

Application of High Reliability Organization Principles in State Sector Obstetric Care

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Abstract

Patient safety and high reliability related to obstetric care has become a global concern especially during this COVID-19 pandemic period. This study aims to assess the application of High-Reliability Organization (HRO) Principles in Obstetric care. This is a hospital based descriptive cross-sectional study conducted using a self-administered questionnaire.

Out of the five HRO Principles “Deference to Expertise” has the highest score (mean of 4.64 and SD: 0.661) followed by Commitment to Resilience (Mean: 4.50, SD: 0.682) and “Preoccupation with Failure” (Mean: 4.43, SD: 0.621). “Reluctance to Simplify Interpretations” was having the lowest score (mean 4.14 with SD of 0.664). There is a statistically significant (95% significant level) difference in Principles of HRO Practices among the Male and Female. HRO practices were higher among females (Mean:4.43) than males (Mean:4.48). Further, it was found at 95% significant level there is a statistically significant difference of Principles of HRO Practices among the selected designations (probability value <0.05). It was found the mean value of Principles of HRO Practices is higher among nursing officers (4.52) compare with all the other designations. But practice of HRO principles does not statistically different among different age or educational level or working experience.

Key words: High Reliability Organization, safety, adverse events and healthcare.

1. Introduction

1.1. Background

Globally there is a growing concern regarding Patient safety, due to the potential catastrophic nature of medical errors. Up to four out of every ten patients are harmed in health care in primary and ambulatory care settings according to a report by World Health Organization¹ indicating the gravity of errors [1].

Due to the disastrous nature of errors, healthcare institutions have started applying High-Reliability Organizations Principles (HROs) [2].

Sri Lanka has demonstrated the commitment HRO in Healthcare by implementing the Continuous Quality Improvement programme, which is centrally coordinated by the Directorate of Healthcare Quality and Safety (DHQS)[3].

The National Strategic Plan on Maternal and Newborn Health 2017-2025 emphasizes the importance of improving the quality and safety of maternal care [3]. The policy on Healthcare Quality and Safety [4]. Circular on reporting of adverse event quality review programmes and monitoring visits conducted by DHQS are some instruments for operationalizing safety strategies. Studies have been conducted on “factors associated with patient safety practices [5] and quality improvement [6]. But assessment of the progress of the healthcare institutions on adopting HRO principles, is a necessity as it is mentioned under process auditing element of HRO practices [7].

Obstetric units are more prone to adverse events. Catastrophic consequences are death of a person in economically productive age, disability and prolong stay, leading to increased cost of care. Hospital staff is at risk of litigation and bad reputation to the healthcare institution. Although precise data is lacking regarding the cost implications of medical errors in Sri Lanka, according to the Centers for Disease Control, there are 2 million acquired infections in hospitals in the United States every year and between 44,000 and 98,000 preventable medical deaths occur in healthcare facilities in the United States each year (IOM, 2000). In the Lower Middle-Income Countries (LMICs) 134 million medical errors annually (hospitals), associated with

to 2.6 million deaths because of unsafe health care [1]. Estimated cost of medication errors is 42 billion USD annually) [1]. Hence, it is important to understand causality of adverse events to remedy the errors in healthcare [8].

Initially many initiatives were made to understand patient safety [2]. The studies of James Reason have a major contribution on systemic accident model[2]. It was found there are organizations in which errors have the potential of catastrophic consequences, but which seem to avoid such errors [2]. There are certain principles which governs the behaviour of High Reliability organizations. These HRO principles are, “Preoccupation with failure, Reluctance to simplify interpretations, Sensitivity to operations, Commitment to resilience, Deference to expertise” [2]. Elements of HROs are, process auditing, appropriate reward, avoiding degradation of quality, risk perception and command and Control [7].

This study aims to understand staff perception on factors associated with the practice of High Reliability Principles in Obstetric Wards in a selected Tertiary Care Maternity Hospital.

Obstetric services operate in an environment which is prone for high risk. Therefore, implementation of HRO principles is essential to reduce the number of adverse events and consequently to obtain better outcome from clinical care.

2. Methodology

This study is a hospital based descriptive cross-sectional study which was conducted in Obstetric wards in De Soysa Hospital for Women. Calculation of the sample size was done according to the formula for cross sectional survey standard formula by Lwanga & Lemeshow⁹ and sample size was 384. With the assumption of 10% non-response rate the sample size was 422 in this study.

Stratified random sampling technique was used to select the participants from the population. Population proportionate sampling was done to select required number participants within each stratum. The strata consisted of five staff categories:

1. Medical Doctors (Administrators, Consultants, Senior Registrars, Registrars and Medical Officers including MO)
2. Nursing Category Staff (Special Grade Nursing Officers, Nursing Officer Grade I/Sisters, Nursing Officers).
3. Professionals Supplementary to Medicine (PSM) category (Pharmacists, Medical Laboratory Technicians, Physiotherapists, Radiologists and Occupational Therapists).
4. Midwives.
5. Healthcare Assistants.

2.1. Data Collection Instrument

Structured pre-coded self-administrated questionnaire was used to collect data. The Practice

3. Results

With a 90% response rate the final sample size ended up with 384 responses. The analysis was carried out with two sections; descriptive data analysis was focused on understanding the demographic features of the respondents while inference data analysis was focus on the constructing compositive variables and testing associations and formulating multiple linear regression. The content validity assessed whether all the components of the concept being measured by the tool. A validated questionnaire was used in this study; hence it is assumed that the tool satisfies the minimum requirement of the content validity.

3.1. Socio Demographic Data

Table 1: Distribution of the sample according to gender.

Gender	Number of Respondents (N)	Percentage (%)
Male	42	10.9
Female	342	89.1
Total	384	100.0
Educational Level	Number of Respondents (N)	Percentage (%)
Passed O/L*	55	14.3
Passed A/L*	30	7.8
Diploma (After A/L)	218	56.8
Basic Degree	21	5.5
MBBS	37	9.6
PG Diploma	8	2.1
Master's Degree	5	1.3
MD	10	2.6
Total	384	100.0
Designation	Number of Respondents (N)	Percentage (%)

of High-Reliability Organization (HRO) Principles was measured through five different dimensions namely Sensitivity to Operations, Preoccupation with Failure, Deference to Expertise, Commitment to Resilience, and Reluctance to Simplify Interpretations (Part A of the questionnaire).

Part of the same questionnaire (Part B) was used to capture the demographic features of the respondents as well.

Ethical clearance was obtained from the Ethics Review Committee (Faculty of Medicine, University of Colombo). The study was performed complying the ethical principles of the Ethical Review Committee.

Medical Consultant	8	2.1
Medical Officer	53	13.8
Nursing Officer	190	49.5
Public Health Midwife	40	10.4
Supportive Staff, SKS	93	24.2
Total	384	100.0
Age	Number of Respondents (N)	Percentage (%)
21 – 30	146	38.0
31 – 40	201	52.3
41 – 50	31	8.1
51 – 60	6	1.6
Total	384	100.0
Designation / Service	Service in the Ministry of Health (yrs.)	Service in the Hospital(yrs.)
Medical Consultant	19.1	5.0
Medical Officer	5.0	2.2
Nursing Officer	5.1	2.4
Public Health Midwife	4.7	2.6
Supportive Staff, SKS	5.4	3.5
Mean	5.4	2.7
Standard Deviation	4.96	2.24

(Source: Study Statistics)

According to Table 1 (Socio Demographic characteristics majority of the population are females (89%), who have diplomas after A/L-56%). Nursing officers (49.5%) constitute the main occupational category. Majority (52%) are in the category of 31-41years. The population has 3.5 years of average experience in the Ministry of Health and 2.7years in the respective hospital.

3.2. Describing the Principle of HRO practices

To describe the HRO principles, practiced in the respective Tertiary Care unit, was done using a self-administered questionnaire.

A self-administered questionnaire (Section A) was used to assess five HRO practices where twenty-five questions were used as each practice having five questions. The response was measured using a 1-6 Likert scale. Before constructing the respective five variables that measure the five HRO practices, the internal consistency was measured using Cronbach’s Alpha.

Table 2: Testing the internal consistency using Cronbach’s Alpha.

HRO practices	Cronbach’s Alpha Value	Number of Items
1.Sensitivity to Operations	0.759	5
2.Preoccupation with Failure	0.765	5
3.Deference to Expertise	0.729	5
4.Commitment to Resilience	0.746	5
5.Reluctance to Simplify Interpretations	0.799	5

(Source: Study Statistics)

According to Table 6, all the five HRO practices can be measured using the above tool as the minimum requirement of Cronbach’s Alpha Value 0.70, has been fulfilled by all the five composite variables.

Table 3: Descriptive statistics five HRO

HRO practices	N	Min.	Max	Mean	SD
Sensitivity to Operations	384	2.4	5.6	4.39	0.500
Preoccupation with Failure	384	2.0	5.6	4.43	0.621
Deference to Expertise	384	2.0	6.0	4.64	0.661
Commitment to Resilience	384	2.0	6.0	4.50	0.682
Reluctance to Simplify Interpretations	384	1.2	6.0	4.14	0.664

Practices – Composite variable

(Source: Study Statistics)

Table 7 illustrates Mean and standard deviation of five HRO Practices, “Deference to Expertise” was having a mean of 4.64 and SD: 0.661 while varying from 2.0 to 6.0. which has the highest mean value followed by Commitment to Resilience (Mean: 4.50, SD: 0.682, Min 2.0,

Max. 6.0)” and “Preoccupation with Failure” (Mean: 4.43, SD: 0.621, Min. 2.0, Max. 5.6). “Reluctance to Simplify Interpretations” was having the lowest mean value of 4.14 with SD of 0.664, Min. 1.2, Max. 6.0.

Table 4: Descriptive statistics Principles of HRO Practices

Descriptive Statistics	Value
Minimum	2.52
Maximum	5.36
Mean	4.42
Std. Deviation	0.396
Skewness	-0.814
Kurtosis	1.895

(Source: Study Statistics)

The average of the Principles of HRO Practices which varies from 2.52 to 5.36 was found as 4.42 with 0.396 of Standard Deviation. The skewness was negative 0.814 and kurtosis was 1.895.

Table 5: Normality Test Results of Principles of HRO Practices

HRO Practice	Kolmogorov-Smirnov		Shapiro-Wilk			
	Statistic	df	Sig.	Statistic	df	Sig.
HRO Practice	0.088	384	0.00	0.965	384	0.00

(Source: Study Statistics)

HRO Practices is normally distributed as the corresponding probability is not greater than 0.05. Principles of HRO Practices is not following the normal distribution, hence using one-way ANOVA would be not statistically sound as it violates the assumption of normality of the continuous variable. Therefore, The Kruskal-Wallis H test (sometimes also called the “one-way ANOVA on ranks”), which is a rank-based nonparametric test to determine if there are statistically significant differences between two or more groups of an independent variable on a continuous or ordinal dependent variable was used to test the association of Principles of HRO Practices with categorical demographic variables.

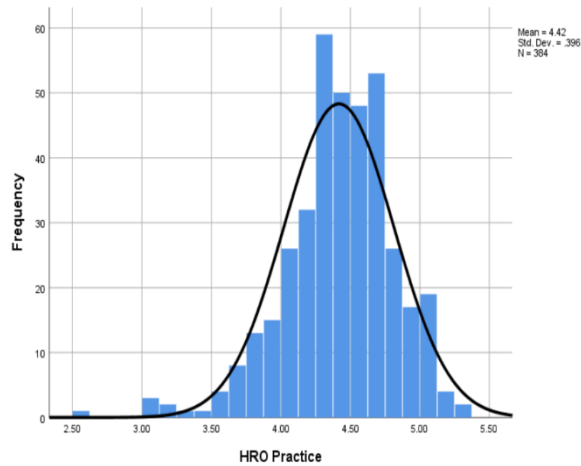


Figure 1: Histogram of the Principle of HRO Practice

Figure 4.1 illustrates the distribution of the Principles of HRO Practices. The graphically the distribution seems to exhibit a bell-shape but the statistical tests of Kolmogorov-Smirnova or Shapiro-Wilk do not provide enough evidence to state the distribution of Principles of HRO

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Table 10: Testing association of Principles of HRO Practices with Categorical demographic variables

Features	Categories	Mean HRO	Kruskal-Wallis	df	Asymp. Sig.
Gender	Male	4.28	7.709	1	0.005
	Female	4.43			
Age	21 - 30	4.41	2.977	3	0.395
	31 - 40	4.43			
	41 - 50	4.44			
	51 - 60	4.07			
Education	Lower than Degree	4.44	2.186	1	0.139
	Degree or higher	4.34			
Designation	Medical Staff *	4.29	32.089	3	0.000
	Nursing Officer	4.52			
	Public Health Midwife	4.24			
	Supportive Staff, SKS	4.36			

females (4.43) than males (4.28). Further, it was found at 95% significant level there is a statistically significant difference of Principles of HRO Practices among the selected designations as the corresponding probability value is less than 0.05. It was found the mean value of Principles of HRO Practices is higher

among nursing officers (4.52) compare with all the other designations. But Principles of HRO Practices do not statistically different among different age or educational categories.

* include Medical Administrator, Medical Consultant, and Medical Officer
(Source: Study Statistics)

The statistical non-parametric test of Kruskal-Wallis H suggests, at a 95% significant level there is a statistically significant difference in Principles of HRO Practices among the Male and Female as the corresponding probability

value is less than 0.05. Further, the mean value of Principles of HRO Practices is higher among

Table 11: Testing association of Principles of HRO Practices with continuous variables.

Working Experience	Correlation Coefficient	Sig. (2-tailed)
Working Experience in Ministry of Health(yrs)	-0.044	0.388
Working Experience in Hospital(yrs)	-0.054	0.294

(Source: Study Statistics)

Since the Principles of HRO Practices is not exhibit normal distribution, Spearman

Correlation was used to test the association of Principles of HRO Practices wit

Working experience. According to Table XI, there is no statistically significant association between working experience in Ministry or the hospital as the corresponding probability value is not less than 0.05.

staff for another 20 years indicating benefits of investment on development and training of human resources.

4. Discussion

For the quantitative data collection, a total of 422 were invited to participate in the study with a 10% non-respondent rate. 385 participated with a response rate of 91%. Out of 385 who participated in the survey that, 342 (89.1%) were females. This shows this population is female dominant in terms of staff composition. Majority (52.3%) of the staff members were of 31-40 years age group. This shows a young healthcare staff giving the long-term benefits of interventions (i.e., training), provided retirement age is 60 years they will remain in healthcare

the majority (n=218, 56.8%) of the respondents were Diploma holders and 14.3% (n=55) had passed only O/L, while 9.6% (n=37) were MBBS and 2.6% (n=10) having MD. So, 21.1% of the respondents were having a Degree as the minimum level of education. In a similar study application of HRO principles which was conducted in A & E units in three selected tertiary hospitals maximum educational level, 39% (n=150) of them had completed Diploma after Advanced Level qualifications, 0.8% (n=3) of them were degree holders (other than MBBS), 47% (n=182) of them having MBBS and 13% (n=50) of them had done postgraduate studies [2], which needs to be considered in

comparison of results in two studies (In A & E sample more-47% of MBBS doctors).

Regarding current designation, the majority (49.5%)

we're Nursing Officers, 24.2% (93) of them were Supportive staff, and 13.8% (53) of them were Doctors who had. This finding shows the importance of getting the involvement of Nursing Officers and supportive staff in training and patient safety interventions.

To describe the High-Reliability Principles, practised in the Obstetric wards, a self-administered questionnaire (Section A) was used. The 1-6 Likert scale was used to measure the response, and scores of >3 were considered as positive. These findings are compared here with the observation of the practice of five HRO principles using a separate checklist.

Both quantitative and qualitative analysis of the processes and systems are needed to get a better picture of the frontlines of health service provision and at the national level (i.e., patients' experience and experience of the healthcare staff and policy development) [2]. Hence, results of the self-administered questionnaire - Part A were interpreted and discussed here with the results of the check list.

Although for the situational analysis as a as a baseline study for describing the practice of HRO practice (with mean and SD), all these practices need essentially constitute the different facets of one entity called collective mindfulness [2]. HROs operations are governed by a unique structure demarcating them from conventional industrial safety models. "Hence, these five principles of HROs that have been identified by Weick & Sutcliffe as responsible for the "mindfulness" making them successful in avoiding catastrophic consequences adverse events and when encountered with unexpected and unfavourable situations [2].

To describe the practice of HRO principles the mean and the standard deviation of the each of HRO principles were used. Difference to expertise had highest mean (4.64, SD-0.661) followed by Commitment to Resilience (Mean: 4.50, SD: 0.682) whereas in the previous study which was conducted in A and E units Sensitivity to operations" (Mean: 4.69, SD:

0.64) had the highest mean value followed by Commitment to Resilience (Mean: 4.47, SD: 0.74)" [11]. "Reluctance to Simplify Interpretations" (Mean: 4.14, SD: 0.664) has the lowest score as indicated by mean, while "Difference to Expertise" (Mean: 4.2, SD: 0.81) had the lowest mean score in the previous study. The high value of standard deviation from the above table infers that there are variations of responses (Table XI).

The highest scored practice is mentioned as "Deference to Expertise," explains relevant expertise, is given priority rather than organizational hierarchy or authority in obstetric decision making, especially in critical situations which are prone for catastrophic consequences. In obstetric care appropriately, can be due to the fact deliveries need more practical skills which is a contrast from an A and E setting. In tightly coupled Socio technical systems which complex in nature, like healthcare due to the associated high-risk, expertise is important in decision making and responding especially in high-risk situations. This is a finding compatible with a HRO setting.

As clinical decision making is challenging (i.e., difficult delivery in the labour room) or as the pace of tasks change, decision – making needs shifted to staff members with the most expertise, irrespective of their hierarchical position. This results in process variability and unreliability [2]. Getting the highest score for difference to expertise despite the hierarchical nature of Sri Lanka Healthcare System is something remarkable and this can be due to the fact, obstetric care is based on hands-on skills (i.e., deliveries). Hence expertise is more important in obstetric care (i.e., difficult deliveries than authority or hierarchical). Making difference to expertise a part of organizational safety culture which is an important factor affecting the practice of HRO principles, will ensure expertise is getting priority. Clinical and administrative leadership can take measures to utilize expertise appropriately. Therefore, getting the highest mean indicate a positive trend, facilitating high reliability in obstetric care when healthcare

institutions practice difference to expertise and other four principles of HRO.

The second-best scored practice “Commitment to Resilience,” was the second according to the score in both of the studies.

Resilient organization shows two main abilities:

- (1) Capability to learn (i.e. from mistakes)
- (2) Capability to quickly respond

As there are unexpected changes and there is a need to divert resources (human resource, equipment and regents, and knowledge/training) how these resources would be allocated and utilized the best [2]. In the respective obstetric wards, there is an obstetric risk assessment according to the nationally agreed clinical standards and simulation - based training is there, which prepares the staff to be ready and anticipate problems and safety issues [2]. Vigilance on potential errors and training are vital components of HROs, and these are observed in the respective wards (Annexure II and III) hence innovative safety solutions can be planned and implemented once an adverse event occurs. Being a professorial ward where medical training is done is a facilitating factor.

Consequently, the Obstetric team is capable of anticipating errors and respond if an unexpected occurs. In these units’ prompt identification of adverse events, helps quickly responding evitable mistakes and minimize escalating response. According to a hospital based descriptive cross-sectional study in Sri Lanka regarding patient safety culture, shows there is a reactive culture in those selected hospitals [2]. Even though there are concerns regarding the generalizability of this study this study recommends strengthening adverse errors reporting system with expert guidance anticipate errors proactively and need of process analysis for the organization to be resilient.

Third and fourth priority practices “Pre-occupation with failure” and “Sensitivity to Operations” indicate the importance of adverse event reporting, and analysis of reported events to take corrective measures and importance of having an idea about the “big picture” (entire system) of the organization to improve reliability.

Lowest score is Reluctance to Simplify Interpretations. But it is positive score (>3). “Reluctance to Simplify Interpretations” explains HROs as complex by Socio technical systems and organizational thinking accepts that complexity. These obstetric wards in the observation were not willing to accept simple solutions to complex safety problems as simplification carries the potential of losing valuable information [2]. Like HROs in the observation it was revealed these obstetric wards conduct root cause analysis when an adverse event encountered and there is a near miss review in obstetric wards with the participation of all staff categories, instead of simple diagnoses.

Under JCI accreditation, international patient Safety goals it was mentioned commitment to reduce adverse events worldwide. National Policy on Healthcare Quality and Safety in Sri Lanka has stated Risk management and safety as fourth key result area showing National level commitment regarding adverse event prevention [4].

Pre-occupation with failure is the HRO principle which has scored as the fourth. And it was shown by adverse event review, maternal mortality review and perinatal mortality reviews like HROs this maternity hospital also does not ignore any failure, even if they are small (Annexure III). Hence, HROs completely address safety issue (i.e., human, technical or failures of the process) immediately. In this obstetric hospital like other Sri Lankan Healthcare Institutions analysis of adverse events is done with the support of Nationally implemented adverse event analysis form and take necessary corrective actions and information is documented.

Lowest score can also be due to the fact majority of this study population (Nursing category of staff, supportive staff and midwives) are involved less in adverse event reporting and analysis as adverse event analysis as adverse event analysis is mostly done by the Quality management Unit (QMU) Medical Officer.

There is a statistically significant difference in Principles of HRO Practices among the Male

and Female as the corresponding probability value is less than 0.05. Further, the mean value of Principles of HRO Practices is higher among females (4.43) than males (4.28). Further, it was found at 95% significant level there is a statistically significant difference of Principles of HRO Practices among the selected

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