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## Creating high reliability organization using mindfulness

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# Creating High Reliability Organizations Using Mindfulness

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## ABSTRACT

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High Reliability Organizations (HROs) are organizations with processes that have extremely low failure rates, because the costs of failures are extremely high. According to Weick, et al. (2008) key aspects of HROs are: preoccupation with failure, reluctance to simplify, sensitivity to operations, among others. While we understand *What* the aspects of HROs are, we lack the understanding of *How* to implement HROs and *Why* they work. Using a Soft Research Methods approach with Mindfulness techniques, this study demonstrates implementation of HRO in Healthcare. In doing so, this research finds that Mindfulness techniques used with Soft Systems Methods provide an effective framework to create HROs. In doing so, this study also discovers a sixth aspect of HRO's.

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**Keywords:** High Reliability Organizations, Mindfulness, Soft Systems Methods, Healthcare Operations Management

# Creating High Reliability Organizations Using Mindfulness

## 1. Introduction

High Reliability Organizations (HROs) refer to organizations that typically operate in hazardous environments where the consequences of process failures are extremely high (Baker, et al., 2006). They are very costly to create and manage, and usually involve large technical systems like utilities, military institutions, healthcare, etc. Overtime however, HRO investment pays-off by preventing the high costs of process failure (Hales et al., 2012) which according to Deming (1986) are the highest costs of all. One recent example is the failed launch of the Affordable Healthcare Act website (HealthCare.Gov) in November 2013. Blamed on an incompetent contractor (CGI Group), and over-site failures of the U.S. Department of Health and Human Services (HHS), this single failure threatened to destroy a key accomplishment of U.S. President Barack Obama. Several researchers (e.g., Wieck, et al., 2008) have identified key aspects of HROs: (1) a preoccupation with failure, (2) a reluctance to simplify interpretations, (3) sensitivity to operations, (4) under-specification of structures, and (5) a commitment to resilience. Despite their value, there is a paucity of management research on HROs, specifically on *how* they are created and *why* they work. In fact, Weick et al. (2008, p. 32) states that important features of HRO implementations still “remain unarticulated”. While we understand *what* the aspects of HROs are, we lack the understanding of *how* to systematically create HROs and *why* they work to improve reliability.

The purpose of this research is to show *how* to systematically implement HROs using a Soft Research Methods approach moderated with Mindfulness techniques. Soft Research Methods are qualitative techniques used when formal experimentation and quantification of the variables are difficult or impossible (Liu et al., 2012). The activities of Mindfulness fit into the Soft Research Methods framework because they are qualitative techniques as described by Chakravorty and Hales, (2013). This study describes *how* an HRO implementation improved the reliability of patient care in a critical care unit (CCU). In doing so, this research contributes in two ways. First, for practitioners this research suggests *how* to create HRO organizations through systematic implementation of the HRO aspects using Mindfulness techniques. Second, it answers the question of *why* the aspects work to improve reliability. This is important because

developing and operating an HRO is challenging due to the extraordinary reliability demanded by its clients and the high costs of failure (LaPorte and Consolini, 1999; Hales et al., 2012). In doing so, a sixth HRO aspect was discovered; the aspect of “fast, accurate, and robust information systems”. Second, for academicians, this study suggests future research in the impacts of failures can benefit the management literature, as they have done in engineering (e.g., Beer, et al., 2012).

## 2. Literature Review

### 2.1 Highly Reliability Organizations (HROs)

HROs focus on delivering high reliability outcomes to clients through very low failure rates (Issel, Michele, and Narasimha, 2007; Kaplan, 2002). Since reliability is a key dimension of quality (Garvin, 1987) greater reliability can lead to greater organizational competitiveness. Since most HRO studies are conducted in large technical systems, i.e. the Military, public utilities, and healthcare, its’ assumed that these contexts benefit the most from HRO implementations. A few organizations that successfully compete on reliability demonstrate this (i.e. Schulamn, 1996). While several researchers worked on HROs over the years (e.g., Seaman and Williams, 2012; Chassin and Loeb, 2011), Weick and Sutcliffe’s work is considered seminal (Weick et al., 2008; Weick and Sutcliff, 2007; Weick and Sutcliff, 2006; and Weick et al., 1999). Their collective work identifies five aspects that are present in all HRO implementations.

1. (5A1) *A preoccupation with failure* suggests that is to prevent failures by preoccupying itself with discovering them and their causes. Preoccupation with failure focuses on points of failure by increasing alertness, fighting inertia, looking for new alternatives, identifying errors, and developing processes to prevent mistakes.
2. (5A2) *A reluctance to simplify interpretations* promotes a thoughtful, data-driven process that considers the uniqueness of a problem before applying a solution. It discourages the form-fitting application or popular ‘best practice’ solutions to problems without thorough consideration of the problem’s unique context.
3. (5A3) *A sensitivity to operations* recognizes that a solution to one problem may create another and therefore process-wide measurement is essential. Sensitivity to operations is similar to the concept of a “bubble” in Navy terminology that refers to the awareness of a ship’s overall condition in the moment. This is accomplished through sharing real time data, shifting problems to experts, and engaging in face to face communication.
4. (5A4) *An under-specification of structures* refers to using the highest level of recognized expertise in improving reliability, not necessarily the higher-ranking “boss”. Under-specification of structures discourages excessive formal ranks because the ranking individual may not be in the proximity when the event occurs, may be too detached from the event to quickly respond, or may not possess the requisite knowledge, instead it relies on the lowest-level possible.

5. (5A5) A commitment to resilience encourages the use of individual initiative to maintain process improvements long-term. It encourages activities to prevent failures and relies on the expertise of front-line workers to reduce response time and counter immediate, evolving threats or “absorb” as much of the threat as possible.

Weick and Sutcliffe identified aspects of HROs but not a method for implementing them or why they improve reliability. In addition, they don't identify how they measured reliability or how reliability increased. The purpose of this study is to examine a measured increase in reliability through a successful HRO implementation using Soft Research Methods moderated by Mindfulness techniques. In doing so, a sixth aspect of HROs was discovered.

## 2.2 Soft Research Methods

Soft Research Methods such as Case Studies, Action Research, Soft Systems Methodology (SSM) are formal methods appropriate when examining *How* and *Why* questions because the variables are ill-defined, the causal links in real-life interventions are poorly understood or too complex for surveys or experimental designs (Yin, 2014). This makes soft methods appropriate for exploratory research addressing problems that are difficult to quantify, and involve multiple objectives inappropriate for traditional analytical techniques (e.g., Checkland, 2011; Checkland, 2000). Soft methods are appropriate for this study since the knowledge of *How* and *Why* real-world HRO implementations work is lacking in the literature (Ackermann, 2012). Soft methods, have been applied to initiate problem-solving and research in many studies (Ormerod, 1998; Paucar-Caceres, 2010; Mingers, 2011). Over the years authors have discussed varying types and stages of soft methods (e.g., Rodriguez-Ulloa and Paucar-Caceres, 2005; Creswell, 2002). Checkland's work on soft methods, which he refers to SSM, utilizes seven steps and they are:

1. (SSM1) Confronting/Identifying the problem situation (or Event)
2. (SSM2) Identifying the people, culture, or norms involved (i.e. the stakeholder's and context)
3. (SSM3) Developing root definitions that describe the ideal system
4. (SSM4) Building a Conceptual Model or a diagram of the system
5. (SSM5) Comparing models to the real world which questions each relationship in the model
6. (SSM6) Identifying changes that are needed to the current system related to the problem
7. (SSM7) Taking action or using an action plan to implement the changes previously identified

While this study uses the seven steps of SSM described above, it does not use Checkland's 5 E's (Checkland, 2011) which suggests SSM outcomes should include measures of

efficacy, efficiency, elegance, effectiveness, and ethicality. But HROs are primarily concerned with reliability so therefore ‘reliability’ is the key measure. Because of this, a full use of SSM is not claimed.

### *2.3 Mindfulness*

Mindfulness practices are qualitative techniques that encourage high levels of alertness to a task (Weick and Sutcliffe, 2006). It promotes understanding among the players in how their actions contribute to improving process performance. Mindfulness techniques have improved reliability in healthcare (Matook and Kautz, 2008; Hales et al., 2012; Weick and Sutcliffe, 2006). Mindfulness is often operationalized through three activities; a) the use of frequent meditation, b) a willingness on the part of providers to objectively solve problems using context-specific solutions, and c) time to meaningfully communicate with others on the problem at-hand. This is important because it challenges the “best practice” approach suggesting that solutions in one context will automatically work in a different context; which practitioners know is not always true (Brown, and Duguid, 1999; Szulanski, 1996).

### *2.4 Integration of HRO-SSM with Mindfulness*

In this case, Mindfulness improved the implementation of SSM stages 1, 2, and 6 because it encourages a high level of alertness to a task, and an understanding how the players activities contribute to improve reliability for customers (Weick and Sutcliffe, 2006). The first step in Mindfulness, frequent meditation, clears the mind of random thoughts so that full attention can be given to identify an immediate threat to a patient, a problem, or its’ causes (SSM Step 1). The second step encourages objective understanding of the context and stakeholders affected by an action (SSM – Step 2), and develops solutions that are more effective because they are context specific (SSM – Step 6). The objectivity encourages data-driven analysis of a situation so that the best solution is applied. In this case, healthcare workers are encouraged to meditate 5-10 minutes every few hours, and then to clear their mind for 1-2 minutes before treating each patient. To prevent superficially reacting to an issue, providers are taught to (third step in Mindfulness) communicate with other providers frequently on patient condition and briefly

evaluate how a treatment affects each patient. Figure 1, the implementation model, shows the relationship among the seven SSM steps, HRO Five Aspects, three practices of Mindfulness, and their effects on reliability. It shows that Mindfulness supports the SSM Steps and implementation of the HRO Aspects (SSM steps \*1, \*2, and \*6 were found later to be most affected by Mindfulness). The SSM steps supported the HRO Aspects, leading to improvement in patient care reliability.

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Insert Figure 1

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### **3. The Case Study**

Regional Health Care (RHC) decided to implement HRO to address a decline in CCU performance, a unit treating 4,000 patients/annually. Healthcare literature promotes HRO because failures result in higher societal costs like higher healthcare costs and patient deaths (Hines, et al., 2008). Beginning in June of 2010, CCU receives patients from other units when intense and specialized treatment is required, usually from Emergency Centers, Trauma/Burn Units, and Operating Recovery. CCU's a 20-room facility with rooms at the perimeter and an open-facing central nurse's station for monitoring patient care. Administration is performed in the nurse's station on patient's medical charts, medication and treatment, and incident reports. The nurse-supervisor, researchers, stand-by equipment, and volunteers called "candy-stripers" are located there. Nurses rotate between the 20 patient rooms, returning to the station to complete paperwork.

#### *3.1 Data Collection*

Baseline data was collected January-June, 2010; with implementation data July-December, 2010; and follow-up through the summer of 2012. Data collection included direct participation and observation, review of log books, and interviews with patients, nurses, supervisors, and RHC managers as suggested by Yin (2014). The interviews began with semi-

structured questions developed in advance and then revised based on the responses and feedback from participants, as proposed by Kvale and Brinkmann (2009).

The researchers participated in training and mentoring nurses, CCU staff, and nurse-supervisors. Training was conducted over a two-week period and included Mindfulness techniques and demonstrations in meditation by a yoga instructor. Nurses practiced pausing 1 – 2 min. between patients and communicating important information. For novices, she conducted a 30-min. class in the Mind-full room. Researchers provided daily feedback to nurses on the results of their previous days' performance, observed new issues in the unit supervisors and volunteers, reviewed incident logs, observed nurse-patient interactions, and documented unit HRO efforts. Nurses contemplate entries for incident logs - including observations of possible root causes of problems including a) RHC policies that they feel interfere with patient care, b) activities of supervisors/others in CCU that harm reliability, c) suggestions for improving reliability, and d) ideas or observations about how the five-aspects were implemented. Nurses discussed their problems with HRO, and their perception of the effect on patients. Next, a plan was developed to implement the suggested solutions and responsibility was assigned for implementation of each activity. This was repeated weekly beginning with a gap analysis of the difference between existing system and ideal targets. This approach is referred to as “Learning by Doing” (Hayes et al., 2004) where training is followed by practice on real problems. Hayes et al., demonstrates that improvement techniques will fail unless managers develop this capability in their organizations. Learning by doing is another soft methods concept that relies on front-line experience to solve problems. The data collection cycle is shown in Figure 2.

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Insert Figure 2

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### *3.2 Data Analysis*

The analysis was performed iteratively with a panel of healthcare experts comprised of the two researchers (R1 & R2), a nurse consultant, CCU supervisors (Superv 1 & Superv 2), the RHC Chief Financial Officer (RHC Fin Chief) and three external members from other units. Responses were shared to ensure that the panel accurately captured their meaning. Then, the

expert panel was shown the implementation model, Figure 1, and the definitions shown in the Literature Review (SSM 1 -7; Mind 1-3; and 5A 1-5), and asked to evaluate the relationships between the three factors using interview responses and their own observations. To analyze the activities a Q-sort was used to classify the opinions of the panel (Chakravorty and Hales, 2008). Q-sort places panel observations on 3x5 cards - who then classify them by similarities into fewer groups, in an iterative, multi-round process, until consensus is reached. This classification and relationship approach is often referred to as Grounded Theory (Creswell, 2002), where the definitions and each element are identified by classification and then sequenced by relationship. Results are shown in Table 1. Because the full Q-sort examined 105 possible relationships (3-Mind x 5-Aspects x 7-SSM) across 6 respondents (630 Q-cards), only those with strong support are shown (Support Level = 3 – 6). Support Level in the “last” column reports the respondents supporting the proposed relationships from the “first” column. The details of how each factor moderated the others are in the case descriptions.

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Insert Table 1

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### *3.3. Cost of Process Failures in RHC – Stated in U.S. Dollars \$*

In CCU, 10% of healthcare cost is for malpractice insurance, plus additional liability costs for high-risk treatment with anesthesiologists, neurosurgeons or obstetricians. Therefore, 90% of the external failure costs are built-in through insurance premiums, averaging \$500/day/patient. RHCs share of liability claims is 10%, with the average malpractice award of US \$1.81 Million. Roughly 77% of claims are in this range (Karpoff and Lott, 1999); RHC’s average for each paid claim is \$90,500. Malpractice claims occur in 3.7% of admissions, with 27.6% resulting in payouts (Brennan, et al., 2004). In the U.S., 5/4,000 claims receive awards. Averaging \$1.81 Million/award, CCU payouts are \$9 Million/year plus \$410,000/claim co-pays. This equals \$2.5 Million/year for failure costs, but more importantly it equates to \$11.5 Million in system losses. Implementing HRO could save RHC \$2.5 Million/year, with system-wide savings of \$11.5 Million.

## **4.0 Description of HRO Implementation**

RHC prepared a detailed implementation plan using the SSM seven steps. Note that multiple examples for each HRO aspect were found as the implementation progressed, which are too numerous for a single article; therefore, a few examples recommended by the panel are reported. In the following discussion each HRO aspect was executed through SSM, including Mindfulness.

#### *4.1. Soft Methods – Step 1 – Confronting/Identifying the Problem Situation*

In HRO, identifying the potential failure is accomplished through aspect, *A Preoccupation with Failure*. This means that CCU is focused on identifying activities that lead to process failures that affect reliability. The reliability of CCU prior to the HRO effort is measured as the ‘percentage of patients discharged alive’. Viewing unit failure as the death of a patient means that interim mistakes on patient care are not perceived as critical as long as they are recoverable. The participants realized that CCU’s performance is directly related to many possible failures along two dimensions – a) its ability to discharge patients alive (a dichotomous variable – true/false), and antecedents as b) stable vital signs (physiological indicators such as blood pressure and temperature; and behavioral indicators such as alertness and agitation). As part of the effort, these become CCU’s measures of reliability.

A preoccupation with failure that harms reliability becomes the focus of this step. CCU personnel were asked to meditate for 10 minutes daily and focus on potential failure points. Nurses and supervisors identified seven major factors that harm reliability; a) unqualified caregivers, b) unqualified volunteers, c) faulty monitoring equipment, d) poor nurse-physician understanding on treatment, e) slow nurse response time, f) inappropriate patient admissions, and g) patient intangibles. CCU releases patients either through a death certificate or discharge to other RHC units, never directly. A preoccupation with failure treats any activity that threatens reliability as a potential failure.

Actors identified several antecedents to the seven key failures reported in the unit supervisor inspection. They were asked not to presuppose any cause-effect relationship nor assign blame to individuals, but instead try to maintain objectivity and consider behavior, not perceived intentions or motivations of those involved. Unit inspections were conducted

informally at the beginning of each rotation to ensure the physical unit met minimum standards. For example, items on the inspections that affect “nurse-physician understanding on treatment” include the accuracy and timeliness of treatment and medication. Another item is “cleanliness of the unit”, where failures can lead to source infections for the patients. The item “completeness of unit paperwork” is important because CCU nurses receive unit-specific training on paperwork needed to order maintenance and replenish supplies. Each day failed items on the inspection report are discussed at staff meetings and corrective action is taken. The report encourages a “preoccupation with failure” culture by listing the problems encountered each shift that can harm reliability. Potential failure points are in the report along with the acceptable tolerances. Differences are flagged for corrective action.

#### *4.2. Soft Methods - Step 2 - Identify the People, Culture, and Norms Involved*

After the opportunity is identified, Step 2 encourages understanding of the people involved in patient reliability – i.e. Actors, Customers, Process Owners, and the culture and norms they practice. This links the system inputs to outputs so that relevant variables and activities can be identified, and their relationships to reliability. In this case, the rates of “live discharges” and “stable vital signs”. One application of the HRO aspect *A Reluctance to Simplify* literally means to stop oversimplifying problems and understand their unique relationship to reliability. It encourages questioning assumptions related to solutions, or especially so-called “best practices” that have reportedly improved reliability in other CCUs. It encourages the understanding of how process change affects unit reliability.

As the name implies, “over simplification” of the causes and effects of any failure point leads to ineffective solutions, and thus harms reliability. *A Reluctance to Simplify* implies discouraging “best practices” promoted in the Operations literature to ensure that the process stakeholders are not stereo-typed into some preconceived context that may or may not be accurate or improve reliability. In CCU there are many norms that may affect reliability. First, there is a strong sense of diversity where appreciation of culture has harmed unit response time. For example, in Moslem cultures males are not allowed to perform physical examinations on women, so these patients must wait until a suitable physician is found. In a different context, Spanish speaking-only patients are increasingly common but caregivers that speak fluent Spanish

are rare. These cultural considerations are addressed in - Step 2. Mindfulness in this stage encourages nurses and physicians to take 1 – 2 minute breaks and clear all matters not related to the patient. It creates focus on the immediate threat and understanding of the unique characteristics of the problem to prevent hasty application of a treatment.

#### *4.3. Soft Methods – Step 3 – Developing Root Definitions that Describe the Ideal System*

Once the context is fully understood, Step 3 builds on Step 2 by clearly defining the *CATWOE* – Customer, Actors, Transformation, Worldview, Owner, and Environment for those who make the unit safer, and articulate CCU’s ideal state. The ideal state doesn’t need to be immediately practical, but must accurately identify and clearly articulate the future. In HRO, this can encourage *A Reluctance to Simplify*. Customers are the beneficiaries of CCU’s reliability and include societal benefits such as preserving life. Actors are all those participating in transforming inputs into outputs that increase reliability. The Transformation process defines what and how inputs are transformed into the outputs. The Worldview ensures that reliability contributes to society by preserving life - the basis for modern civilization. The Owner has the legal authority and responsibility for the resources and outcomes. The Environment considers the limitations on any solution based on context. With clear consideration for these variables in HROs, *A Reluctance to Simplify* is encouraged by identifying the current and ideal condition of *CATWOE*. The use of *Current State* and *Future State* diagrams from the Lean literature meet these criteria.

Developing root definitions in HRO, i.e. the ideal CCU system, can be done with six brief statements. First, the Customers in CCU are the patients and society in general through lives saved. Currently millions of dollars in malpractice claims are paid on healthcare failures, so improving unit reliability reduces societal costs. To RHC and insurance companies, the ideal condition is to prevent malpractice claims. Second, the Actors are the participants in CCU, such as nurses, doctors, volunteers, etc. who contribute directly to improve reliability. The ideal condition is for Actors to improve reliability by addressing key drivers such as faster response and better understanding. Third, the Transformation Process is reflected in CCUs performance measures. The primary inputs are critically-ill patients with unstable vital signs, and caregivers such as nurses, physicians, medicine, and equipment. The outputs are “transformed” patients

who leave the unit alive and stable. Successful transformations result in no paid malpractice claims. Fourth, in the Worldview, reliability results in the preservation of life. Reduced medical costs free resources to be used in other departments and provide greater benefits for the Owners. A root definition in SSM refers to a type of mission statement encompassing individual root definitions. The ideal condition for CCU is, “Actors improve reliability to 100% so that all patient lives are preserved, resulting in societal savings and no malpractice payouts.”

Fifth, the Owner identifies who controls and accepts liability for CCU. The RHC President and insurance companies are ultimately responsible for poor reliability. Sixth, the Environmental constraints in CCU are conditions that limit reliability, but for which the Owners have no immediate control. This includes treatment recommended by a physician but not allowed by RHC or insurance. Another Environmental constraint is that CCU can't choose patients, and occasionally patients are admitted who are inappropriate for the type of care the unit provides; those too sick and should be admitted to ICU; or those too healthy and appropriate for general care. Constraints are identified by events that are difficult, or sometimes impossible to control by the process Owners and Actors.

#### *4.4. Soft Methods Steps 4 & 5: 4) Building a conceptual model and 5) Comparing models to the real-world situation.*

This step recognizes that conceptual models are needed to understand complex processes. After models are diagrammed they can be shared and tested to evaluate their representativeness of real-world processes. In HRO, model development can be used as one tool to create *A Sensitivity to Operations*, which can include the customer and externally the Worldview, organization, or society. To evaluate effects on other units, SSM encourages building conceptual models of CCU activities and causal links to create common understanding among the Actors in how each activity affects reliability. Figure 3 is the conceptual model of the variables that affect CCU reliability. It demonstrates the transformational process from inputs to outcomes and facilitates sensitivity analysis, where the impact of a change in one operation can be evaluated for its effect on others.

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Insert Figure 3

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For example, CCU only accepts patients from other units such as ICU; and are usually released back to these units. CCUs performance directly affects other units, often involving numerous Actor interactions. Additionally, the unit receiving the patient can also affect reliability. During the implementation of sensitivity to operations, physicians and nurses from other units are encouraged to share their experience with CCU, face-to-face, so that meaning is clear.

#### *4.5. Soft Methods – Step 6 – Identifying Changes Needed to the Current System*

Identifying Changes in Soft Methods refers to identifying problems and solutions to improve reliability. The problems and solutions must be measurable, or else improvement can't be achieved (Deming, 1986). In HRO, any change should improve reliability. Mindfulness methods were especially helpful in this stage because providers were asked to meditate on a specific issue and conceptualize solutions to a unique problem. Patient issues can be complex due to high variance in illness or injury, degree of injury, age and gender of patient, patient attitude, etc. where “best practices” may not apply. To facilitate this, an unused break-room, called the Mind-full room, was set aside with comfortable furniture, mats, and quiet areas. At the end of each break, the providers documented their ideas to discuss later on. The Identifying Changes step can be used to encourage the timely recognition and reactions that harm reliability. This is expressly recognized in HRO aspect *An Under-specification of Structures* which encourages the identification and implementation of solutions to address or prevent threats at front-line levels; based on the idea that front-line workers and supervisors recognize threats and try potential solutions much faster than hierarchical ranks (Brown and Duguid, 1999). Mindfulness supports Soft Method's identifying “feasible and desirable changes” to counter immediate threats at the lowest level of the organization. Under-specification of structures is a control model that suggests control in HRO organizations should be relatively flat and decisions should be left up to expertise.

In RHC the unit structure is relatively flat. CCU's nurse supervisors control manpower and assignments, while physicians control treatment. Nurses are the next level and are

responsible for implementing care. When a CCU nurse executes a physician's treatment protocol, this is identified in Soft Methods *taking action*. In under-specification of structures at the unit level, the majority of requests to change/adjust treatment are generated by a nurse at the low end of the organizational structure, not the physician. Before recommending changes however, nurses were encouraged to meditate on the problem and discuss their ideas with peers before discussing with a physician. The inhibiting factor in implementing under-specification of structures in RHC has been the insurance, managed-care structures, which have become over-specified structurally where control is held in hierarchical ranks outside the unit.

#### *4.6. Soft Methods – Step 7 – Taking Action or Developing an Action Plan to Implement Changes*

In CCU, this step is straight forward and encourages the implementation of a solution or at least an action plan where the implementation may be complex. This step can also be used to assist HRO because it encourages the use of expertise to develop and implement solutions. This means that the greatest expertise at the lowest practical level of the organization should be those who implement solutions because the HRO literature reports they can be more effective.

In HRO, this is referred to as *A Commitment to Resilience* where organizations that have created high reliability process must put forth effort to maintain the reliability. *Action plans* encourage resilience because they can contain a protocol that specifies the activities to be executed when a failure occurs. In doing so, it quickly recovers from a failure. Resilience is part of the action plan in CCU. For example, a key element for the unit is life-support equipment, which can alarm and quickly initiate life-saving procedures when patients are threatened. CCU had to share equipment with ICU - and since ICU was considered higher priority the equipment was minimally available. An action plan was developed called "critical locator", which is initiated by any nurse or physician. It begins with a wireless tracking device that can locate any equipment, and if available rushed to CCU. In fact, underlying this entire HRO implementation is the speed, accuracy, and resilience of communication. We argue that this is the sixth aspect of HROs, namely that all HROs must have a fast, accurate, and robust information system to enable implementation of the other five aspects.

## **5. Results**

As mentioned earlier, the RHC uses national performance measures (NQMC, 2009) instead of the 5Es. The RHC measured Efficiency, Process, and Outcomes. These are shown in Table 2, Column 1. Column 2 reports the metrics that comprise each measure. Column 3 shows the benchmark data, January, 2010 – June, 2010. Column 4 provides the data for January, 2010 - December, 2010, including six months of implementation. Column 5 displays the follow-up data for June, 2011 - June 2012, to report the impact of HRO implementation. Data not provided are shown as Not Reported (NR). Efficiency measures the time and cost of patient care. While not directly related to reliability, the costs are essential measures to justify the benefits of HRO. As seen in Table 2 – the costs of patient care dropped by \$100/patient during the period following the implementation, reversing a trend of increasing costs. This improvement is partially driven by the fewer hours needed to achieve a successful discharge (70 hours/patient versus 75 hours).

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Insert Table 2

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The most direct Process measure for reliability is c) *percentage of patients discharged alive with stable vital signs*. During the benchmark period, this reliability measure was 93.8%. After implementation it increased to 99.5%, improving by 24 patients. Given an increase in admissions of 22 patients, this is a statistically significant improvement of 5.3% in reliability. Additional Outcome measures b) *mortality rate of AMI*, and f) *live discharge* are also reliability measures. This shows that fewer patients died from AMI, 1.5% before HRO, down to .9% after implementation, a 60% improvement in reliability. The percentage of patients discharged alive improved by 100%, going from 22 deaths per 1,997 admissions, to 22 deaths per 4,020 admissions.

While it is difficult to directly measure how Mindfulness positively impacted performance, all of the nurses and many of the physicians used the 30-minute meditation and the 1-2 mini-break techniques before treating a patient. They all reported benefits of using Mindfulness in improving focus and attentiveness, supporting the Mindfulness concept that paying more attention to patients and their unique characteristics leads to improved care. The difficulty of using Mindfulness is during peak demand, when care is often relegated to “putting out fires”, where pausing for meditation is not practical.

These results objectively demonstrate that the five aspects of HRO can improve process reliability as long as key information is communicated effectively and efficiently. We argue that this is the sixth aspect of HROs. The improvement between the benchmark period and the post-implementation period in 2012 are not only statistically significant, but practically important since they represent human lives.

## **6. Implications of HRO Implementation**

We argue the implementation of HRO is effective because it contains the framework of Soft Methods developed from scientific principles. Although semantically different, the aspects of HRO are highly similar to those of SSM. Improved reliability of CCU suggests that Soft Methods is an effective approach to guide HRO. This means that a preoccupation with failure is an effective method to prevent process failures. Mindfulness creates better understanding and attention to the stakeholders involved in the process (actors, customers, etc.). A reluctance to simplify a problem or solution, or misidentifying the stakeholders, can lead to poor understanding and ineffective solutions, especially where “best practices” dominate. Next, the processes that control the outcomes must be visual so that everyone understands their role in preventing failures. This is especially important to creating Sensitivity to Operations to prevent one improvement from harming another. Care-giver sensitivity to patients was improved using meditation prior to treatment. Once the operations, processes, and their relationships have been identified, individuals with the greatest expertise can manage these processes. Because “time is of the essence”, those with expertise closest to the failure have the greatest chance of responding quickly with the correct action. Only after a solution has been shown to work can the unit move to ensure it is enforced. The enforcement of solutions requires discipline that creates resilience.

In HRO’s preoccupation with failure, RHC relentlessly pursued activities that harmed reliability. These efforts often began with providers identifying failure points that occur in the system and their potential impacts. Failure studies can provide incredible insights in improving performance (e.g., Capozzi, et al., 2013), and have been extensively conducted in engineering (e.g., Beer, et al., 2012). There is a need for more failure studies in organizations, specifically on the mechanisms that identify failure points, how they are dealt with, and why, despite these

efforts, organizations still fail over time? Future research should report what we learn from these failures that can prevent future failures?

Second, HRO's reluctance to simplify interpretation was implemented by developing a robust context for the problem (e.g., root definition) to generate custom solutions. There is a propensity to over-simplify situations and adopt popular best practices without success. In this case, the Mindfulness and SSM methods encouraged communication and contemplation among caregivers to improve patient care through unique, targeted treatments. This reveals a sixth aspect of Mindfulness, namely that HROs have fast, accurate, and robust information systems. This is important because Mindfulness methods combined with "Learning by Doing" encourages reflection of these front-line providers. One of the physicians admitted that "...during heavy demand periods, standard treatments are sometimes applied without due consideration to the patient...due to the desire to relieve immediate suffering at all costs, even when alternative treatments may be more effective long-term..." Even after 50 years, there seems to be a paucity of published studies examining how Soft Methods can benefit organizations in United States (Checkland, 2011).

Third HRO's sensitivity to operations was accomplished by creating and validating models of the system to adequately represent the real-world phenomenon. Organizational sensitivity and what-if scenarios can only be useful with adequate models. Examples such as Figures 1 and 3 help participants visualize the relationships in key processes.

Fourth, HRO's under specification of structures encourages decision-making at the lowest levels of an organization. In CCU this was implemented with soft methods approach to identify and implement best solutions. It is important to understand that, despite heavy promotion, there have been cases of improvement program failures (Beer, 2003). One reason is that improvements are often driven from the top by external consultants, instead of front line workers who best understand the process (Ko, et al., 2005; Vrakking, 2006). Mindfulness encourages using front-line employees in decision-making, regardless of their rank. Practitioner research indicates that significant improvements do not take place until decision-making is pushed to the front-line (Robinson and Schroeder, 2009, p.33). More research is necessary to examine how to adopt SSM at the lowest-level, and how they interact with HROs and Mindfulness.

Fifth, HRO's commitment to resilience was implemented by providing fully-functional life-support equipment. It is important to develop resilience because disruptions severely limit an organization's ability to perform (Bhamra, et al. 2011, p. 5375). According to Sutcliffe and Vogus (2003) not much attention has been given to the resilience of organizations. The concept of resilience is known in science (Holling, 1973), engineering (Callister, 2003), organizational psychology (Powley, 2009), and supply chain management (Sheffi, 2007). There is an opportunity to answer the *How* and *Why* questions of organizational resilience in different business context using soft methods.

## 7. Conclusions

HROs are organizations maintain processes with extremely low failure rates. The purpose of this research was to show *How* to systematically implement HROs using SSM in a CCU. It shows how Mindfulness techniques such as quiet meditation, mindful reflection, and communication are used to support and facilitate steps 1, 2, and 6 of SSM, and their counterparts in HRO aspects. In doing so, this research contributed to practitioners, showing *How* to systematically implement the five aspects of HRO using the steps of SSM, and how Mindfulness interacts with both to improve process reliability to create an HRO organization. *Why* the aspects of HROs work is because they include the science-based framework of SSM, which can be supported though Mindfulness. While they differ in semantics, the aspects of HROs are very similar to those in SSM, where Mindfulness literature reports improved healthcare reliability. A graphical representation of the proposed relationships among SSM, Five Aspects, and Mindfulness is shown in Figure 4. However, this study found a sixth aspect related to communication, namely that HRO's have "fast, accurate, and robust information systems". In CCU, effective communication was key to supporting the other five aspects.

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Insert Figure 4

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An important step in SSM is to reflect on the implementation process. One of the key issues the participants discovered was the importance of information. At first they struggled with

is how to best report the information on daily and weekly progress, and in a timely and concise manner. Nurses and supervisors already read so many procedural and patient charts that the thought of reading more reports became distasteful. The expert panel identified a tool to report essential information in Lean and Six Sigma implementations could have been applied here called a “Toyota’s A3” report (Shook, 2009). The A3 report is an effective tool because it contains minimal text, relying primarily on pictures, diagrams, and charts to communicate in a timely and concise manner. According to Liker (2004) and Chakravorty and Hales (2013), world class companies such as Toyota routinely apply soft methods through A3’s to guide improvement efforts. Future studies should examine how A3 reports can be used to implement the sixth aspect of HROs, namely “fast, accurate, and robust information sharing”.

Finally, Wieck et al. (2008) identify organizations destroyed by a single incident of failure. We find that harm can also occur in smaller doses. In fact, healthcare providers are no longer compensated for mistakes made by their own institutions. As these costs run into the millions of dollars per incident (McLaughlin and Kaluzny, 2004), the benefits of HRO have huge impacts. These failure costs can also apply to improvement programs such as Lean, Six Sigma, and Constraint Management. Some organizations attempt to restart these failed improvement programs and encounter a unique set of problems. The RHC refers to these restart attempts as Improvement Systems Recovery (ISR).

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## FIGURES

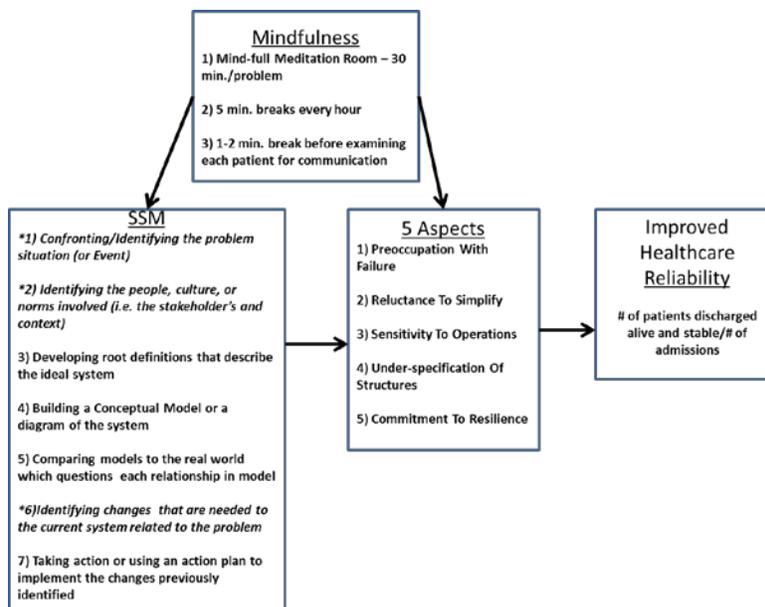


Figure 1 – Implementation Model

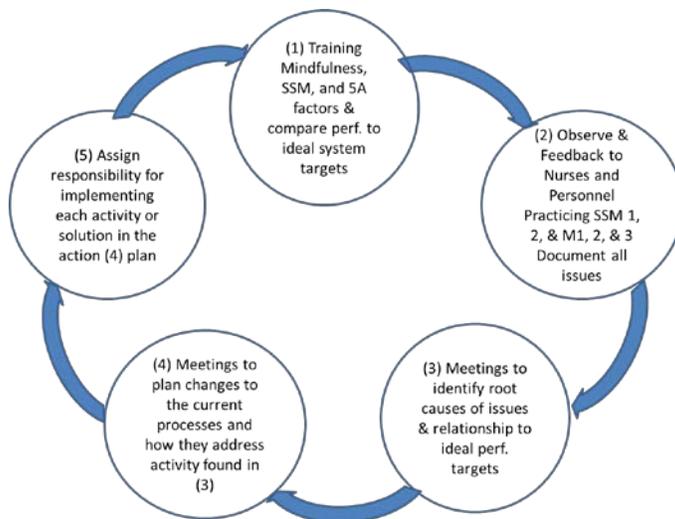


Figure 2 – Data Collection Cycle

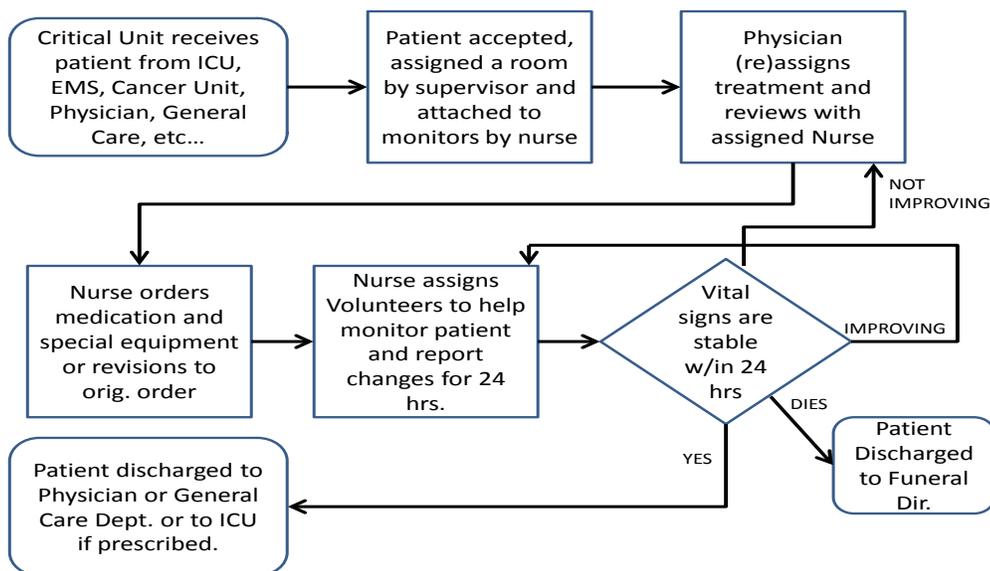


Figure 3 – Conceptual Model of Critical Care Unit



Table 2 – Performance Measures for Critical unit

Measures		Prior to HRO January,2010 – June 2010 - 6 mo.	During HRO January,2010 – December 2010 12 mo.	After HRO Impl June 2011- June 2012 12 mo.
Efficiency	a) Total Cost for the CU Unit b) Total Cost per patient/day c) Number of patients/year admitted to CU d) Average number of hours in the CU/patient e) Average bed occupancy/utilization	NR \$5,350 1,997 73 hours 87%	NR \$5,500 3,998 75 hours 92%	NR \$5,400 4,020 70 hours 94%
Process	a) # of negative interactions between nurse and patient's family b) # of negative interactions between Dr. and patient's family c) reliability of patient care measured as the percentage of patients discharged alive – and stable d) number of incidents of improper medication, dosage, or timeliness by CU e) number of improper/unnecessary notification to physicians f) number and duration of unit equipment failures – average time to repair/replacement g) number of failed shift-supervisor inspections for cleanliness, orderliness, and aesthetics h) number of CU unit policy violations such as visitation hours	965 NR 1,875/1,997=93.8% 0 341 32 – 3.5 hours 53/550 = 9.6% 5	1,302 NR 3,974/3,998= 99.4% 0 510 61 – 3.25 hours 87/1100 = 7.9% 8	911 144 3,998/4,020=99.5% 0 120 71 – 2.25 hours 21/1100 = 2% 8
Outcome	a) accidental patient lacerations by nurse or physician b) mortality rate of AMI (Acute Myocardial Infarction) measured as [# of AMI deaths/# of AMI live discharges] c) acute stroke mortality rate measured as [# of stroke deaths/# of stroke live discharges] d) central-line associated blood stream infections (CLABSI) e) death of surgical patients with STCs (Serious Treatable Complications) f) live discharge [# of deaths/# of admissions]	0 10/642 = 1.5% NR 0 7 22/1,997 = 1.10%	0 14/1,310 = 1.1% NR 0 9 24/3,998 = .60%	0 13/1,312=.9% NR 0 11 22/4,020 = .55%