Review paper

The healthcare safety environment: health workers' attitude to medical errors

Abstract

Medical errors overwhelm the healthcare environment worldwide. **Aim:** Identify correlates of the healthcare workers' attitude toward medical errors prevention within the health facility environment. **Methods:** Healthcare providers from selected private health organizations in greater Cairo, Egypt were surveyed; their work load (WL), burnout (BO), leader-member exchange (LMX) quality; their influences upon attitude toward medical errors (ATEs) were analyzed. **Results:** Among 5,725 health professionals surveyed, 2,260 (39.5%) returned valid responses. Participants' mean age was 33.4 years (±7.76SD), male-female ratio was 1.26:1. Nursing predominate other occupations, e.g., 35.4% vs. 21.6% physicians. Both LMX and ATEs scores were significantly higher in male workers [t(df=2258)=0.106, p<0.05; t(df=2258)=1.22, p<0.05, respectively]. The LMX and ATEs scores varied by occupation [F(df=4, 2,255)=2.48, p=0.045]; physicians score higher than technicians, nurse, and pharmacists, [F(df=4, 2,255)=6.65, p=0.02]. Respondents' LMX score increased by age [F(df=3, 2,237)=3.52, p=0.016]. Burnout score decreased by decreasing age [F(df=3, 2,237)=3.37, p=0.042]. LMX and ATEs are correlated (r= 0.16, p=0.015). WL positively correlated with BO (r= 0.351, p<0.001), and inversely correlated with ATEs (r= –0.161, p<0.016). Otherwise, ATEs and BO inversely correlated (r=-0.473, p<0.001). BO could predict changes in ATEs (β= –0.032, p<0.001); work experience was a predictor for BO (β = –0.122, p=0.008). **Conclusions:** Work stressors impact health workers' ATEs, including private health workers, who are often under a financial target pressure. Given their favorable ATEs and LMX attitude, older health workers can play a role in combating medical errors risk in the healthcare institutions arena.

Keywords: Health workers, medical errors, Cairo, Egypt

Introduction

Enthusiastic health systems strive to achieve quality and "perfection" in performance throughout the healthcare providing process to assure a maximum leverage upon the patient's safety and health outcomes. Distinguished health services now immensely depend both upon adherence to highest performance standards and the need to embrace advanced, and often sophisticated, technologies which provide better diagnostic and therapeutic opportunities to the patient's and the provider's best interest. In such a highly challenging atmosphere, a system's management approach is inevitable in order to assure well adjusted and smooth flow of the healthcare process, with minimal flaws, uncertainty, and errors potential. Although errors are an unavoidable trait of mankind, (e.g., "to err in human") **(1)** planners for interventional human services, including healthcare, work diligently to furnish an appropriate environment for the most favorable outcome, safety, and minimal unwanted events. Medical errors involve mistakes medical professionals make in patient testing, care, or treatment (2). Categories of medical errors include failures of planned actions, mistakes of execution and use of wrong plans to achieve outcomes. Specifically incorporated are wrong or inaccurate diagnosis or wrong site, wrong surgery, wrong procedure, and

incomplete treatment of illness or injury. Also encountered are hospital acquired infections (HAIs), blood transfusion reaction and anesthesia errors. Incriminated causes of medical errors include modest experience, poor communication either between patients and healthcare workers or between healthcare workers and unclear lines of authority, emergency care inadequate staffing, and complexity of the procedure (3). Regardless the quality and resources devoted to assure perfection, many of the negative patient safety events are still related to systems and how people operate within them. This attitude likely leads to continued suffering of patients so that every year, thousands of patients die because of medical errors. Such errors can occur anywhere in the health care system, whether public hospitals, private practices, nursing homes, patients' homes, and pharmacies.

To help reduce the incidence of medical errors and hence improve patient safety, we need to identify error-prone initiation factors and to develop approach for prevention. For instance, BO has been considered a major cause of medical errors (4). The negative outcome of such risk for individuals and organizations is overwhelming. If burnout is a proximal cause of medical error, efforts by individuals and healthcare organizations to overcome stressful work conditions, particularly burnout, may help decrease the occurrence of medical errors (5). Other factors impacting medical errors include workload work experience, load tolerance, continuous professional training, the organization's reward policy, and the organization's leadership philosophy; how far it is internalized within the mindset of the health workers community. Scholars working on these risk areas often prioritize a risk of interest over other risks. For instance, one critique of the burnout literature is that it has largely ignored the study of how the leadership processes affects burnout. For this reason, correlates of impaired patient safety and medical errors, such as burnout, LMX quality, and workload need to be addressed integrally yet in a more balanced way. In essence, LMX involves an approach that conceptualizes leadership from the perspective of relationship and implies that leaders develop different relationships with their followers. (6) When the leader has a strong LMX relationship with the subordinates in terms of mutual trust, respect, and obligation, a positive effect on employees' attitudes toward patients, the organization and the perception toward the organization are high, and expectedly, medical errors may well be prevented from happening. Especially in health care, supporting high quality LMX relationships may indirectly influence organizational and personal outcomes by reducing BO. (7) Since healthcare managers often tend to discriminately treat their subordinates, the influence of LMX quality on the overall work performance either subjectively and objectively varies.

Workload refers to the amount of work or number of work units assigned to an individual to perform or complete over a given period. (8) Occupationally, WL has been linked to fatigue, anxiety, and overall impaired physiological, mental, and physical performance. In most healthcare settings WL can be a primary risk for BO, which predisposes to medical errors (4). The "WL- BO - medical errors" series is well observed in most healthcare stingers that overloaded nurses are liable to emotional stress, cynicism, anger and ultimately BO. Especially the heavy WL of nurses has been considered as a major problem for healthcare systems across the world. For instance, in Europe, heavy WL adversely affected patient safety to the degree that patients may die after common surgery when they are cared for by a heavier workload nurse. The issue is that the burden of care for nurses increased in recent years as a result of an increase in patient numbers and population aging, in the presence of an inadequate nurse staffing and mandatory overtime work to treat chronic understaffing. Moreover, nursing overload negatively affects job satisfaction

which contributes to high nurse turnover and the nursing shortage. Physicians, too, are subject to workload, especially in such highly competitive healthcare climate and where national economic difficulty forces a cut on budget and reluctance to invest in human resources. In which case over working physicians render patient safety in jeopardy. For instance, it was found that nearly half of surveyed physicians by Johns Hopkins investigators believe that excessive WL can affect the safety of their patients and consider as the cause of a large number of medical errors. (9) On the other hand, BO refers to a state of emotional, physical and mental exhaustion results from excessive and prolonged occupational stress, such as work overload. (10) Burnout is considered a serious public health problem due to its increasing rate of incidence and negative impact on the entire healthcare system, for its has been largely connected with work performance, job satisfaction, quality of life (QoL), and psychological health. Particularly nursing is a stressful occupation because of their work characteristics that requires mutual interactions to maintain services, and due to work overload and on the job conflicts. These stressors lead to professional BO. Physicians, too, are prone to BO that is directly connected with increased medical errors and impaired patient care. (5) In Shanafelt, et al., (2009) (4) work to evaluate the relationship between BO and perceived major medical errors among, the majority of medical errors American surgeons have reported were strongly related to the degree of BO and mental QoL they have been suffering. Another source of BO which has received attention in recent years involves self efficacy, a social learning concept the reinforcement of which prevents BO. (11) A self efficacious employee is in a better position to keep and perform calm in stressful conditions, and therefore is less likely to fall into BO as easy. Ultimately, a healthcare place that is disturbed by workload and burnout and incapacitated by poor control on medical errors risk is prone to a multitude of devastating complications on the patient's part, in terms of worsened morbidity, mortality, and disability likelihood, and on the organization's stability. In the presence of terrifying figures, e.g., 98,000 deaths in 1999 due to mistakes in hospitals, (1) many of which could have been prevented, or 180,000 of Medicare deaths in 2010, (12) the credibility of the whole healthcare system is questionable. The cost to hospitals and community is unbearable. Medical errors, adverse effects, and mistakes committed during care providing can be prevented or reduced (13) and hospitals undoubtedly need to seek all possible opportunities to reduce and avoid the threat of medical errors. Definitely, error reduction is a difficult mission due to the sophisticated nature of today's healthcare organizations, however understanding key factors contributing to medical errors and developing approach for prevention bring us closer to a healthcare environment with minimal error potential and maximum patient safety opportunity.

In Egypt, the fabric of the public healthcare system is rather unique in terms of types, ownership, access and delivery of service. All people have the right for a free healthcare service, regardless their social, employment or citizenship status. The MOHP is currently the major provider of primary, preventive, and curative care in Egypt (with around 5,000 health facilities and more than 80,000 beds spread nationwide). Specifically, with respect to inpatient services, the MOHP is the largest institutional provider of inpatient care services in the country. It has about 1,048 inpatient facilities, accounting for more than 80,000 beds. Comparatively, the private sector has 2,024 inpatient facilities, with a total of about 22,647 beds, accounting for approximately 16 percent of the total inpatient bed capacity in Egypt. (14) Overall, the Egyptian health care system faces multiple challenges in improving and ensuring the health and wellbeing of the Egyptian people, especially the low social class populations. The system faces not only the burden of combating illnesses associated with poverty and lack of education, but it must also respond to emerging

diseases and illnesses associated with modern, urban lifestyle. To this end, quality, comprehensive coverage, long waiting lists, and the limited availability of updated technologies at a significant proportion of governmentally sponsored public health organizations are issues concerning both the health officials and the people of Egypt. The relatively limited resources the governmental healthcare environment suffers, and the emerging access to global communications which raises the people's expectations for a better and advanced health care, urge a considerable number of middle-class and most high-class populations to seek healthcare at the private healthcare market. After the declaration of an open economic policy in 1974, the private health sector began to grow. Between 1975 and 1990, the total number of private beds rose significantly. Private care facilities in Egypt range from hospitals that are large, modern, and sophisticated to smaller hospitals, day care centers, and polyclinics. This private sector provision of services includes everything from private doctor practices, practice groups, high-tech diagnostic and therapeutic centers and laboratories, as well as private hospitals of all sizes and levels. The Egyptian National Health Care Provider Survey (15) showed that 89 percent of the physicians with private clinics had multiple jobs. Seventy-three percent of the physicians had two jobs (i.e., they had another job outside their private clinic), 14 percent had three jobs, and 2 percent had four jobs. Commonly, those governmentally employed physicians who cannot afford to open their own private clinics opt to work in more than one private facility in addition to their governmental jobs to make up for the income deficit and to achieve some social and prestigious standard of living many doctors are traditionally striving. Likewise, other healthcare professionals, including nurses, pharmacists, health technicians, and allied health care providers, all consider working with private employers upon part-time contractual agreement and many opt to work full-time with these organizations to assure better earning, often at the expense of their family - and leisure times. Such healthcare professionals could be practicing under rather stressful work conditions on daily basis, and this paves the way for work loaded, exhaustion, and probably burnout, a situation that may well be reflected upon their physical and mental well being and eventually work performance. This work has been built on the hypothesis that health workers attitude to medical errors is an intermediary healthcare outcome that may be affected by a set of factors, including LMX quality, WL, and BO, particularly the private care health professional in Cairo, Egypt who are at risk of assuming long working hours and stressful work conditions. Understanding this relationship may well be a step toward the preventing risk of medical errors among health workers and hence alleviating their harmful impact on the entire healthcare outcome including patient safety.

Methods

A multiphase project joining a group of interested researchers and healthcare workers from health organizations in several Arabic districts, including Cairo-Egypt, Saudi Arabia western province, and central Saudi Arabian province was established to study some determinants and outcomes associate with patient safety, performance indicators, and quality assurance of the healthcare environment in these districts. Medical errors, a major component of the risk profile of patient safety, would be among the studied outcomes. In this work, healthcare providers from selected private health organizations in greater Cairo, Egypt were surveyed during the period between March 2014 and June 2014; their WL, BO, LMX quality and the influences of these determinants upon the healthcare workers' ATEs would be analyzed. One-hundred and fifteen health organizations fulfilling official medical, municipal and commercial registration requirements in greater Cairo district were surveyed. Inclusion criteria also included health organizations with a minimum of 95

professional health workers, including medical staff, nursing, technicians, and allied health services staff. Participating hospitals and facilities were randomly selected in a stratified fashion to represent the approximate proportion of licensed private healthcare organizations working in northern, southern, eastern, and western Cairo (29=25.2%, 26=22.6%, 32=27.8%, 28=24.3% hospitals/healthcare facilities, respectively). Further, healthcare employees were proportionately randomly selected from each organization's departments/ sections/units.

A validated predesigned questionnaire to screen the healthcare staff of the selected institutions was utilized. A study sample from the participating healthcare organizations mounting up to 9,340 subjects was reached and invited to respond to the questionnaire, 5,725 (61.3%) of whom returned the self-administered questionnaire. Every effort was done in order to deliver the questionnaire by hand and obtain consent of the participants throughout the study period to assure effective communication and hence maximum response rate of the targeted population. In order to be included in the analysis, only returned questionnaires reporting valid answers on ≥80% of the items would be considered. The questionnaire included a total of eighty-seven items. (The term item may be used throughout this work to describe every single "question" asked to identify to what extent it "measures the same point of interest". Should an item be manipulated, e.g., for a statistical analysis purpose, the term may be referred to as "variable"). Included also are items if the answer to the preceding question was "yes". The questionnaire items cover the following domains: a) demographic and background information (10 questions), b) hospital/health organization information (5 questions), c) work system information (25 questions), d) patient safety climate and culture in the organization (37 questions), perceived performance on unit effectiveness and satisfaction with care provided (6 questions), e) quality of working life (5 questions). The relatively large number of questions was carefully decided and set to assure maximum validity and comprehensiveness of the questionnaire. For instance, the work system domain contained questions on vital work processing and flow, such as communication openness, communication accuracy, communication timelines; time pressures affecting patient safety, workload, coordination mechanisms, workplace design, equipment design, and access to supplies. The personal and demographic domain addresses items related to age, gender, socio-economic status, education, professional information, including occupation, previous years of experience, and years of experience in the current hospital work area of the respondent. Importantly, too, the subscale about factors affecting ATE included questions addressing vital information regarding the LMX, WL, and BO. Likewise, the quality of working life scale included clear questions about fatigue, tension, and also job satisfaction. Specifically, input variables of this research's interest that would potentially influence the study outcome were based on definitions drawn from evidence-based resources. For instance, LMX quality was addressed based on definition by Deluga, 1998, (6) WL as defined by Jex, 1998, (8) and BO, as defined by Maslach, et al, 2001 (10) (see before). On the other hand, both ATEs and medical errors would be dealt with as described by Farger, 2012(16).

Generally, a five-point Likert scale could be used for stratifying such categorical variables. The Likert format uniformly provides options ranging from 1 to 5. The response selection ranges between "strongly agree" and "strongly disagree"; whether or not a "strongly disagree" response would be given maximum score five or least score one depends on the nature of the question. For instance, in questions addressing inquiries the agreement to which is in favor of a positive workers' ATEs (an outcome of this work's interest), "strongly agree" scores five and "strongly disagree" scores one; and vise versa. The

questionnaire takes 35-45 minutes to complete. All required official permissions were obtained; arrangements with the participating organizations done prior to conducting the survey. In preparation for the study, a pilot administration was conducted to assess the questionnaire's test-retest reliability. Thirty health-worker colleagues were given the questionnaire to respond to (response-a). The same questionnaire was re-administered by the same group one week later (response-b). A panel of juries consists of experts in research, healthcare quality, preventive medicine, medical directing, and chief nursing, was selected to judge the responses. Test-retest reliability was calculated to assess the temporal stability of the questionnaire items, using appropriate correlation techniques. An acceptable – to - strong reliability evidence for the questionnaire's items was found: reliability alphas 0.78 for the selected determinants, 0.83 for lifestyle, 0.76 for chronic diseases, and 0.91 for screening tests scales. Onsite, participants were informed about the aim of the study prior to the completion of questionnaire. A verbal consent from each participant was considered a personal permission to participate in the study. Otherwise, it was made clear that participation was voluntary, and that any participant could opt to withdraw any time during the study. We have also stressed the anonymity and confidentiality of any collected information, and that only generic outcome data might be disseminated in scientific settings. Data were entered to a Microsoft program with adequate back up; open-ended questions coded, and observations made ready for statistical analysis. First, descriptive statistics, including frequency data, would be displayed. Parametric techniques, e.g., *t*-test of independent samples, could be used comparing mean differences, considering normal distribution of the continuous data. Testing the differences between three groups or more in their observed levels of a continuous data, considering normality assumption, one-way ANOVA test would be used. Correlation techniques, whether Pearson's or Spearman's depending on normality distribution, to compare the strength of correlation between any two continuous variables of interest could also be used, as appropriate. Multiple linear regression models, e.g., to predict the change in the workers' ATE as a result of a unit change in the predictor variables (e.g., work experience, occupation, LMX, workload, burnout), could be constructed. The SPSS software for Microsoft- version-20 was used for statistical analysis. All tests were at level of significance α=0.05; results with *p*-values <0.05 were considered "statistically significant."

Results

In the study, 2,260 returned questionnaires with fulfilling response validity criteria out of 5,725 responses (39.5%) were entered in the analysis. (In the display of data, either term such as "respondents", "participants", "health professionals", or "health providers", might be used interchangeably, study individuals, would be used to describe the individuals who were included in the analysis).

Table 1a describes selected demographic and professional data of the study participating group. Age-wise, younger age group (20 - <30 years) constitutes almost one-third of the participants (32.3%, n=730). The majority (46.0%, n=1040) belong to the next age group (30 - <40). The number of the study individuals then decreased by decreasing age: 340 (15%) were 40 - <50 years old, 130 (5.8%) were 50 or above (Table 1a). Male workers slightly dominate the study population (55.31%, n = 125), constituting a male – to female ratio of 1.26:1. The participants are practicing at 12 primary work areas (Table 1a), highest of which was "other unit/ward" category (63 = 27.9%), followed by laboratory (36 = 15.9%), ICU, all types (26 = 11.5%), and pharmacy (23 = 10.2%). The remaining areas recorded low numbers of participants, e.g., surgery (14 = 6.2%), until the emergency

department which recorded least participating frequency (4 =1.8%) (Table 1a). According to the study design, five healthcare occupations were reported: “physician”, “nurse”, pharmacist”, “technician” “other” (Table 1b). Nurses constituted the greatest frequency of participation (800 = 35.4%), followed by technician (580 = 25.7%), physicians (510 = 21.6%), and least were pharmacist (160 = 7.1 %) and “other” occupation category (190 = 8.4%).

Table 1a: Distribution of the study group by demographic

	Characteristic	n	%
*Age (y)**	20 to <30	730	32.3
	30 to <40	1040	46.0
	40 to <50	340	15.0
	≥50	130	5.8
	Missing	20	0.9
	Total	2260	100.0
Gender	Male	1250	55.3
	Female	990	43.8
	Total	2260	100.0
Primary work area	Medical ward	50	2.2
	Surgical ward	140	6.2
	Intensive care unit (ICU), (any type)	260	11.5
	Oncology	110	4.9
	Hematology	70	3.1
	Emergency department	40	1.8
	Anesthesiology	50	2.2
	Laboratory	360	15.9
	Pharmacy	230	10.2
	Radiology	180	8.0
	Other unit/ward	630	27.9
	No specific unit	120	5.3
	Missing	20	0.9
	Total	2260	100.0

* Mean age = 33.4 (±7.76SD)

Table 1b: Distribution of the study group by professional criteria

	Characteristic	n	%
Occupation	*Physician*	510	22.6
	Nurse	800	35.4
	Pharmacist	160	7.1
	Technician	580	25.7
	Other	190	8.4
	Missing	20	0.9
	Total	2260	100.0
*Work experience duration **	*Less than 5 years*	460	20.4
	5 to 10 years	980	43.4
	11 to 15 years	380	16.8
	16 to 20 years	190	8.4
	More than 20 years	200	8.8

	Missing	50	2.2
	Total	2260	100.0
Years of experience in the current organization **	*Less than1 year*	280	12.4
	1 to 5 years	1690	74.8
	6 to 10 years	270	11.9
	Missing	20	0.9
	Total	2260	100.0

* Mean work experience: 9.5±6.98y ** Mean years of experience in current work: 3.1±1.2

Table 2: Difference in the mean scores of the study variables of interest among the participants two gender groups

Variable	*Gender*	n	*Mean*	*SD*	*Test statistic*	*p-value*
LMX	*Male*	1250	3.64	0.963	t(df=2258)=	<0.05
	Female	1010	3.52	0.838	0.106	
WL	*Male*	1250	3.05	0.914	t(df=2258)=	>0.05
	Female	1010	3.07	0.893	0.112	
BO	*Male*	1250	2.30	0.788	t(df=2258)=	>0.05
	Female	1010	2.23	0.767	0.699	
ATEs	*Male*	1250	3.52	0.559	t(df=2258)=	<0.05
	Female	1010	3.44	0.405	1.22	

The least common work experience durations were >20y and 16-20y [200(8.8%, 19(8.4%), respectively]. As in Table 1b, too, 1,690 (74.8%) of the respondents dominantly had been employed with their current employers for 1 to 5 years, 280 (12.4%) spent less than 1 year, and lastly 270 (11.9%) were those who have spent 6- 10 years.

Table 3: Difference in the mean scores of the study variables of interest among the study occupation groups (physician nurse, technician, pharmacist, other)

Variable	*Test statistic*	*p-value*
LMX	$F(df = 4, 2255) = 2.48$	0.045
WL	$F(df = 4, 2255) = 3.13$	0.043
BO	$F(df = 4, 2255) = 2.65$	0.020
ATEs	$F(df = 4, 2255) = 2.75$	0.041

Table 2 shows the distribution of the participants' scores of the LMX, WL, BO, and ATEs scales by gender analyzed. The mean scores both for LMX (male 3.64±0.96, female 3.52±0.84) and ATEs (male 3.524±0.56, female 3.445±0.40, respectively) shows a statistically significant difference between male and female workers [$t(df=2258)=0.106$, $p<0.05$and $t(df=2258)=1.22$, $p<0.05$]. Both the participants' WL and BO mean scores did not significantly vary in the two gender groups.

Table 4a: Difference in the mean scores of the study variables of interest among the study's age groups

Variable	Test statistic	*p*-value
LMX	$F(df = 3, 2237) = 3.521$	0.061
WL	$F(df = 3, 2237) = 2.350$	0.094
BO	$F(df = 3, 2237) = 3.372$	0.042
ATEs	$F(df = 3, 2237) = 2.960$	0.117

In the one-way ANOVA testing (Tables 4a) to measure the influence of age upon the difference in the study population scores of the main study scales, first, LMX showed a significant different in the mean scores between age groups [F(df=3, 2237)=3.52, p=0.016]. [Further, respondents aged 20-<30 scored significantly lower compared to those who age ≥50 (post hoc LSD test, mean difference = –0.769, p=0.005), and those aged 30-<40 had a significantly lower LMX score than the ≥50 peers (mean difference = − 0.75, p=0.005)]. Unexpectedly, the respondents' BO mean score significantly decreased by decreasing age [F(df=3, 2237)=3.372, p=0.042], where those aged 30-<40 scored significantly higher compared to those who age 40-<50 (post hoc LSD test: mean difference = 0.331, p=0.031). Otherwise, both WL and ATEs mean scores were not influenced by age (Table 4a).

Table 4b: Difference in the mean scores of the study variables of interest among the study's occupation groups

Variable	*Test statistic*	*p-value*
LMX	F(df = 3, 2237) = 2.408	0.045
WL	F(df = 3, 2237) = 3.139	0.033
BO	F(df = 3, 2237) = 1.325	0.098
ATEs	F(df = 3, 2237) = 3.758	0.014

Another set of 4 ANOVA tests has been calculated to analyze the difference in the mean scores of each of the principal study scales among different occupation groups (Table 4b). The LMX mean scores were significantly different [F(df=4, 2255)=2.408, p=0.045]. *[Further, post-hoc test for LMX score differences within occupation groups showed that physicians had a significantly higher mean LMX scores than all occupations (technicians, nurse, pharmacists), except "other" occupation (mean score differences: physician – technician=0.53, p=0.02, physician – nurse=0.55, p=0.01, physician – pharmacist= 0.64, p=0.012)]*. The WL mean scores varied between occupation groups [F(df=4, 2255)=3.139, p=0.033]. *[Within group post hoc test showed that "other" occupation was significantly higher than "technicians" (mean score difference = 0.47, p=0.0034). The WL score differences within the remaining occupation groups were not statistically significant]*. The difference for the ATEs mean scores between occupation groups was also significant [F(df=4, 2255)=3.758, p=0.014]. *[Within group post hoc test showed that "other" occupation was significantly higher than "technicians" (mean score difference = 0.47, p=0.0034)]*. The score differences for the WL scale between the occupation groups were not statistically significant (Table4b).

Table 5: Correlations analyses of scores of the scales of interest

		LMX	*WL*	*BO*	*ATE*
LMX	*Pearson correlation*	1	0.003	−0.123	0.162
	Sig. (2-tailed)		0.963	0.064	0.015
	n	2260	2260	2260	2260
WL	*Pearson correlation*	0.003	1	0.351	−0.161
	Sig. (2-tailed)	0.963		<0.001	0.016
	n	2260	2260	2260	2260

BO	*Pearson correlation*	−0.123	0.351	1	−0.473
	Sig. (2-tailed)	0.064	<0.001		<0.001
	n	2260	2260	2260	2260
ATE	*Pearson correlation*	0.162	–0.161	–0.473	1
	Sig. (2-tailed)	0.015	0.016	<0.001	
	n	2260	2260	2260	2260

In Table 5, the correlation analysis between the study scales, one another, first shows that both LMX and ATEs had a rather weak, yet significant, mean scores correlation (r= 0.162, p=0.015). No significant correlations between LMX and both WL and BO have been reported. On the other hand, WL and BO mean scores reported a moderately positive correlation (r= 0.351, p<0.001). Significantly too, WL and ATEs weakly inversely correlate (r= –0.161, p<0.016). The ATEs mean score and BO's were inversely and moderately correlated, too (r= –0.473, p<0.001).

Table 6a: Predicting the change in ATEs against the change in BO: a bivariate linear regression analysis

Coefficients [a]

Model		*Un-standardized coefficients*		*Standardized coefficients*	*t*	*Sig.*	*95.0% CI for β*	
		β	*Std. Error*	*Beta*			*Lower*	*Upper*
	Constant	4.175	0.090		46.245	<.001	3.997	4.353
	BO mean	–0.302	0.038	–0.473	–8.031	<.001	-0.376	–0.228

a. Dependent variable: ATEs mean score

Tables 6a and 6b exhibit data of the two linear regression analysis attempts. The first regression (Table 6a) shows how WL could predict the variability in the ATEs as a result of BO change. For each unit score increase in BO, ATEs score decreases by 0.032 score unit (β = –0.032 p<0.001) (Table 6a).

Table 6b: Predicting the change in BO against the change in WL and work experience: a multiple linear regression analysis

Coefficients [a]

Model		*Un-standardized coefficients*		*Standardized coefficients*	*t*	*Sig.*	*95.0% CI for β*	
		β	*Std. Error*	*Beta*			*Lower*	*Upper*
1	*Constant*	1.348	0.172		7.830	<0.001	1.009	1.687
	WL mean	0.302	0.054	0.351	5.607	<0.001	0.196	0.408
2	*Constant*	1.567	0.188		8.320	<0.001	1.196	1.938
	WL mean	0.318	0.054	0.369	5.948	<0.001	0.213	0.424
	Experience mean	–0.112	0.042	–0.167	–2.689	0.008	–0.194	–0.030

a. Dependent variable: BO mean score

In the second regression model (Table 6b) to predict the variation in BO, as an intermediary dependent variable, due to changes in a selected group of predictors, including gender, work experience, occupation, LMX, and WL was calculated. (Only WL and work experience were significantly entered to the model). Each unit increase in WL score significantly yields ATEs decreases by 0.302 unit score in BO (β = 0.302, p<0.001). Significantly, too, a unit increase in work experience score leads to a decrease in BO score by 0.112 units (β = –0.122, p=0.008).

Discussion

Early in the design of this work, there was keenness to admit to the study the largest sample possible of Cairo health professionals. The private healthcare field in Cairo sector covers a considerable portion of the health demand of the Egyptian society. Further, this sector enjoys a wide veriety of healthcare expertise with profession-related risks to exercise analyzing the healthcare ATEs patterns in the target population. First the study sampling frame contained 9,340 affiliates who were diligently reached to assure as large sample size as possible and to cover up for any low questionnaire response rates to predict (613% return rate and 39.5% valid response rate). Not uncommonly, lower figures, (e.g., 25.5%) of a response rate, e.g. to Web-based surveys or a slightly higher rate (31.5%) surface-mail surveys have been reported. (17) In the first phase of the analysis, we meant to thoroughly describe the study scales (LMX, WL, BO, ATEs); their distributions by socio-demographic/ professional status, including occupation and work experience. This helped identify the weight and significance of each of these factors in exploring the medical errors impression trends of the studied population. For instance, younger professionals (20-30 years old) tended to report lower LMX scores than older-age counterparts, and vise versa. Since the majority (46.0%) of respondents aged 30 to <40, age should be given an utmost consideration in interpreting the organization's medical errors profile.

Why young age people are less resistant to burnout: The 30 to <40 year old respondents reported a significantly higher BO score compared to older groups. Apparently, older professionals seem to tolerate BO more frequently than younger colleagues. To start with, the pattern of the effect of age, e.g., on LMX could easily be understood, since age has been perceived as human trait that promotes the individual's ability to make wiser decisions and more effective leadership performance. Therefore, we can easily accept the finding that the health professionals' age is pro better LMX quality. In contrast, it sounds little uncommon that younger individuals report a higher subjectivity, and hence less tolerability to BO while on the job. As such, we may argue that BO itself is not an "all or none" issue. Burnout in the healthcare arena has many causes to think about other than age. (18) For instance, several job traits come into play in determining the level of BO in healthcare institutions, such as role conflicts and role overload. Absence of a clear guideline for the tasks and duties assigned to health workers makes them uncertain about the limits of the task and therefore they become liable to put-off more easily. In which case, even junior practitioners may be at risk of BO in a shorter time interval as compared to doing the same task under better job conditions. The organization's characteristics also have an important role in the BO challenge, for linking the organization's reward-punishment policy to work performance does guard against BO overload. Personal traits other than age also have a role in the higher incidents of BO, such as the health worker's self-efficacy (19) and the amount of social support workers receive from the surroundings. Thereby, age here should be handled carefully while planning for a medical errors improvement. For instance, tasks that need

more communication and leadership experience, or tasks of planning and policy making nature may be assigned to older age professionals who have higher communication and LMX skills, until all staff has been able to live up to the expected level of LMX and BO tolerance standard, all in parallel with diminishing the effect of the factors that lead to a BO tendency among staff. Of note, too, is that BO was not significantly related to our study group occupations. Instead, it was only significantly related to WL; the latter varied by occupations, (e.g., “other” specialties tend for higher WL levels than technicians). In fact, BO has been a matter of focus in medical errors research. The issue encompasses emotional, physical and mental exhaustion as a result of excessive work stresses, especially work overload. (10) Neglecting the BO challenge leads to devastating drawbacks on the whole healthcare system. Otherwise, BO not uncommonly varies between different healthcare occupations, elsewhere. For instance, 50% of physicians believe that among the contributing factors to medical errors is fatigue, as a form of BO. (20) Likewise, medical errors reported by surgeons were significantly linked to their degree of BO and their mental QoL. (4) Nursing also experiences a voluminous work overload and has to perform an endless number of duties and may eventually end up with BO. (21)

Work experience, as well as self efficacy on the job has been given the due care in the analysis. More than 43% of our participants had 5 -10 years of relevant work experience. Also, 74.8 % of the respondents had 1- 5 years of experience with their current employers. Work experience scoring enabled us to predict the variation in BO tendency secondary to the change in the work experience standard. In a study by Perry et al (2014) (22) on voluntary medical male circumcision (VMMC) services in Kenya, South Africa, Tanzania, and Zimbabwe, a multivariate analysis for predictors of work fatigue/BO had been undertaken. The average work experience for Kenyan providers was 31 months compared to South Africa (10 months), Tanzania (15 months), and Zimbabwe (11 months). In comparison to our health professionals, except for a considerable proportion of the Kenyans (67%), less number of VMMC providers started to experience work fatigue/burnout around the end of the work durations (33% South African, 17% Zimbabwean, and 15% Tanzanian providers). In their regression analysis, Perry et al (2014) (22) first report an increase both in age and duration of work which was associated with an increased likelihood of experiencing work fatigue/BO. However, higher career duration total at VMMCs decreased the likelihood of experiencing BO. Evidently, the same trend of a decreasing variability in BO by work experience in the VMMC survey has been shared by our study.

In the analysis of our ATEs domain by occupation, physicians attained a significantly higher ATEs score than nurses. As a matter of fact, both professions have always been obsessed with medical errors committed at the worksite and down the healthcare road. Both professions are held accountable for their patients’ safety and remotely unlikely that an average physician or nurse would mean to intentionally inflict harm upon their patients. In a study by Valiee, et al (2014) (23) conducted a study to evaluate nurses’ perception about nursing error who had at least one year of work experience in critical care units in Tehran and Kurdistan, the participants reported that nursing errors were deemed unavoidable. Work pressure, caring blindly, and lack of coordination were among the condemned reasons. The nurses supported the recommendations given to alleviate their concern about errors, not to impact patients’ wellbeing. Shanafelt, et al (2009) (4) also indicate that when American surgeons were surveyed utilizing a validated depression screening instrument and standardized assessments of BO and QoL, they showed a strong desire that medical errors be diminished on the job. The surgeons blamed burnout and their mental QoL for medical errors, some of which may have been as fatal.

Medical errors, whether those related to failure of planned actions or mistakes of execution and the use of wrong plans to achieve outcomes, alongside with the risks of medical malpractice, all involve a multitude of underlying causes and triggering factors. Among these factors are heavy WL and communication problems in the health organization. Under such climate, medical errors are prone to be encountered and their occurrence could be on the rise, unless otherwise mitigated by effective measures. To that end, medical errors largely jeopardize both patient safety and the health organizations stability. In a given health facility, unless the service environment was designed to the best outcome of patients' wellbeing, at least patients should not be harmed by the care they are given at the healthcare facility ("primum non nocere" = "first, do no harm" principle). (24) Especially in BO among healthcare workers' research and in the realm of healthcare profession, seemingly there is a moving of the focus from just "errors" to the broader favorable outcome of health service, which is patient safety. (25) An adequate understanding of medical errors plays a pivotal role in achieving the improved patient safety goal.
Three main levels of inputs were studied in this work: organization level, as expressed by LMX quality, job level, as expressed by WL, and individual level, as expressed by BO; each has been analyzed as a hypothesized predictor for the health professionals' ATEs. The philosophy of selecting healthcare staff attitude toward medial errors as an outcome is envisioned in a sense that ATEs stands as an important intermediary step toward the prevention and control of medical errors. (26). In the literature, too, researches such as that by Frager (2012) (16) tended to utilize ATEs to measure and provide recommendations for medical errors prevention. Actually, utilizing ATE as an outcome in error research provides a vehicle for understanding opportunities to improve patient care safety. Understanding the circumstances related to errors is the starting point to work on the prevention of medical errors; furnishing a healthy environment for quality care and improved outcomes of the provided service. On the health institution's part, establishing a culture where a shift from punitive - to non-punitive approach, e.g., adopting "root cause analysis" (RCA) technique to depict the reason of errors so not to repeat, and "forward mode and effect analysis" (FMEA) to forecast potential reasons for errors, so prevent initially, enhances the success potential of the institution's health maintenance and improvement mission.

The score trends of the principal study's input scales (LXM, WL; BO) reflect the prevalence status of these factors among the studied population sample. The mean LMX score of the study group was 3.59±9.1; the higher the age, the higher the health professionals' LMX. Gellert (2011) (27), too, studied the influence of age upon the workers' perception of LMX in physically and mentally demanding case working settings. In agreement with our age-dependent LMX findings, Gilbert (2011) (27) reported that older employees tend to have a better exchange of relationship with their supervisors; and that mediated the relationship between age and job satisfaction. Since age positively impacts LMX, older health workers in Egypt can have an important role in transmitting a sound leadership experience to coworkers, e.g., being proactive in leadership promotion education and training activities. Incorporating leadership and communication skills in continuous medical education activities on a periodic basis where the attending staff are incentivized by credit hours and further rewarded by opening to them attractive career promotion opportunities, all are creative ideas to invest the currently preferable LMX result in this healthcare population.

The mean WL score of the study population was borderline moderate (3.06 ± 0.903). Workload is another universal cause of medical errors in most health occupations and in

most healthcare settings, worldwide. (4) Fortunately, the WL standard within our study boundary was only revolving around a moderate level, an encouraging situation so that with some more effort to improve the workload domain in the studied institutions WL stressor could be suppressed and a workplace with the least medical errors burden could be brought about. Workload among health professionals can vary by the type of healthcare occupation, particularly in the presence of shortage of staff, patient overflow, and shortage of logistics to satisfy the required volume of service. In our study, the mean score of WL reported by healthcare occupations ranged between 2.87 and 3.34. The highest score (3.34 ± 0.75) was reported by "other" occupation, followed by "physician" (3.23 ±0.78), followed by "nurse" (3.03 ± 0.86), "pharmacist" (3.02±1.02), and least (2.87±1.04) to encounter were health technicians.

Among the work stressors analyzed, too, BO has achieved the lowest mean score (2.27±0.78) in the main two work stressors (WL and BO) analyzed. There has been a traditional critique about using BO as a parameter for assessing the healthcare work environment and the often inherent stressors, meanwhile ignore studying the possible counter-regulatory effect of the LMX processes on the level of BO of healthcare workers. (28). Nonetheless, we can argue here this criticism claiming that our addressing the most recognizable factors affecting medical errors, particularly LMX could treat for the deficiency in the BO inquiry. Although LMX in our population shows a favorably negative, yet insignificant correlation with BO, LMX could exercise its effect on reducing the tendency for medical errors through other pathways, e.g., its direct effect on staff's ATEs. The ATEs scores are already high, especially in older workers, and also high between different health professions. More tangible effect of LMX on BO and subsequently a bolstered patient safety could be accomplished through supporting a distinguished LMX interaction throughout the health care process at the studied institutions. Thomas and Lankau (2009) (7) also supports that providing a quality leadership within the health organization's workers community may indirectly influence organizational and personal outcomes, e.g., reducing BO rate. Reduced BO burden minimizes the health workers' absenteeism due to tiredness from overwork. It also increases their job satisfaction, and ultimately promotes their loyalty to their affiliated organizations. Moreover, to the best interest of the participating institutions' outcomes, ATEs was inversely correlated with BO level, meaning the higher ATEs the lower would be the BO tendency of staff. Until the role of LMX has been mobilized, together with other supportive approaches to minimize the BO among Cairo care providers and necessary logistics have been furnished, there is a good opportunity to work on BO through utilizing the remarkably useful relationship between ATEs and BO among the surveyed professionals.

Near the end of the analysis, it was useful to examine, e.g., how BO could be used to predict the probability of the change in ATEs of the study sample members. The regression model indicates that BO makes health workers unlikely to control the occurrence of medical errors on the job. On the other hand, WL was predictor for the probability of an increase in the degree of BO (β = 0.318 units, p<0.05). Van Bogaert, et al (2012) (29) studied the relationships between nurse practice environment, WL, BO, job outcomes and nurse-reported quality of care in psychiatric hospital staff in Belgium. They found that an improved data collection model could explain 50% of the variation in job outcomes. Thereby, WL itself was a predictor for the job outcomes and enabled the model to significantly explain the variation in these variables.

In conclusion, medical errors occurrence has been s a health service “chronic syndrome”, health organizations are often barely immune to. Several types and risks for medical errors are quite preventable; yet, healthcare providers often continue to fall into the trap of error due to a multitude of reasons, many of which could have been avoided early in the care process. The price of medical errors in terms of jeopardized patient safety, lost opportunities of a better health outcome, and the cost and liability on the part of the health organization and on the overall public health system is devastating. Many hospitals and care providers have started seeking to reduce medical errors within their boundaries particularly through maintaining and improving the quality of care, especially after the era of quality and patient safety awareness, the presence of which have become basic licensing requirements at the international and local levels, and that most health organizations have to assure in order to maintain their licensed status. Interestingly, the levels of three major factors of a notable influence on the frequency of medical errors among our health professionals support the probability of rather reduced medical error load within the studied organizations. For instance, BO frequency is on the low side, and both LMX and ATEs are more than moderate level. Another finding in support of this BO situation is that it has not been related to the health workers’ occupation. Moreover, in the presence of such relatively low burnout trend, the health professionals may well be entitled for a relatively high level of ATEs, which is a mediator for a reduced frequency of medical errors. Alarmingly, the age profile of our participants indicates a dominance of middle age (46.0% aged 30 to <40), as the tendency for BO in this age group has been higher than older ages. However, the professionals’ age sustains a desirable LMX pattern; the latter is a strong mediator both toward burnout and ultimately medical errors frequency. A tendency for a desirable level of ATEs on the job, especially physicians is predominant. Having such positive ATEs provides a convenient opportunity to a lowered medical errors workplace. Just less than half (43%) of our staff are among those who have 5 -10 years of relevant work experience. The latter has been associated with reduced errors, e.g., experienced practitioners can make better decision about patients’ health, and handle the increasing demand for patient safety. A future medical error improvement plan, e.g., retrieving findings of the study’s regression analyses, needs to consider those factors predisposing medical errors, especially BO and WL. It is quite feasible to utilize our relatively low BO level in improving the medical errors strategy, in collaboration with other supportive measures, such as thrusting the organization’s staff communication, and an employee reward system for commitment to quality recommendations and immediate reporting of error incidents. Prevention of medical errors should go simultaneously with any measures contemplated to treat the prospected medical errors situation. Accordingly a systematized plan to prevent errors using database from this research could be established. The issue is that medical errors prevention, by far, implies many personal, cognitive, and behavior considerations health workers have to recognize in order to improve their attitude to prevention of medical errors. Specifically better leadership management and wise supervision help reduce medical errors and adverse events by those health professionals striving providing better care to their patients. All healthcare staff members are in need for continuous training in patient care focusing on medical error prevention and patient safety incidents reporting. Nursing overload should be handled with an utmost care in order to reduce the possibility of nursing errors, e.g., investing in preparing quality nursing cadres and offering generous incentives and career promotion opportunities for distinguished calibers. Among the methods to alleviate the consequences of medical errors incidents is medical malpractice insurance. Physicians and some other health professions in Egypt are encouraged to sustain an appropriate insurance to pay off any claims and settle lawsuits brought by harmed patients. However, malpractice insurance is not the radical solution for

medical errors. It may pay a portion of the cost of harm and disabilities incurred as a result of the providers' malpractice, yet, it does not restore lost lives or restore trust in the health system which could not guard its affiliates against errors and did not provide an adequate climate for an error-protected environment.

Future research on the pattern and determinants of medical errors in the Cairo health institutions, probably utilizing a hybrid methodological approach, such as sampling the medical records for detailed clinical information, reviewing morbidity and mortality reports, and interviewing stakeholders, including administrative and technical staff, may be included. A future qualitative research project where patients, and probably health practitioners in parallel are interviewed, their opinions, wants, needs and demands for a safe care environment are identified is also advised.

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