

## Original Paper

# Accident and Emergency Care Made High Reliable: Perception of Staff on Factors Affecting Application of High-Reliability Organization Principles in Accident Emergency Units

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### Abstract

*There is a growing concern regarding patient safety and high reliability which made more intense with this ongoing pandemic.*

*Aim of this study is to assess the organizational factors affecting the practice of High-Reliability Organization (HRO) Principles as perceived by staff in selected Accident and Emergency Units.*

**Methodology:** *A hospital based cross-sectional study in three Accident and Emergency care setting, among healthcare staff, conducted using a self-administered questionnaire.*

**Results:** *Out of the five factors affecting HRO practices as perceived by staff, “Organizational Safety Culture” (Mean-4.27., SD-0.49) has the highest mean value followed by Leadership (Mean: 3.96, SD: 0.44) and Teamwork (Mean: 3.95, SD: 0.5). “Work Environment” (Mean: 3.94, SD: 0.46) has the lowest score. All independent and dependent variables have a significant positive correlation with HRO principles (Correlation is significant at the 0.01 level-1-tailed). Multivariate analysis was carried out to assess the proportion variability of the dependent variable. The linear regression model explains 22% of the variability of the HRO practices (dependent variable) by factors affecting HRO practices (independent variables) if all the factors operate together.*

*The distribution of Coefficients, Standardized B value is 0.29 (significant at the 0.01 level), showing if “Organizational Safety Culture” operates together with the other four independent variables 29% of*

*the variability of the HRO practices (dependent variable) can be explained by Organizational Safety Culture.*

**Conclusion:** *Organizational safety culture shows significant ( $< 0.01$ ) effect on determining HRO practices.*

**Keywords**

*High Reliability, Accident and Emergency, safety, quality and medical errors*

## 1. Introduction

Globally there is a growing concern regarding Patient safety, due to the potentially catastrophic nature of medical errors. According to the World Health Organization report in 2019, unsafe patient care in health setting results in 134 million adverse events annually and 2.6 million deaths per year alone in low-and middle-income countries. Up to four out of every ten patients are harmed in health care in primary and ambulatory care settings (World Patient Safety Day. WHO, 2020). The most harmful errors are in relation to diagnosis, prescription errors and medication errors (World Patient Safety Day. WHO, 2020). Each year is estimated that about 42 billion US\$ estimated expenditure is due to is spent on medication errors (World Patient Safety Day. WHO, 2020).

**Patient safety to High reliability:** Based on previous research by Perrow, Karleen Roberts in the 1990s, Weick and Roberts in 1993, “High Reliability Organizations (HROs) can be defined as organizations in which errors have the potential of catastrophic consequences but which seem to avoid such errors, e.g., Commercial aviation, air traffic control system, nuclear power plants and naval” (Spath, 2011).

Weick and Sutcliffe studied diverse organizations, where the potential for disaster can lead to catastrophic event in the next instance itself. They found that not only HROs have a unique structure but and also it acts differently from other organizations. “Thus, these five principles of High-Reliability Organization that have been identified by Weick & Sutcliffe as responsible for the ‘mindfulness’ that keeps them working well when facing unexpected situations” (Spath, 2011). HRO principles are, “Preoccupation with failure, Reluctance to simplify interpretations, Sensitivity to operations, Commitment to resilience, Deference to expertise.”

In the research in financial institutions, Carolyn Libuser identified the following five elements of HROs, processed auditing, appropriate reward, avoiding degradation of quality, risk perception and command and Control (Roberts, Madsen, Desai, & Van Stralen, 2005).

Due to the catastrophic nature of medical errors, healthcare systems now started adopting principles of High-Reliability Organizations (HROs). Sri Lanka has demonstrated the commitment to High Reliability in Healthcare by establishing patient safety practices under the guidance of Directorate of Healthcare Quality and Safety (Ministry of Health, 2016).

**Adopting principles of (HROs) in the healthcare system in Sri Lanka:** HRO principles have been considered at the policy-making level in Sri Lanka while taking patient safety initiative (Ministry of

Health, 2016). Strategic Master Plan 2016-2025 of Ministry of Health, expecting a people-centered health system which is sensitive to the needs and expectations of the patients/people as the outcome. Quality of care is a major component in the essential healthcare package which is designed to achieve Universal Health Coverage (Ministry of Health, 2016). Directorate of Healthcare Quality and safety has been established as the apex body and there are Quality management Units to assess and support to improve quality of care in the respective hospitals.

**HRO in Accident and emergency care:** Factors affecting the implementation of HRO principles need to be identified in all selected Accident and Emergency Care Units in Tertiary Care Hospitals (A and E Units), due to the fact errors in A and E Units has the potential for catastrophic consequences.

Aim of this study is to assess-organizational factors affecting the practice of High-Reliability Principles as perceived by staff in selected Accident and Emergency Units in Tertiary Care Hospitals Western Province.

## 2. Methodology

### 2.1 Conceptual Framework for the Study

In the study the staff perception on factors affecting High Reliable Organization Principles was assessed. The framework of the research was developed based on Moray's model of the organizational, human and technical components of socio-technical systems. Factors affecting patient safety programme in government hospitals in Sri Lanka have been studied, and it was revealed "Organizational Safety Culture, Leadership, Communication, Teamwork, and Work Environment" as main factors associated with patient Safety programme (Sridharan S., 2017; Sridharan M., 2017). This study of factors affecting HRO principles is specifically focused on above five subscales.

This is a hospital based descriptive cross-sectional study conducted in Level I A and E units of three selected tertiary care hospitals in Western province in Sri Lanka.

The study population consisted of medical doctors (Administrators, Consultants, Senior Registrars, Registrars and Medical Officers) and nursing staff (Special Grade Nursing Officers, Nursing Officer Grade I/Sisters, Nursing Officers), who have worked more than three months in the respective A and E unit.

Sample size was calculated using standard formula by Lwanga & Lemeshow, sample size was calculated, and it was 384. A non-response rate of 10% was assumed and further 38 were added to the minimum sample and the sample size was determined to be 422 in this study. Stratified random sampling technique was used to select the participants from each of these hospitals. Population proportionate sampling was done to select the required number of participants within each stratum from the two staff categories.

### 2.2 Data Collection Instrument

Staff perception of factors associated with practice of HRO principles was also assessed using a self-administered questionnaire which consisted of two parts; the first part (Part A) was designed to

assess staff perception of factors associated with practice of HRO principles (Organizational Safety Culture, Leadership, Communication, Team Structure and Work Environment) with 25 questions (five questions for each variable). Six-point Likert scale of agreement (“strongly agree” to “strongly disagree”) was used in this study. The second part (Part B) comprised six questions on socio-economic characteristics of the study population. This instrument had been developed and used by Davies et al. (2007) and Mary Dixon-Woods (2012) and adopted to the Sri Lankan setting (Sridharan S., 2017) to assess factors affecting patient safety programme in government hospitals in Sri Lanka. A focused group discussion was conducted with the participation of experts in this field of Health and Safety, to adapt the questionnaire to A and E setting in Sri Lanka.

### *2.3 Pre-testing*

The research instrument was pretested in Teaching Hospital Karapitiya, Accident and Emergency Unit and the necessary steps were taken to enhance the response rate to eliminate interviewer variations and possible biases.

### *2.4 Analysis*

Internal consistency reliability was estimated with the Cronbach  $\alpha$  coefficient. In this study questionnaire, Cronbach’s  $\alpha$  coefficient for section A was 0.745. Test-retest Reliability revealed that the significance level for paired sample correlation and paired samples test is more than 0.05 for all the variables. Therefore, this questionnaire can be regarded as reliable.

Upon completion of data collection, statistical analyses were completed using the Statistical Package for the Social Sciences (SPSS 25.0). Statistical associations between categories were evaluated by the Pearson correlation. Descriptive statistics were used for all primary variables. The six-point Likert Scale was transformed into 1-6 weighted score, and the data obtained after analysis will be expressed as mean  $\pm$  standard deviation (SD). Data were analyzed to explain the factors associated with HRO principles.

### *2.5 Ethical Considerations*

Ethical clearance was obtained from the Ethics Review Committee, Faculty of Medicine, and University of Colombo (Annexure VII). The study was performed in accordance with the ethical principles of the Ethical Review Committee. Faculty of Medicine, University of Colombo, was notified of any amendments to the study proposal.

Permission was obtained from and Heads of all selected three hospitals before data collection.

The purpose of the study was explained to the participants. Informed written consent was obtained after explaining the study. The confidentiality and anonymity of data was maintained.

### 3. Results

This is a descriptive cross-sectional study carried out to assess the factors affecting implementation of HRO principles as perceived by staff working in level one A & E units in three main Sri Lankan Teaching hospitals, among doctors and nursing staff. A total of 422 were invited to participate in the study of which, 385 participated in giving a response rate of 90%.

**Table 1. Socio-Demographic Data**

		No.	%
Gender	Male	121	31.4
	Female	264	68.6
Age Groups	21-40yr	355	92
	41-60yr	30	08
Educational Qualifications	Diploma	150	39
	Degree other than MBBS	3	1
	MBBS	182	47
	*PG (Started PG or completed PG)	50	13
Occupation	Doctors (PG)	49	12.7
	Medical Officers	183	47.5
	Nursing Category	153	39.7
Service in Ministry of Health (yrs.)	Medical Officers	5.44	
	Doctor.PG	5.59	
	Nursing Category of Staff	6.14	
Service in Ministry of Health (yrs.)	Medical Officers	4.71	

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Doctor PG	4
Nursing Category of Staff	3.8

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\*PG (Post Graduate qualifications)

A self-administered questionnaire (Section A) was used to determine the factors associated with HRO practices as perceived by staff. The response was measured using 1-6 Likert scale, and positive attitudes were defined as having mean of scale scores >3 (More than 03),

**Table 2. Describing Factors Associated with Patient Safety Practices as Perceived by Healthcare Staff**

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Factors	Mean	Std. Deviation	Standard Error of	
			Mean	N
Organizational safety culture	4.2748	0.488	0.02487	385
Leadership	3.9626	0.44118	0.02248	385
Communication	3.9444	0.44032	0.02244	385
Teamwork	3.9455	0.49858	0.02541	385
Work Environment	3.9423	0.46267	0.01747	385
The total mean for part A	4.0139	0.34288	0.02358	385

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Out of the five factors affecting HRO practices as perceived by staff, “Organizational Safety Culture” (Mean-4.27., SD-0.49) has the highest mean value followed by Leadership (Mean: 3.96, SD: 0.44) and Teamwork (Mean: 3.95, SD: 0.5). “Work Environment” (Mean: 3.94, SD: 0.46) has the lowest score as indicated by mean. The standard deviations from the above table infer that there are variations of responses.

**Table 3. Correlation between HRO Practices and Factors Associated with HRO Practices**

Factors Affecting HRO practices	Pearson Correlation	Sig.(2-tailed)	N
Organization Safety Culture	0.257	0.000	385
Leadership	0.301	0.000	385
Communication	0.364	0.000	385
Teamwork	0.349	0.000	385
Work Environment	0.387	0.000	385

Correlation between Mean HRO Practices (Mean: 4.402 SD: 0.533) and factors affecting HRO practices was calculated using Pearson correlation. Pearson correlation matrix indicates the direction and strength of bivariate relationships. All independent and dependent variables have a significant positive correlation with HRO principles (Correlation is significant at the 0.01 level-1-tailed). HRO practices show the highest correlation with the work environment (0.387) and lowest with Organizational safety culture (0.257).

Correlation does not imply causation (Minitab, n.d.). Relationship between HRO practices (dependent variables) and factors affecting these HRO practices (independent variables), although correlated it does not imply that a change in, independent variables causes a difference in dependent variables or vice versa (Minitab, n.d.). Therefore, to see the variability of the dependent variable according to the independent variable Multiple Regression Model was carried out.

Coefficient of Determination ( $R^2$ ) is the proportion of the variability of the dependent variable that can be explained by the independent variables. Adjusted  $R^2$  is 0.224. Therefore, the linear regression model explains 22% of the variability of the HRO practices (dependent variables) by factors affecting HRO practices (independent variables).

**Table 4. Multiple Regression Models for Factors Associated with HRO Practices**

R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
0.483	0.234	0.224	0.46973	1.669

ANOVA shows this model gives significant ( $< 0.01$ ) results, in predicting variance of dependent variables.

**Table 5. Distribution of Coefficients of Factors Associated with HRO Practices**

	Unstandardized		Standardized Coefficients		
	Beta	SE	Beta	T	Sig
(Constant)	1.096	0.327		3.351	0.001
Organization Safety Culture	0.317	0.05	0.29	6.356	0
Leadership	0.012	0.084	0.01	0.142	0.887
Communication	0.139	0.124	0.114	1.118	0.264
Teamwork	0.142	0.102	0.133	1.392	0.165
Work Environment	0.203	0.155	0.176	1.308	0.192

Organizational safety culture shows statistically significant ( $< 0.01$ ) effect of variability of HRO practices (dependent variable) Standardized B value is 0.29 and coefficients B as 0.31. This finding is significant at the 0.01 level. If Organizational Safety Culture operates together with the other four independent variables (Leadership, Communication, Teamwork and Work Environment) which are acting like independent variables, 29% of the variability of the HRO practices (dependent variable) can be explained by Organizational Safety Culture. If Organizational Safety Culture operates alone 31% (unstandardized B 0.31), variabilities of the HRO practices can be explained by Organizational Safety Culture. This is a statistically significant (at the level of 0.01) finding.

#### 4. Discussion

4.1 Mean age of the population 33 years (SD-4.509) majority of the participants (57%) were between the age of 31-40 years and 92% of the population were less than 40 years, indicating relatively young healthcare staff composition. This shows the benefits long term of interventions (i.e., training), provided retirement age is 60 years will remain in service for another 20 years indicating long term yield of investment on human resources.

Regarding current designation, the majority (60%) were doctors 47.5% (183) of them were Medical Officers, and 12.7% (49) of them were Doctors who had followed of who are having PG qualifications or who are following PG studies). Nursing category were 40%. This finding shows the importance of getting the involvement of doctors in training and patient safety interventions. This higher proportion



of MBBS degree holders and Doctors can also be due to the fact that separate carder for A and E units was not defined were not defined in certain hospitals (i.e., Colombo North Teaching Hospital Ragama (CNTH) at the time of data collection. In CNTH PCU, ETU and OPD all the staff (Including Residential physician, Doctors in the Surgical, vascular and Anaesthesia units as all of them were included in on-call duty roster) is considered as A and E staff in Administrative matter. And due to the selection criteria as well. There can be nurses who are having less than six months experience in A & E service.

This study was conducted to determine the organizational factors associated with the practice of HRO principles as perceived by the staff in selected Tertiary Care Accident and Emergency Units.

Out of the five factors affecting HRO practices as perceived by staff, “Organizational Safety Culture” (Mean-4.27., SD-0.49) has the highest mean value followed by Leadership (Mean: 3.96, SD: 0.44) and Teamwork (Mean: 3.95, SD: 0.5). “Work Environment” (Mean: 3.94, SD: 0.46) has the lowest score as indicated by mean. The standard deviations from the above table infer that there are variations of responses.

As perceived by staff, “organizational safety culture” (Mean-4.27, SD-0.49) has the highest mean value with a significant (Sig. one-tailed < 0.01) positive correlation of 0.277. In a descriptive cross-sectional study conducted to assess the factors affecting patient safety programme in Government hospitals in Sri Lanka (Ministry of Health, 2016), Organizational safety culture has the mean value of 3.208 and the correlation with patient safety programme is 0.253. The mean more than 03 is considered as a positive response. Both shows positive mean values showing that organizational safety culture has an important role in the patient safety programme.

All independent and dependent variables have a significant positive correlation with HRO principles (Correlation is significant at the 0.01 level-1-tailed). HRO practices show the highest correlation with the work environment (0.387) and lowest with Organizational safety culture (0.257). Communication has a correlation of 0.364 with HRO practices, which is an essential factor next to the work environment. Teamwork has a correlation of 0.349 and Leadership has the value of 0.301, and both have a significant correlation with HRO practices.

But correlation does not imply causation (Sridharan, 2017). Therefore, some of the independent variables (factors affecting HRO practices) which have relatively a higher correlation has failed in showing a significant effect on the variability of the dependent variable. Therefore, a multivariate analysis was carried out to assess the proportion of the variability of the dependent variable.

Coefficient of Determination ( $R^2$ ) is the proportion of the variability of the dependent variable that can be explained by the independent variables. Here  $R^2$  is 0.234. Therefore, the linear regression model explains 23% of the variability of the HRO practices (dependent variables) by factors affecting HRO practices (independent variables). In a descriptive cross-sectional study on patient safety programme (Ministry of Health, 2016) which was carried out using the same methodology showed an Adjusted R

square of 0.405 indicating 40% proportional variability dependent variables according to same factors, indicating the need of further studies to find the difference.

The distribution of Coefficients, the proportion of the variability of the HRO practices (dependent variable) that can be explained by each factor, affecting HRO practices (independent variables) shows Organizational safety culture shows significant ( $< 0.01$ ) effect on variability of HRO practices (dependent variable). Standardized B value is 0.29. This finding is significant at the 0.01 level. According to this result if “Organizational Safety Culture” operates together with the other four independent variables (Leadership, Communication, Teamwork and Work Environment) which are acting like independent variables, 29% of the variability of the HRO practices (dependent variable) can be explained by Organizational Safety Culture.

#### *4.2 Limitations of This Study*

The study was carried out only in A & E units in three Line Ministry Hospitals only among medical doctors and nurses. Therefore, factors affecting HRO practices in other hospitals (Provincial General Hospitals, District Hospitals, and Base Hospitals) and perception of the other staff categories who were not included were not identified. Hence, there will be problems in generalizing the findings.

Since, prevailing patient safety culture as being indicated as reactive in a previous study (Amarapathy, 2013) reluctance of the staff to express their views will affect quality of data.

Although the establishment of A and E Units was initiated, the establishment is not completed due to inadequate infrastructure (buildings are under construction) and separate human resource allocation is not done.

### **5. Conclusion**

Organizational safety culture shows significant ( $< 0.01$ ) effect on determining HRO practices. Organizational Safety Culture accounts for 29% of the variability of the HRO practices (dependent variable) if Organizational Safety Culture operates together with the other four factors conceptualized to associate with patient safety (i.e., Leadership, Communication, Teamwork and Work Environment). Based on above it is recommended that since twenty-nine per cent (29%) of the variability of the HRO practices (dependent variable) can be explained by Organizational Safety Culture, improving organizational safety culture will improve the reliability of Healthcare Institutions.

Patient safety culture explains only 29% variability of the HRO practices. Although the other four factors affecting patient safety are highly correlated, they have demonstrated a significant effect on HRO practices. Therefore, further research is needed to find other factors affecting HRO practices.

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