic, but unfortunately they are not always asked. It is rarely appreciated how much of the value of the system depends upon what appear to be minor inconveniences to the user. Focusing on cognitive fit however, reframes these inconveniences and reveals what they really are – major drivers for creating value with the KM system.

Learnability

Going from a verbal or handwritten order to CPOE will change the way most physicians think about medication orders. More dramatically, implementing evidence-based medicine (EBM) will change how physicians think about diagnosis and treatment planning. With EBM we are asking clinicians to change mental habits from a "rapid-fire" decision making process based on local experience to one that is more reflective and based on scrutiny of the literature and application of national guidelines. To see this more specifically, consider the five-step process for doing EBM advocated by Sackett:

1. Translate need for information into a answerable question
2. Find best evidence which answers question
3. Assess applicability of answer
4. Integrate assessment with clinical judgment and specifics of case
5. Evaluate effectiveness of result of making evidence-based decision

This is very different than the cognition most physicians use to deliver care. Any KM system that supports it therefore will not be designed to emulate current mental practice but instead teach or support a new one.

Ultimately, systems that change the way users think – because they are amplifying their problem solving ability – are the best use of KM, but they must be designed so they can learn how to use them. As learning a new way of thinking is a key outcome of the system, designing the system for ease of learning from an intellectual, emotional and social standpoint becomes key.

Specific questions to ask about the learnability of a KM system include:

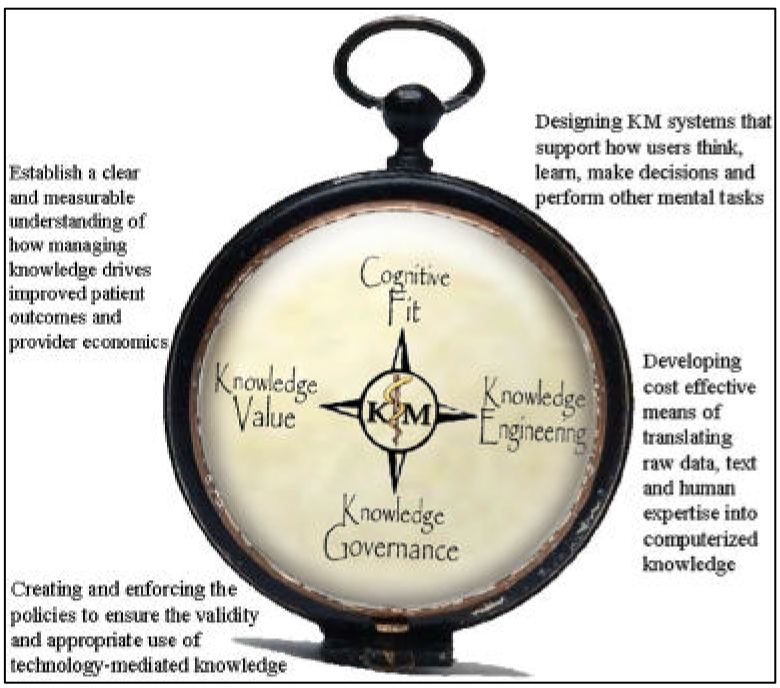
- Have the new ways of thinking (mental models, cognitive processes) been made explicit and taught independently of the system?
- What level of involvement have the users had in developing or evaluating the new approach?
- Is the value of the new approach clear?
- Do the users believe in the new approach?
- Will users have an opportunity to practice and learn the new process in an emotionally and socially safe setting?

As healthcare continues to evolve there will be additional demands placed on clinicians to change the way they make diagnoses, develop treatment plans, educate patients and otherwise deliver care. Next to EBM, pay-for-performance guidelines that advocate preventive medicine and the use of genomic information in prospective medicine are two likely paradigm shifts in clinical decision-making. Successful KM in these areas starts with a clear definition of the new cognitive process and mental models needed to make the approach work.

Getting Started: The KM Compass

Knowledge care means improving how we create, use, share and protect the knowledge needed to deliver quality outcomes and profits across the patient care continuum. To use technology for knowledge care we must design applications with a high-level of cognitive fit and have a mechanism in place for knowledge governance. Further, a clear vision of exactly how the KM improvements will create value is essential. Finally, in the case where knowledge is being computerized, a cost effective way of engineering and maintaining a knowledge base must be found. Accomplishing all of this requires more time and resources than is typically allocated in an IT-based knowledge management project.

In most organizations, doing knowledge care does not require a new or separate project but rather a better understanding of the KM-dimensions of ongoing IT projects in EMR, CPOE, telemedicine, order sets, clinical decision support, patient portals and other projects that involve changing how knowledge is created, shared, used and protected.



To help navigate the KM issues in any IT project we have created a simple framework called the KM compass, shown in the figure above.

The KM Compass is an executive tool where each of the four critical factors is now a direction on a compass. It can be used to guide KM work on a specific project or more broadly as a framework to drive discussion on how we can navigate the “perfect KM storm” brewing in healthcare delivery.

One way we have used the compass on specific projects is to understand what knowledge is required by the project (knowledge inventory), document how it will be created, used, shared and protected (CUSP analysis), dig into the relevant critical factors of governance, fit, engineering and value (directions on the KM compass) and then implement the results.

Physician executives are uniquely positioned to champion this approach because:

- They have a deep and often expert level understanding of the clinical knowledge, business knowledge and patient knowledge needed to drive successful KM systems
- Physician executives can navigate the politics and offer the organizational leadership needed to examine and take action around difficult knowledge governance and economic challenges
- As users of the system they are well positioned to identify, assess and lead the way to resolving issues of cognitive fit

In short the physician executive has just the right blend of domain expertise, political savvy and organizational position needed to seize the knowledge management opportunity.

In the next section of this paper we will look at an example of how to use the idea of knowledge care to tackle the difficult challenge of implementing a clinical decision support system.

Clinical Decision Support Systems

One popular form of a KM system in healthcare is CPOE or computerized physician order entry. In its most basic form, CPOE is an application that allows physicians (or other clinicians) to directly enter orders into the main clinical system in their practice or at a hospital. Such systems, because they avoid handwriting, eliminate transcription and reading errors and also speed up the order flow process. In a more sophisticated form, CPOE systems include computerized knowledge, usually in the form of rules and alerts that interact with the physician to ensure orders are complete, accurate and appropriate. Armed with this computerized knowledge, these CPOE systems provide clinical decision support helping to, for example, reduce medication errors (dose, allergies, and interactions) and avoid the cost of unnecessary or repetitive testing.

In short, decision support systems aim to improve patient safety and make operations more efficient.

Interest has been high and is growing as national quality initiatives point to CPOE with decision support as a major patient safety strategy. For example, the influential Leapfrog purchasing group has this to say on their website:

> "The potential benefits for patients, payers and providers led national experts in health care quality and safety to recommend computer physician order entry as one of Leapfrog's recommended practices. Recent research shows that if this Leapfrog practice was implemented in all urban hospitals in the U.S we could prevent as many as 907,600 serious medication errors each year. Studies have also shown that CPOE reduces length of stay; reduces repeat tests; reduces turnaround times for laboratory, pharmacy and radiology requests; as well as delivering cost savings."

They go on to add:

> "Most of the potential benefits of CPOE do not come from merely replacing paper orders with electronic ones. Rather, during a physician's decision-making process about what to order and how to order it, the computer applies edits, displays relevant information and advisory prompts to help the physician enter orders correctly and make optimal ordering decisions. All of this support to physician ordering is delivered by the CDS (clinical decision support) tools in the product and how the hospital sets up and maintains them."

As the Leapfrog Group astutely points out, the value in CPOE actually resides in the clinical decision support functionality. Despite the promise, decision support systems have been installed in relatively few offices and hospitals (less than 10%) and have met with significant resistance. Early work in the area has been characterized as high cost and likelihood of failure. Current efforts are achieving mixed results. [10]

Decision Support on Knowledge Care

We believe the penetration and success of CPOE and decision support systems will be significantly enhanced by understanding them primarily as KM systems and managing their implementation with discipline towards the four points on the KM compass: governance, fit, engineering and value. Such a focus is sorely needed, as these systems seem to be failing along all four of these critical factors. More specifically, our research indicates that current decision support systems exhibit the following:

1. Low cognitive fit: Systems overload users with alerts (e.g. create alert fatigue), don't sufficiently emulate the user's cognitive processes, have complex interfaces and have not been designed for learnability.

2. Lack of effective governance of computerized knowledge: Some studies show users frequently "blow by" alerts without causing adverse consequences. Other studies show that decision support systems fail to detect as many as 70% of the clinically relevant interactions. This raises questions about the effectiveness of the knowledge engineering and/or governance processes supporting the use of decision support.[11]

3. Unclear value for physicians: Doctors accustomed to handwritten and verbal orders see their ordering time increase many fold and thus resist CPOE with decision support due to concerns about falling productivity.

Although digging into each of these issues in depth is beyond the scope of the paper we do want to spend some time looking at the issue of alerts.

Consider a study published in February 2004 in the *Archives of Internal Medicine* by Dr. Saul Weingart and others on "Physicians' decision to override computerized drug alerts in primary care." This study revealed that five adult primary care practices using the same decision support system experienced a 90% override rate with drug allergy and interaction alerts with no corresponding increase in adverse drug events. More simply, physicians ignored the alerts and nothing bad happened to the patients. An external physician review agreed with the decision to override the alerts 98% of the time and found some 36.5% of the alerts to be invalid. The study concluded, among other things, "CPOE designers need to identify and eliminate inappropriate alerts that physicians don't find credible".

This is not the only study that signals the need to tune the computerized knowledge (rules and alerts) in decision support systems. In 2002 a study at the VA Puget Sound showed a similar rate of override and concluded that refinements in "order check logic" are needed. A recent (2004) analysis at Brigham and Women's Hospital in Boston showed that doctors overrode 80% of the drug-allergy alerts. Alert override may well be a rampant disease.

From a KM standpoint, these studies point to the need for improved knowledge engineering and governance. Potential solutions are being explored or advocated by various groups and include, for example,

- Tuning rules for renewals verus new prescriptions to have higher vigilance on new prescriptions
- Tuning rules to the specifics of patients (e.g. some patients tolerate certain types of drug interactions)
- Refining traditional drug-drug interaction classification systems to allow finer granularity in alert notification

- Considering the use of noninvasive alerts in addition to the classic invasive alerts. Invasive alerts interrupt workflow and require action. Noninvasive alerts do not control workflow but send a signal via a highlight or sound
- Simplifying the visual presentation of the interface to lower the cognitive load and make noninvasive alerts less risky
- Implementing a small rather than large set of rules with an effort to target those 20% of the orders that cause 80% of the ADE's
- Considering tuning rule sets and alerts by department or individual
- Integrating decision support with your documentation and pharmacy systems to avoid having to deal with alerts from multiple systems

Managing alerts means having a governance process for evaluating the clinical relevance and workflow impact of any proposed alert. It also means being able to tune the rules that are used to capture the logic of when they are triggered (knowledge engineering). Further special effort is required to understand how alerts are embedded in work flows and the effectiveness of the system's interface for calling attention to and displaying alert information (cognitive fit).

Left unmanaged, high rates of override lead to alert fatigue (i.e. a desensitization to the importance and relevance of the recommendation and information in the alert) and defeat the promise of improved patient safety. In the worse case, high rates of override lead to a lack of trust by clinicians and "alert blow by" (i.e. override without considering the content of the alert).

Significant KM work needs to be done before the full benefits of CPOE (and other forms of CDS) can be realized in healthcare delivery- especially in community hospitals. The challenge, for vendors and entrepreneurs, is to develop the cognitively effective interface, clinical rules and governance models needed to resolve the problem of alert blow-by and fatigue.

Summary of Knowledge Care

This white paper presented a case for an impending state of knowledge failure in healthcare delivery and described an emerging approach to knowledge management that offers the beginnings of a remedy. Specifically, we have defined knowledge care (<u>knowledge</u> management in health<u>care</u> delivery) as improving how to create, use, share and protect the knowledge needed to deliver quality outcomes and profits across the patient care continuum. We offer an executive-level tool built on the metaphor of a compass that advocates a systematic focus on knowledge governance, cognitive fit, knowledge engineering and knowledge value as a way to use technology to do knowledge care. Special note has been made that the physician executive is uniquely qualified to provide leadership energy in using the KM compass to help guide healthcare organizations away from a knowledge crisis.

Endnotes

1. Estimates on the doubling rate for medical knowledge vary from 10 years to less than four years. The National Center for Policy Analysis reports "… by some accounts, medical knowledge doubles every 42 months" and quotes R. Larson, "Medical Advances Can Outpace Doctors; Retraining Not Enforced, Critics Say," *Washington Times*, March 1999.
2. J.C. Wyatt reports that each physician in the UK receives about 15kg of guidelines in "Knowledge for the Clinician- 7. Intranets", Journal Royal Society of Medicine, 2000 Oct;93(10):530-4. In a New England Journal article from June of 2003 Elizabeth McGlynn's group reported that patients with community acquired pneumonia receive only 39% of recommended care, patients with diabetes receive only 45%, with congestive heart failure and hypertension patients into the 60% of recommended care range.
3. See for example, Jonathan B. Perlin's, M.D., Ph.D., Under Secretary for Health, article "Veteran Healthcare: Meeting Tomorrow's Challenge" in *FORUM*, June 2005.
4. There are many reports on the health care worker shortage. See for example, Kenneth Raske, "One problem we can't staff out; Healthcare worker shortage won't go away until the industry takes action, *Modern Healthcare*, May 2002.
5. In the US is it possible to get a patent on methods for doing business. These are called class 705 patents. Two subclasses deal directly with health care delivery including: 705/2- Health care management (e.g., record management, ICDA billing) and 705/3- Patient record management. Both of these subclasses have seen a rapid growth in the last few years.
6. An overview of the field can be found in Clinical Knowledge Management: Opportunities and Challenges, Rajeev K. Bali, BIOCORE, Coventry University, UK.
7. Peyman Akhavan , et. als. "Exploring Failure-Factors Of Implementing Knowledge Management Systems In Organizations", *Journal of Knowledge Management Practice*, May 2005**: "**Some researchers peg the failure rate of knowledge management projects at 50%. But Daniel Morehead, director of organizational research at British Telecommunications PLC in Reston says the rate is closer to 70%. "Most knowledge management projects simply don't hit their stated goals and objectives," Morehead says. So that 70% doesn't mean they fail totally - it means that they don't accomplish what they set out to do."
8. The Center for the Advancement of Health Reports, "Behavioral health risks are tied to higher ambulatory care and hospitalization costs and account for as much as 70 percent of all medical care spending". See for example, Health Behavior Change in Managed Care- A Status Report at http://www.cfah.org/pdfs/health_execsumm.pdf
9. Gorge Miller, "Magical Number Seven, Plus or Minus Two: Some Limits on our Capacity for Processing Information"**,** *Psychological Review, 63*, 81-97, 1956. Find it on the web at http://psychclassics.yorku.ca/Miller/#f1
10. Google "CPOE implementation failure" to get a sample of the literature. For example, take this quote from *Healthcare Informatics* (August 2004): "Physician resistance has been a barrier to CPOE implementation in the past, along with dissatisfaction over vendor offerings, system complexity and expense."It's an $8 million to $12 million cost," says Jonathan Teich, M.D., Ph.D., vice president and chief medical officer at Irving, Tex.-based HealthVision and chairman of the electronic prescribing steering group at the eHealth Initiative, Washington, D.C. Plus, a few very high-profile failures have been off-putting. "There need to be more [successful CPOE implementations] out there for confidence-building, so that there will be a sense that this can be done," Teich says."
11. Wendy D Smith, PharmD et. als., **"**Evaluation of Drug Interaction Software to Identify Alerts for Transplant Medications" *Annals of Pharmacotherapy*: Vol. 39, No.1, 2005.

