Knowledge Management for the 21st Century Hospital System

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This paper discusses a systems approach to the delivery of healthcare, taking care of the caregiver, a process-based quality management system, and patient safety quality management tools.

Knowledge management *is defined as the art and science of changing or transforming data and information into useful knowledge.*

Knowing what to fix is the first step in quality improvement. We must know what is wrong, and have the ability and resources to fix it. An organization is a system within itself. All systems have inherent active failures, like an act of omission or commission, and latent failures, like a hazardous condition or flawed process designed into policies, protocols, and procedures, which, in the correct sequence of events, will allow the system to fail. Healthcare is a complex system comprised of multiple subsystems, each of which operates independently and creates a ripple effect throughout the entire organization.

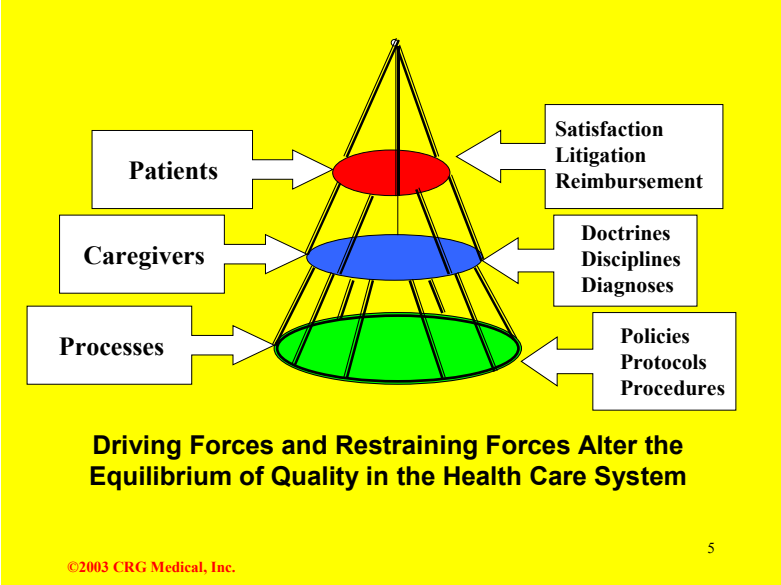
Systems have interactions at the interface of various processes. The more interfaces there are, the more complex the system, and the more opportunities there are for error. Complex processes are more prone to fail than simple processes, thus increasing the occurrence of an unplanned and undesirable event. In a November 1998 presentation, Don Berwick, MD proposed--if the probability of success in a one step process is 99%, likelihood of error is 1%. Similarly, 25 steps, 22%, 50 steps, 39%, and 100 steps, 63%.

A Systems Approach to the Delivery of Healthcare

Health and Human Services, the Agency for Healthcare Research and Quality, CMS, JCAHO, NQF, and the Leapfrog Group, all have requirements for the healthcare system and its caregivers. Sixty days after the January 24, 2003 publication of the final rule in the Federal Register, hospitals, to comply with the Conditions of Participation, are now required to meet the standards described in the Quality Assessment and Performance Improvement Program (QAPI). There is a need to document knowledge of processes that require improvement, methods to achieve improvement, and ways to measure outcomes of the change. To comply, all hospitals will need an event reporting system. The need for e-Health IT, CPOE, EMR, and other health information systems continues to grow.

A systems approach integrates human resource solutions with organizational needs and priorities. Systems' thinking enables us to see the 'whole picture' and recognize that everything we do is interrelated. An event in one part of the system affects all other parts of the system. Every system has driving forces and restraining forces that upset the steady state, or equilibrium. Driving forces, like the QAPI, alter a steady state. Restraining forces hinder movement toward a desired goal, *e.g.*, restrictions on the

quality of care for an HMO patient are greater than for a PPO patient. Although a system in equilibrium is predictable and safe, every system is in a constant state of change.



Dynamic systems like healthcare, have input (caregivers deliver care), throughput (processes to deliver care), and desired output (patient is satisfied and treatment successful).

Figure 1.

The Importance of Taking Care of the Caregiver

Reducing vulnerability to the threat of medical errors is the most effective way to achieve patient safety. An effective patient safety event reporting system should demonstrate trust-based processes between the caregivers themselves, and between the caregivers and the administration. It should be non-punitive and proactive in eliminating defects and minimizing variation. For caregivers to speak up, the identity of the reporting party must remain confidential, and resulting remedial action must be disseminated throughout the system.

A Patient Safety Event Reporting System should be designed to demonstrate a measurable increase in patient safety, analyze events, and lower operational costs. It should mitigate the potential for harm, increase caregiver and patient satisfaction, and enhance process-based quality management and performance improvement. Variation in care provided and failure to disseminate evidence-based best practices are factors leading to preventable medical errors. Currently, we must reduce variation in medical practices and provide evidence-based medicine, yet minimize the potential for the occurrence of medical errors, and provide better medical care and service to our patients. Health care providers and students in medicine, nursing, and pharmacy who make better use of systems and systems thinking can create change. Caregivers must be part of the solutions to patient safety problems.

A Process-based Quality Management System for Healthcare

Quality system goals are to develop, implement, maintain, and continually improve the healthcare quality management system to enhance patient safety and satisfaction, prevent errors, and increase workflow effectiveness and efficiency. Meeting industry healthcare requirements and standards will reduce variation and waste.

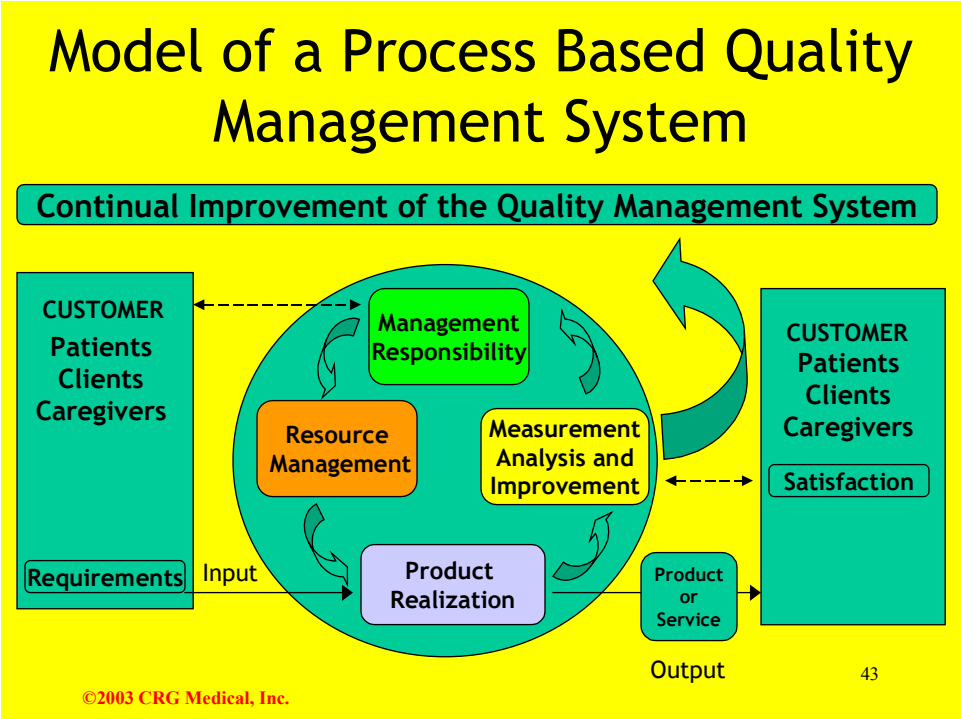


Figure 2.

Tools for Patient Safety Quality Management

Artificial Intelligence (AI) is the integration of knowledge-based systems (KBS) and expert systems (ES). KBS provides computer-based automation of logical reasoning. It uses AI techniques to perform deductive and inductive reasoning.

Detection solutions involve data mining techniques that include neural networks, decision trees, decision tables, naive Bayes, and clustering methodologies. Data representations that maximize the power of discrimination between good and bad events (pattern-related enhancement) are used. The segmented forecasting model uses a mature or frequently done event model, and a new or sparsely done event model that uses rules derived from specific domain knowledge. Complex indicators are implemented to define potential incidents. Specific techniques are utilized to build clusters characterized by risk density, *i.e.*, potential incidents.

Early recognition/detection of conditions, action, and lack of action that have the potential to cause medical errors are essential. Key activities are classification: analysis, segmentation, correlation, clustering of the data and information and forecasting: descending trends and behaviors from clustered data.

Fundamental components of a healthcare delivery system are analyzed and modeled. Relationships and interrelations between components are analyzed and classified. As events are reported over time, patterns of similar characteristics emerge.

The "detection real-time solution" classifies good action, uncertain action, and bad action. Qualitative results obtained are shortest delays in detection, efficient use of signals, ease of change, adaptive, and have robustness in time. These solutions have structural flexibility in merging between data learning and specific knowledge with a reasonable level of false positives and effective management of signals.