CHANGING A PEDIATRIC SUB-ACUTE FACILITY TO INCREASE SAFETY AND RELIABILITY

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ABSTRACT

This chapter describes the efforts of a team of health care workers to make a sub-acute health care care facility (SCF) serving profoundly damaged children into a high reliability organization (HRO). To obtain this goal, the health care team implemented change in four behavioral areas: (1) risk awareness and acknowledgment; (2) defining care; (3) how to think and make decisions; and (4) information flow. The team focused on five reliability enhancement issues that emerged from previous research on banking institutions: (1) process auditing; (2) the reward system; (3) quality degradation; (4) risk awareness and acknowledgment; and (5) command and control. These HRO processes emerged from the change effort. Three additional HRO processes also emerged: high trust, and building a high reliability culture based on values and on beliefs. This case demonstrates that HRO processes can reduce costs, improve safety, and aid in developing new markets. Other experiences in

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implementing high reliability processes show that each organization must tailor make processes to its own situation (e.g. BP, U.S. Chemical Safety and Hazards Board, Federal Aviation Administration, U.S. Navy Aviation Program, and Kaiser Permanente Health Care System). Just as in the flexibility called for in organizing for high reliability operations, flexibility is called for in deciding which HRO processes work in specific situations.

For a number of years researchers and practitioners have been interested in understanding how organizations which must operate nearly flawlessly, because errors in them can result in catastrophic consequences, do so. Those organizations in this set which succeed were labeled High Reliability Organizations (HROs) (Weick, 1987; Rochlin, La Porte, & Roberts, 1987). Roberts (1990) defines an HRO as an organization conducting relatively error-free operations, over a long period of time, and making consistently good decisions resulting in high quality and reliability operations. There are many examples of organizations which should be HROs in the health care industry. For example, recently Cedars Sinai Hospital, a hospital usually lauded for its clinical quality, injected actor Dennis Quaid's infant twins with doses of Heparin more than 1,000 times larger than normal.

Assuming health care HROs perform as well as early research showed other industries could perform (e.g. Weick & Roberts, 1993; La Porte & Consolini, 1991; Eisenhardt, 1993), and for the reasons described in that research, one question remains: How does one create an HRO? Or, if the organization already exists, how does one transform it from an ordinary organization into an HRO? This chapter attempts to answer the second question. It does so through a case study led by the chapter's first author.

For the last few years researchers and practitioners interested in implementing HRO concepts have met in workshops, first in Southern California and then in Europe. The questions above were the center of discussion in all the workshops. Today there are various attempts at HRO implementation running across a variety of industries including health care (e.g. education, finance, military, commercial aviation, the military, and NASA).

One of the problems with implementation is that there are now a plethora of constructs about behavioral processes in HROs. HRO researchers say implementation programs must be tailor made to the settings in which they are applied. But they have yet to sort out which processes are best suited to which situations. This study did not review the growing literature on HROs

and select from this literature a set of processes. Instead it went back to an early set of processes developed by Carolyn Libuser (1994) for the banking industry. It did this because many managers said these processes can be implemented and some have successfully implemented them. In addition, an assessment device based on the Libuser model is available. Thus, an organization can track how it is doing in maintaining high reliability (Gaba, Singer, Sinaiko, Bowen, & Ciavarelli, 2003). Then, too, other processes identified in the HRO literature seem more difficult to implement (e.g. sensemaking and improvisation). The Libuser study provided an initial conceptual lens to guide this effort. However, several additional high reliability principles emerged from the implementation process.

The study is important in that it highlights the ability to implement a set of processes in an organization that needed to become an HRO, and it points out some of the difficulties in doing so. First we will describe Libuser's guiding principles, then the setting, the behaviors focused on for change, the outcomes, and, finally, we provide some conclusions from this activity.

THE GUIDING LENS

Libuser's model consists of five processes: (1) process auditing, (2) reward system, (3) quality degradation, (4) perception of risk, and (5) command and control. Each of these processes is described below.

Process Auditing

An established system of ongoing checks designed to spot expected as well as unexpected safety problems. Safety drills and equipment testing are included in this category. Follow-ups on problems revealed by prior audits are also important.

Reward System

The reward system is the payoff an individual or organization receives for behaving one way or another. Reward systems in organizations tend to have powerful influences on behavior of people in them. Inter-organizational reward systems also influence the behavior of organizations.

Quality Degradation

Organizations must struggle to avoid degrading quality. Usually some referent system is perceived to be the gold standard in this area and all other organizations attempt to reach the quality levels of the referent.

Perception of Risk

There are two elements of risk perception: (a) whether the organization knows risk exists, and (b) the extent to which steps are taken to acknowledge and minimize it.

Command and Control

Libuser borrows this notion from previous research and highlights four key elements.

1. *Migrating decision making*. The person with the most expertise, not the one with the most chevrons, makes the decision.
2. *Redundancy*. People and hardware provide back up systems.
3. *Senior managers who can see the big picture*. Managers do not micromanage.
4. *Formal rules and procedures*. The existence of hierarchy, but not bureaucracy.

THE SETTING

In 1995 a pediatric nursing home that cares for severely damaged children received poor ratings from the state licensing agency and had a poor reputation in the local medical community. The state banned new admissions for several years and applied a high level of scrutiny to the nursing home's routine reports. It also reduced the number of beds for this level of service to about half of the facility's capacity (from about 60–30 beds). This ban lasted from mid-1995 well into 1998. During this period, the state also refused to increase payment rates to offset increased costs.

The medical community (physicians and nurses) and the local Emergency Medical Services (emergency medical services, fire, and paramedic services)

believed the nursing home used poorly trained staff members and provided substandard care. The nursing home found itself in a destructive situation because its reputation precluded it from seeking quality staff members to assist in a turn-around; the admissions ban and refusal to increase reimbursement did not allow for consultants or major changes in the program; and adequate time for a change in trajectory was uncertain before events led to closure.

A medical director, contracted through a nearby medical school, brought a strategy for change based on the Libuser research findings. These processes are the subject of this study. About the same time these problems occurred, the nursing home changed its license to a pediatric sub-acute care facility (SCF). Children with chronic illness increasingly contribute to the census of pediatric intensive care units (PICUs) (Briassoulis, Filippou, Natsi, Mavrikiou, & Hatzis, 2004), while children with chronic ventilator needs have increased by nearly threefold in 15 years in one state (Graham, Fleegler, & Robinson, 2007). Sub-acute facilities reduce the burden that long-term ventilator patients place on the resources of an ICU (Lindsay, Bijwadia, Schauer, & Rozich, 2004), and provide care for medically complex, non-communicative, severely disabled children who suffer from severe central nervous system (CNS) diseases such as profound mental retardation, severe developmental delay, and persistent vegetative state. These children typically have limited mobility, which leads to further complications such as scoliosis, contractures, decubitus ulcers, osteoporosis, and fragility fractures. The state regulatory agency defines sub-acute care (for purposes of Medicaid reimbursement) as dependence on two or more medical technologies. For example, many children in sub-acute facilities have both tracheostomy and gastrostomy tubes. Importantly, their reliance on technology and their medical fragility can result in sudden physiologic destabilization and death.

The facility was staffed by certified nursing attendants (CNAs) and licensed vocational nurses (LVNs), with one supervising registered nurse (RN). Several respiratory care practitioners (RCPs) provided respiratory care and managed the mechanical ventilators, which were the type used in private homes.

The facility desired to improve the level of care provided to clients, rehabilitate its image to licensing agencies and medical professionals, expand its market, and increase the level of clinical services offered to clients. Without these changes, the facility would continue to struggle financially, and possibly fail.

THE CHANGE

To implement change, the administrative team focused on four areas of behavior: (1) risk awareness and acknowledgment, (2) defining care, (3) how to think and make decisions, and (4) information flow. In varying degrees, Libuser's five processes (process auditing, reward system, quality degradation, perception of risk, and command and control) inform each of these four areas of behavior.

Risk Awareness and Acknowledgment

Hospitals' risk profiles are quantitatively and qualitatively different from nursing homes. Hospital risks arise from acute or critical illness that can lead to rapid physiological destabilization affecting the respiratory, cardiovascular, or neurological systems. Nursing home risks are generally due to complications of care such as falls, dehydration, or aspiration of oral secretions or gastric contents into the airway. Time dependence for action in hospital operations is in minutes (critical care) or hours (acute care); in contrast, time dependence is in hours or days for the typical nursing home. As a result, nursing home work cultures rarely incorporate processes for clinically engaging and responding to dynamic physiological dysfunctions. Instead, at the earliest sign of such dysfunction, a nursing home will typically transfer the client to an acute care hospital, usually through the emergency medical services 911 system. Interestingly, these different time dependencies are symbolically captured by the way these institutions refer to their primary customers. Hospitals refer to patients who receive treatment, while nursing homes refer to clients who reside at the facility.

Differences in hospitals' versus nursing homes' time demands and dependencies lead to staff self-selection paradigms. Staff members elect to work in acute care hospitals for the greater variety of patient situations, increased responsibility for care decisions, and short-term relationships with patients. Hospitals generally use RNs to provide care. Staff members who migrate to nursing homes generally prefer low-tempo work conditions and building long term, connected relationships with clients.

Sub-acute facilities may be viewed as a hybrid of intensive care, acute hospital care, and nursing home care where clients with chronic, stable illness reside, but may abruptly deteriorate. Given the prevailing nursing home culture, it is counter-intuitive that the typical long-term care staff members would become proficient at the tasks required to care for such children.

Hence, without differently trained and motivated staff members, sub-acute nursing home children would quickly lose their chances at life. Educational programs do not prepare nursing home medical caregivers to engage in unexpected high-risk problems. As noted previously, when faced with a sudden medical emergency, the typical nursing home caregiver calls for emergency services through the 911 system. Moreover, when faced with a vague or ambiguous medical condition, nursing home staff members will call the physician for a "change of condition," which usually leads to the physician referring the client to the 911 system without further treatment.

The first objective, then, was to have staff members identify the high-risk nature of the environment by identifying their internalized beliefs. The medical director began asking staff members if the children were in danger. Invariably, a CNA, LVN, or RCP answered, "No this is a nursing home." After a series of such answers, the medical director invited the staff to a picnic in the parking lot for several hours. No one accepted the invitation because they all believed that if the children were left alone, one of them would die. In subsequent discussions, each staff member identified several ways children would die if vigilant care was not present. Staff members began identifying the more obvious causes such as tracheostomy tube dislodgement, falls from the bed, and fever. With time, they began to discuss these obvious risks in terms of early heralds of events, such as the active child who may pull at the tracheostomy tubing or the child who, with strengthening arms, has the strength to pull to a sitting position and may now fall over the rail. These discussions became the basis for developing the facility as a HRO.

Conversation was now opened to discuss both client risks and the expertise the staff had developed to identify early subtle signals and engage in problem solving. Early attention to problems allowed treatment when a child's disease was more amenable to therapy, with fewer and less severe complications. Staff members began to understand that they provided high-risk care in a medically austere environment, with special characteristics.

To elaborate, in nursing homes, staff members have inherent difficulties interpreting responses from non-communicative clients. They are taught to use physiologic findings rather than any diagnosis, as complications frequently develop from the synergy between diagnoses or between physiologic systems. Collaboration among staff members helped interpret these signs.

For example, the LVN might call an emergency for a respiratory problem. After evaluation, the RCP might recommend a rectal suppository to assist the client's bowel movement. After the bowel movement the client returned

to the pre-emergency state. The RCP identified a non-pulmonary cause of respiratory distress caused by the Val Salva maneuver required for the bowel movement. Upward abdominal pressure on the weak diaphragm compressed the chest cavity which decreased chest volume and airway compliance causing patient-ventilator asynchrony. Collaboration between the RCP for evaluation of the respiratory system and the LVN for treatment of the gastrointestinal system, along with recognition by both members that one specialty's problem might appear in the other specialty's area, solved the problem and further increased risk awareness of the interactions among physiological systems.

Once risks are identified, staff and the organization's leadership must acknowledge them through policies, procedures, and education. State regulation does not allow the facility to use protocols for treatment, as protocols are plans for carrying out a patient's treatment regimen before contacting a physician. This limits the facility's planning and places more reliance on staff member judgment and actions.

Because of limited resources, staff could not rely on technology to assess the patient or provide care. Clinical assessment at the bedside was an important factor for treating patients. This involved use of and trust in staff members assessment skills each day to learn to identify normal signs for the patients, to predict the direction of change (deterioration or improvement), and further signs to look for in such situations. Staff members relied heavily on identification of response to therapy, followed by interpretation of those responses.

For staff members, the greatest threat to identifying and engaging risk is unrecognized fear. The physiologic fear responses are the classic adrenaline-mediated fight and flight responses in the sympathetic nervous system and the cortisol-mediated freeze response (Kalin, 1993). Unrecognized fear can lead to the coning of attention during an emergency, to rapid and unthinking reactions to unfolding events, or to unthinking inaction as events occur. Coning of attention occurs when a caregiver maintains tight attention to one aspect of a problem. Importantly, this is not the same as maintaining focus, which allows for the processing of new information.

Staff members were taught to recognize these fear responses in themselves and others. Fight manifests as anger, and staff members learned to treat the angry parent, outside caregiver, or employee as afraid and then try to identify what triggered the fear response. This involved giving people an action or easily obtained objective to help them bring a sense of control to the situation. For most staff members, flight manifests itself as plausible avoidance, such as filling out unneeded forms or evaluating a stable patient

to avoid participating in the emergency. Mutual support and easy actions that one could quickly complete helped bring in or return the individual to the team. Freeze responses often manifest as confusion or inability to recall information. Staff members were instructed to return to a previously accomplished action, which helped clear the fog and bring staff members back to the situation. All of these processes facilitated staff members' appropriate awareness of risk.

In addition, staff members and supervisors were taught situational awareness (Endlsey, 1995) where both the bedside caregiver and the clinical manager see the big picture. Situational awareness allows the leader to capture migrating decisions and integrate them into actions. The leader of the emergency does not micromanage.

To avoid micro management, the supervisors stood back during STAT (*statim* – a medical emergency situation requiring immediate action) responses to observe both the medical condition of the client and the behavior of the caregivers. The charge nurse or designated leader of the STAT team leads by managing the team and asking questions. The right questions come from observing the client, the responses from caregivers, and the functioning of the team. The charge nurse does not assume the role of bedside nurse, but oversees and manages the interaction between the caregivers and the client.

To develop continued attention to risk awareness, managers shared true, personal stories of patients who appeared to be doing fine, yet suddenly and rapidly deteriorated or developed profuse bleeding. These deteriorations could occur despite the absence of early detectable signs or symptoms. Stories about children who pull their own tracheostomy tubes out, lose their airway, and approach permanent irreversible damage were also used to provide examples of how staff members needed to be aware of and acknowledge client risks.

Defining Care

Developing and using technologies to maintain life for profoundly disabled children is in a nascent state. In contrast, general pediatricians provide care to handicapped children with straightforward technologies, such as tracheostomy and gastrostomy tubes. As the complexities of a child's disability increase, so do the number of potential complications. For example, ventilation dramatically increases both technological complexity and clients' risk to die. As the degree of disability and dependence on

technology increases, the interactions between managing technological complexity and the attendant risks to clients can become deadly.

The medical director came to the facility without experience in the nursing home field or in long-term care for the profoundly disabled. The executive group wanted growth in census by direct marketing to physicians who have the target patient in their practice or to acute care hospitals. A conflict developed between defining characteristics that described children who would benefit from facility care and the type of care the facility could offer. For successful marketing, the facility should provide care that families or other facilities cannot. The facility also had to identify the sources of dissatisfaction from the state and methods to address the problems in an efficient and effective manner.

It seemed that, before the facility could improve care in the judgment of the state, care had to be defined and benefits to the child described. The defined care given by the facility staff member might not be what it appears at first view. The new medical director recalled a question an experienced fire fighter asked his firefighters, ''What do we do in the fire department?'' After firefighters made various attempts to answer, all related to fire suppression and rescue work, he answered, ''We solve problems citizens cannot or will not solve themselves.'' For sub-acute care, when asked, ''What do we do?'' we had to search deeper for the answer than ''provide nursing home care to profoundly disabled children.''

The answer came, not from ''Who do we treat?'' or ''What do we do?'' but from ''What do we say?'' and ''What is the response to our actions?'' Clear, unambiguous descriptions and commands were needed in a culture that readily used slang and jargon as a part of belonging and vagueness and ambiguity as self protection. In high-risk environments where people can die, this use of obtuse terminology leads to deadly incidents.

When the physician was off-site and an occasional unstable situation arose, decisions had to migrate to the person with the expertise to decide, sometimes up the chain of command, but more often down the chain of command to the bedside caregiver. Staff members learned to articulate the situation in a clear, concise, objective manner and without slang or jargon. Observation and interpretation were separated, as the medical director and staff members discussed care in post-emergency critiques or on clinical rounds. They identified straightforward interventions that could be applied immediately and were within the scope of practice of the caregiver. An important aspect of this process was identifying when an intervention failed, possible contributions to failure, and means for identifying successful interventions.

Defining care also was effected through staff members' efforts to improve safety and by their identification of threatening procedures and effective treatments. Across a series of actions, the facility's objectives advanced from use of ventilators to calm children to use of ventilators to enhance their lives. One winter, a hospital PICU had a full census and returned a child to the facility for weaning from the ventilator, which was accomplished. Within the month, the same hospital, because of a full census, could not accept a client in acute respiratory failure. In both cases, the sub-acute facility provided ventilator services without the laboratory or pharmacy services found in a hospital. Subsequent to that incident, and through discussion during client rounds, the facility managers and the medical director set as an over-arching objective to keep the technology in the background to enable the child to live. This practice, too, became a definition of care.

Continued difficulties in transferring children dependent on ventilators to the PICU led the care team to develop new models of ventilator use for these clients. The team developed the model of adjusting the ventilator to calm the child rather than using drugs for that purpose. Asynchrony between the child and ventilators was considered a medical emergency that should receive immediate attention by the RCP. This occurred through ventilation by hand, with a self-inflating resuscitator bag using high rates but shallow tidal volumes or low respiratory rates and large tidal volumes. Once the RCP achieved a calm child, ventilator settings were adjusted and the medical director was notified and discussed the situation.

Once it became clear that this approach produced ventilator synchrony, a search developed for specific interventions that most calmed children on ventilators. RCPs adjusted ventilator pressure for visible chest expansion. During patient agitation episodes, RCPs found that ventilator inspiratory times faster than those used in the PICU produced longer periods between agitation spells. Of all the interventions, the one that worked reliably and with greater permanence was increasing respiratory rates. As a standard practice, intensive care physicians prefer ventilator rates below 20 breaths per minute (bpm) to ensure safety from stacking breaths (too rapid respirations that lead to incomplete exhalation and chest hyper-expansion) and subsequent hypoventilation, agitation, and possible pneumothorax that could result in death. Also, lower rates reduce the risk of apnea if the ventilator becomes disconnected from the patient.

Because child-ventilator asynchrony continued to occur and the team could not be sure why or if higher rates kept the child calm, the team held

long discussions during client care rounds with all staff. It seemed children responded best to ventilator rates between 20–30 bpm. After two months discussing these counter-intuitive findings that higher ventilator rates calmed children, everyone noticed that the children were more awake and alert, and began to smile, play, and laugh.

The clinical care team concluded that, despite normal blood gas findings, these children had the sensation of suffocation when ventilator rates were below 20 bpm, which prevented them from crying, smiling, or laughing. The institutional objective became one of using ventilators for relief of suffocation and to produce calm, smiling children. This change in the model occurred because of decision migration and deference to expertise, the expert being the bedside caregivers.

While developing this evolving model of sub-acute care, the management team began a program to demonstrate to the state, through the peer review process, that the facility provided quality medical care. Presentation of research material directed the clinical team to articulate their work and the processes they used and opened their approach to a limited form of peer review. Within one year, with support from the local School of Public Health and the facility administrative staff members, the facility presented more than 20 research posters at several national conferences and one international conference.

Articulating ideas without hidden assumptions; questioning actions and assumptions; submission of ideas to peer review and criticism; and participation of bedside staff members in improving care all, allowed staff members and outsiders to see that the facility could improve care. Along the way, all staff members further defined what care meant.

Critical to the introduction of intensive care techniques to a nursing home was the support and insight of the general pediatricians on staff. With open-mindedness, the general pediatricians incorporated intensive care techniques into general pediatrics, such as the clinical identification of hypovolemia using tachycardia, prolonged capillary refill, and cool limbs. The general pediatricians also contributed ideas on how to use the ventilators for development issues, such as learning to walk while attached to the ventilator.

This care developed from interaction among intensive care physicians, general pediatricians, nursing, respiratory care, and administrative personnel. The facility care teams now follow a pyramid of care, with technology supporting clients at the bottom of the pyramid. By making the technology invisible, the bedside caregivers can address medical issues. This invisibility allows the children to grow, thrive, smile, play, and laugh.

How to Think and Make Decisions

Medical culture does not easily allow decision migration down the hierarchy to those with less medical education. One way this can happen is through the use of protocols, preplanned medical treatments, approved beforehand for use within the scope of practice of allied health practitioners. This works well with deterministic medical situations where the diagnosis or clinical findings determine an intervention and treatment will not have serious complications. A consequence of this medical culture is a lack of knowledge and experience about how to make independent decisions, particularly in situations in which limited facts are available.

Importantly, physicians are not always in the sub-acute facility and a nurse practitioner or physician's assistant works only a routine workweek, leaving staff members working both weekends and night shifts responsible for emergency decisions. As the level of service increased for complex ventilator problems, the facility managers found that staff members (CNAs and LVNs) did not have knowledge about how to make emergency decisions. Staff members also refused to make decisions because they believed, with good reason, that supervisors and administrators would hold them accountable for undesired or bad outcomes.

To help overcome this resistance, the medical director and RCP manager began a program to teach decision making while on clinical rounds. They understood that developing thinking and decision making is necessary to manage ventilator care without a physician on site. For example, the medical director elicited solutions to problems during clinical rounds, and regardless of the answer, the physician made it fit either by adding necessary facts or presenting reasons that the answer appeared right. He taught the phrase, "Every decision is the right decision, one that I would make." In addition, fine-tuning after each clinical decision was made without the presence of the physician. In a sub-acute facility, a major impediment for staff members is reserving the use of emergency decision-making techniques only for emergencies. The problem, as noted previously, is that of identifying an emergency in its early, latent phase. The guiding principle became, "What you do everyday is what you do in an emergency."

For this purpose, John Boyd's OODA Loop (Hammond, 2001; Coram, 2002) was a helpful aid in structuring the decision process. Col. Boyd developed the OODA loop in response to increased US losses of aircraft in aerial combat during the war in Vietnam. It increases the speed of decision cycles for fighter pilots to outmaneuver their opponents. It operates with minimal or incomplete information about the situation.

The OODA Loop is an iterative set of decision processes of *observing, orienting, deciding,* and *acting*. Within the sub-acute setting, *observing* entails: acquiring sufficient knowledge for a clinical decision and no more by perceiving the unfolding of clinical circumstances; incorporating outside information; and drawing on professional training and experience for implicit guidance and control. Next, o*rienting* involves the synthesis and analysis of the cultural beliefs and genetic heritage of the client caregiver; of previous experience with the client and others; of new information about the client or setting; of the medical facility's values, beliefs, and behaviors; and of human factors and performance decrements. Then, *deciding* requires staff members to hypothesize about the client's condition and how best to respond to it. Lastly, *acting* tests this hypothesis. Because the OODA Loop is iterative, the staff member then observes the results of acting, and so on.

The OODA Loop helps staff members engage in an emergent, problem-solving interaction with the environment. Feedback occurs from the Decide and Act functions to the Observe function. Feed forward occurs from the Observe to Orient and from Orient to Decide functions. For example, the OODA Loop allows the RCP to identify interventions for initiation of mechanical ventilation. These interventions have the objective of calming the client, while ensuring good chest expansion without breath stacking.

The OODA loop model allows rapid interventions to mitigate threat in time-dependent situations. Actions begin without dependence on unavailable resources or loss of time. Disadvantages include its counter-intuitive nature and seemingly high risk. It requires distributed decision making, where all members have this knowledge and skill and it runs counter to the medical culture in which the physician is the central decision maker.

This program did not come easily to the RCPs, who were not accustomed to presenting a patient to a physician for discussion, making decisions in public, or discussing events that could go wrong. For example, after clinical rounds were finished, RCPs became upset that their suggestions were not heard. They believed they should not say anything during clinical rounds if their suggestions were not accepted. There came a time when the RCPs made a pact that no one would make suggestions during clinical rounds, but only provide the information the physician requested and answer his questions. The respiratory manager observed this tension within the group and began work with the RCP staff with particular focus on the change in behavior, where they previously made suggestions and participated in discussions.

The respiratory manager worked with staff on an individual and group basis to identify how different ideas can achieve the same goal. In a group

setting, the RCPs became more observant that each had a different method for reaching similar outcomes. Afterwards, the respiratory manager explained that this is what the physician had taught during clinical rounds. Some of the more insecure RCP staff members were hesitant to enter the discussion on clinical rounds; however, with individual attention and support beforehand from the physician, they would join the discussion, and began making significant contributions to care. Those who were not forthcoming in taking credit for their ideas were singled out and told that their ideas were valuable. This was a slow process from no suggestions or participation in clinical rounds toward more in-depth discussion of what each individual and the team could do to improve.

Information Flow

Communication up and down the chain of command was initially vague and ambiguous. To ensure multi-directional information flow, the medical director encouraged the use of articulate, objective, but succinct presentations. Bi-directional communication consists of concise requests for information and instructive material from up the hierarchy and clear expressions of what is observed in response to therapy from down the hierarchy.

Because they are at the bedside, facility staff members identify early heralds of deterioration, interpret the findings in context, and translate those findings to other staff members and physicians. These staff members learned the importance of accurately capturing data by using the data. For example, during client visits, the physician used all available records, particularly CNA and RCP records. Because the latter records had not been previously reviewed, they often included shortcuts. When staff members observed physicians or managers reviewing bedside records, the comprehensive quality of these records increased.

Routine clinical discussions pointed to the ''ignorance in medicine,'' and staff came to realize much of what is assumed in medicine is either not certain or not known. For example, physicians cannot explain why some bacteria that infect lungs do not infect connective tissue. This openness by the medical director and other physicians facilitated discussions about uncertainty, which both led to a research program and developed a learning environment. Because of this environment, managers and physicians also admitted uncertainty or saying ''I don't know,'' which lead to further evaluation of a client's clinical situation. Staff members now had an

important part in client care. During clinical rounds, staff members also discussed the danger of not saying, "I don't know." After repeated use, it became easy to say and brought all staff members into evaluations and discussions.

Decisions would sometimes need to be made based on the caregiver's assessment before a confirmatory examination by the physician. After the examination, refinements in the decision would bring the decision closer to what it should be. Non-emergency decisions were discussed before execution to help the caregiver learn to think and decide, a major contribution to a high trust environment. Information flow in this manner produced less sense of isolation for staff members when working difficult situations.

With the focus on individual accomplishments, staff members became more open and willing to ask questions about improvements they could make, wanting to learn different approaches. Criticism directed toward any staff member became a sign of system failure. The facility willingly supported staff members who showed interest in growth, giving opportunities to use newly learned tools and advance their education. It is now common for CNAs to become LVNs and LVNs to become RNs while remaining in the facility's system.

A major difficulty for information flow to enable decision making came from the methods medical caregivers use for presentation of a patient. Nurses tend to present the patient system-by-system with problems and treatments discussed each step of the way. They presented the respiratory system problem, evaluation, and treatments, and then moved to the circulatory system. RCPs discussed the respiratory system by chronic or active processes and the ordered treatments or those they were requesting. Physicians presented patients in a systemic manner of all information first followed by an assessment or diagnosis and ending in a plan. This included subjective findings communicated by the patient, and objective findings of the physical examination, laboratory, and radiological findings. A plan was developed only after all information was identified and discussed.

Conflict in presentations occurred when bedside staff reported incomplete findings and offered suggestions or requested treatment orders. Recognition of this paved the way for appropriate use of each model: the RCP active-process approach during an emergency, the nursing systemic approach when an acute problem developed, and the physician review-all-data approach for longer-term plans.

An example of rapid information flow the facility strived to emulate the fire team arriving at a fire. The first arriving unit provides a rapid and accurate evaluation of the fire called a "size up." Similarly, in the 1970s,

before algorithms and protocols were used, paramedics functioned as the "eyes, ears, and hands" of the physician and presented an articulate, objective, succinct patient evaluation.

The facility clinical team developed a similar presentation style through the use of clinical ventilator rounds with the RCP presenting the patient and developing a plan for treatment. All discussions adhered rigorously to an articulate, succinct, objective presentation. The physician always let the final plan come from the RCP or LVN. The team then learned to identify what is important, necessary, and sufficient to make a decision.

BUILDING AN HRO

Most sub-acute facility's problems with the state licensing agency occurred from uncommon but high-risk events whereas problems with the medical reputation developed from frequent, low-impact encounters between the referral hospital staff or emergency medical service providers, and the facility patients and staff members. The existing medical culture impeded improvements in facility medical care and repair of its reputation. The dominant medical culture represents a deterministic system where success comes from proper diagnosis and the application of indicated therapies. The deterministic medical system model uses central command applied through a vertical hierarchy, limited questioning of authority, belief that authorities have solutions, and obedience. The sub-acute facility was often in an unfolding and stochastic setting, in which much is unknown and things constantly change. This required culture change from the predominant medical and nursing home cultures to a more flexible and less brittle culture.

The final question is whether the processes in the Libuser model are reflected in the four areas of change focused on by the change agents. We expand our analysis by asking whether additional or different processes evolved in the course of this intervention.

Process Auditing

The numerous discussions that characterized this effort offer opportunities for audits. For example, the staff discussed risk to children. That helped them measure, in some informal way, risks to children. Recognition of fear responses reduces coning and allows people broader views of their situations. Broader views allow people to see more of the total picture

from which they can develop an accurate audit scheme. The continuous search for definitions of care is an audit process. Driving decision making down the hierarchy creates potentials for redundancy and offers the checks and balances one needs in an audit system. Finally intense review of bedside records makes people create more accurate records and improves the audit system.

Reward System

Rewards and punishments guide behaviors in individuals and organizations. The clinical management team focused on rewards rather than punishments because of their greater impact on behavior (e.g. Kerr, 1975). By focusing on inclusiveness and internalization of values, the team worked to develop a setting in which appropriate rewards were attached to desired behaviors. For example, having greater influence in choosing therapies rewards those who openly discuss their thought processes.

Quality Degradation

To avoid quality degradation, the management team regularly and openly discussed failures and near misses with focus on the thought processes used by bedside care members. The leaders studied small failures as clues to emerging or evolving large system failures. Caregivers constantly discussed whether individuals or teams missed something important. These discussions occurred in anticipation of events (proactive), and during review of care (retroactive). The leaders found the greatest utility of discussions during the event with interactive, real-time risk assessment.

Risk Awareness and Risk Acknowledgment

Risk awareness alone does not lead to reliability; it must be followed by acknowledging that something needs to be done. Clinical discussions helped staff members link risk with clinical interventions. Risk lies in the situation either as probability or possibility. The medical director used the word *possibility* when working with vague risk and great threat. Education focused on early heralds of deterioration, physiologic time-course of diseases, and therapies available in the facility or the Emergency

Department and Intensive Care Unit. Strong responses to these weak signals facilitated engagement of the problem when interventions are most effective and have the least number of side effects or complications.

Early heralds of deterioration were problematic as they tend to be vague and difficult to interpret. For example, hypoxemia may indicate thick secretions that will respond to a fluid bolus through the gastrostomy tube or it could indicate early pneumonia. Bleeding through the tracheostomy tube may indicate problems such as trauma from suctioning, tracheitis, papilomatosis, bronchiectasis, or fatal innominate artery hemorrhage.

Early heralds also tend to be ambiguous, not clearly indicating which system has the pathology. Nasal flaring, tachypnea, and tachycardia develop from early respiratory disease and have also indicated positional pain relieved by repositioning, or gastrointestinal disease such as ileus or constipation.

Transfer by emergency services occurs when a disease state accelerates or the remaining therapies available to a nursing home are limited. As long as the child responds to interventions in a timely manner the facility did not refer the child to the acute care hospital. Non-responders (those patients who were not responding to interventions) were transferred. The team always thought and observed ahead of the problem to identify and know their limits.

Command and Control

Decision migration. Decisions are hypotheses one acts on. In uncertain environments the individual with the most up-to-date knowledge of the circumstances is frequently the person at the environmental interface, yet the person with the greatest knowledge of principles and concepts may be the individual higher in the hierarchy and physically away from the situation. Use of decision processes such as the OODA Loop (above) allow rapid response to perturbations and brings control to uncertain, dangerous, and risky situations.

OODA Loop decision making also allows decisions to rapidly migrate up and down the hierarchy to the individual with the most expertise with the situation. Expertise does not equate with experience or rank. Formal teaching of decision making enables individuals to consistently make more complex decisions and allow them to migrate.

Redundancy. Through his reliance on team training the medical director built redundancy into the system. Routine clinical discussions and rounds

are also ways to build redundancy into situations. Effortsa to define care can also contribute to redundancy because discussions occur in such efforts that illuminate the activities various individuals can substitute for those of other individuals.

Senior managers with the big picture. Throughout the previous discussion we see the medical director as a guiding hand. He tries to implement a hands off posture in order to give his staff sufficient flexibility to learn and do their jobs. These jobs are integrated through such processes as round and staff discussions. Opening up information flow adds to this. The Charge Nurse also takes a big picture view by letting his/her staff engage in operations which she manages those operations.

Formal rules and procedures. Protocols and preplanned treatments are formal rules and procedures. These are used in the deterministic situations often found in any health care unit. They are supplemented by the other command and control processes in more fluid and changing situations.

Additional Emergent HRO Processes

In addition to the HRO processes identified by Libuser three other processes emerged from our analysis. They are: trust, values, and beliefs.

High trust. Focus on the quality of a person's descriptions helped caregivers develop trust in other individual's observations. The leader's development, education, and transformation of individuals also helped grow the person's trust in his/her judgments. Improvement in observations and judgments occurred when a caregiver saw that decisions and actions resulted from trustworthy information the caregiver provided. Medicine typically engages in low trust during highly uncertain situations. Low trust, when used as a redundancy function can strengthen a system. Low trust used to create self-doubt in a person will weaken it.

Values. Values guide the selection of behavior and the evaluation of events, people, and self (Schwartz, 1992). They are concepts or beliefs that help interpret an individual's goals, concerns, or motivations and transcend specific situations to guide the selection or evaluation of behaviors and events. Dynamic relations exist between value types with some serving an individual's interests (e.g. self-direction) while some serve the group's interests (e.g. conformity).

The medical director and RCP manager fostered a system of values dependent on the situation with the expectation that values might shift from obedience in low-tempo times to creativity and leadership in high-tempo

times. During low-tempo times with predominantly deterministic problems, values included conformity (obedience, self-discipline, and politeness) and security (reciprocation of favors, sense of belonging, and social order) as described by Schwartz (1992).

When an indeterminant problem arises or the tempo becomes high, staff members change to self-direction (independence, choosing own goals, curious, and self-respect) and stimulation (varied life and daring). Security is a value necessary for work in high-risk environments. The means to reach security can differ from reliance on obedience to reliance on team formation. The sub-acute facility, in this case, used team formation.

Beliefs. Beliefs are the concepts a group shares. The medical director and RCP manager specifically focused on self-efficacy (e.g. Bandura, 1997) and taught that resilience supersedes rigidity in an emergency or uncertain state. Self-efficacy is a process of self-persuasion that involves motivational and selection processes which give the resilient self-belief that one can influence an outcome. Self-efficacy decreases perceived vulnerability, reduces incidence of intrusive negative thinking and anxiety, and enhances risk discernment. People develop self-efficacy through progressive mastery of decision making through use of bifurcation. The staff member makes decisions under a manager's guidance. If a wrong decision is made, more information is given with the goal of finding the correct response. This identifies how much information a staff member uses in decision making (too much or too early). The staff member always makes the final decision.

When faced with uncertainty many people find comfort in structure and rigidity. The management team encouraged finding comfort in the team and self-efficacy and that, together, the team can solve the problem. This requires resilience in decision processes and cooperation which are destroyed by overly reliant, rigid, thinking. This also allows for a flattened hierarchy during dynamic states.

THE OUTCOMES

During the five years of the implementation process there were no changes in state reimbursement, patient/nurse ratio, or educational level of caregivers. During the same period the relative number of emergency service calls (911 calls) decreased, referrals from pediatric intensive units (PICUs) increased, PICU ventilators began to be used, and the number of intensive care unit ventilator-dependent clients increased. Facility staff members became adept at initiating ventilation for tracheostomy-dependent

children in acute respiratory failure without the assistance of an on-site physician or the aid of blood gas analysis or sedative medications. The focus of caregivers shifted from maintaining life to enhancing life through use of ventilator management. The goal of care for these children evolved from life maintenance to children who smile and laugh.

The facility's market expansion came because they entered new markets, accepting patients from different PUCUs than previously. Their reputation improved as evidenced by the fact that state authorities asked physicians thinking about developing new sub-acute facilities to visit and talk with members of this facility. In addition, at least one state inspector used the facility as a training device to show new inspectors how treatment should be given. The level of care given increased in that this facility began to use ICU type ventilators, which are more complex than home ventilators and require training not everyone can absorb. Market share increased with the utilization of this technology because the facility could handle more complex cases than previously.

CONCLUDING STATEMENTS AND IMPLICATIONS

HRO is a codification type of safety culture found naturalistically in risky, high-tempo environments that operate well, such as naval aviation (Roberts, 1990) and the fire service (Bigley & Roberts, 1993). Resources expended to AU :2 maintain safety are considered wise investments and a part of business. Greater demands and risks within a system, particularly fluctuating or uncertain demands and risks, require greater resources to ensure safety.

In low tempo, less-risky environments, use of such resources may not be available for productivity and could reduce efficiency. Under these circumstances increasing resources to decrease risk could decrease productivity and efficiency and lead to economic failure of the organization. Without the differential use of resources to separate the capabilities of the system from fluctuating demands, catastrophic failure can result.

In the experience of this facility the use of HRO principles increased both safety and efficiency. This allowed expansion into a new market of PICU referrals and decreased regulatory sanctions. Over all cost avoidance to the state Medicaid program was great as patients were transferred from the PICU to the sub-acute facility. At the same time, the facility developed a new model which benefited these children.

This model of HRO use in a nursing home, which allowed it to become a pediatric sub-acute facility, will benefit medical caregivers in other austere

medical environments such as under-developed countries or disaster situations. Governments are concerned that a flu epidemic or terrorist event will lead to a surge in hospital ICU admissions when there is little capacity to accommodate this increased load. Use of an HRO model of sub-acute facility care could allow medical facilities to accept more patients during times of crisis. Further use in medicine can include ventilator management in the ICU after muscle relaxant medications are no longer used. Adjusting the ventilator for patient comfort can decrease use of sedative drugs and improve patient comfort.

Safety and HRO process implementation are sometimes thought of as an increased cost. However, rational behavioral models predict that organizations that could prevent crises would prevent them, thus reducing costs. This case demonstrates that HRO can reduce costs, improve safety, and aid in developing new health care markets. Other experiences in implementing high reliability processes in organizations show that each organization tailor must make processes to its own situation (e.g. BP, U.S. Chemical Safety and Hazards Board, Federal Aviation Administration, U.S. Navy Aviation Program, and Kaiser Permanente Health Care System). Just as in the flexibility called for in organizing for high reliability operations, flexibility is called for in deciding which HRO processes work in which situations.

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