

# Interruptions and distractions in the trauma operating room: understanding the threat of human error

## *Interrupções e distrações na sala de cirurgia do trauma: entendendo a ameaça do erro humano*

BRUNO MONTEIRO TAVARES PEREIRA<sup>1</sup>; ALEXANDRE MONTEIRO TAVARES PEREIRA<sup>2</sup>; CLARISSA DOS SANTOS CORREIA<sup>3</sup>; ANTONIO CARLOS MARTTOS JR.<sup>4</sup>; ROSSANO KEPLER ALVIM FIORELLI, TCBC - RJ<sup>5</sup>; GUSTAVO PEREIRA FRAGA TCBC - SP<sup>6</sup>

### A B S T R A C T

**Objective:** To understand the human factor as a threat to the security of trauma patients in the operating room, bringing to the operating room some important rules already applied in the field of aviation. **Methods:** The sample included 50 cases of surgical trauma patients prospectively collected by observers in shifts of 12 hours, for six months in a Level I trauma center in the United States of America. Information regarding the type of trauma, severity score and mortality were collected, as well as determinants of distractions / interruptions and the volume of noise in the operating room during surgery. **Results:** There was an average of 60 interruptions or distractions during surgery, most often triggered by the movement of people in the room. In more severe patients (ISS > 45), subjected to damage control, the incidence of distractions was even greater. The average noise in the trauma surgery room was very high, close to the noise of a hair dryer. **Conclusion:** Interruptions and distractions are frequent and should be studied by the trauma surgeon to develop prevention strategies and lines of defense to minimize them and reduce their effects.

**Key words:** Medical Errors. Security measures. Patients. Surgery department, hospital.

### INTRODUCTION

The safety of surgical trauma victims is now a central theme in the medical world. Brought to light by the "Institute of Medicine Report To Err is Human: Building a Safer Health System", doctors, nurses and all staff involved in the management of health care have sought answers to questions that lead to an unsafe environment for patients<sup>1,2</sup>.

The "error caused by human factors" is the most common after surgical errors caused by the surgical technique<sup>3</sup>. Substantial data also suggest that at least half of all surgical complications are avoidable and attributed to human error<sup>4-6</sup>. However, there are no guidelines for the management of interruptions and distractions, which are strong factors influencing human errors in the operating room<sup>7-12</sup>.

The primary objective of this study is to understand the human factor as a threat to patient safety and the surgical

trauma victim and to bring to the operating trauma room some important rules already applied to the field of aviation. By creating a suggestion for the management of interruptions and distractions during trauma surgery, it is expected that human errors, complications, and therefore mortality rates be reduced<sup>3,6</sup>. As specific objectives expected, there are: measurement of the frequency of interruptions and distractions in the trauma operating room in a single sample; identify the source of interruptions and distractions in this environment; assess the intensity of sound in decibels (dB) in the trauma surgery room.

### METHODS

The sample included 50 prospectively studied trauma victims undergoing surgical treatment for six months in a Level I trauma center in the United States of America (USA). Trauma of surgery were classified as: simple

Study conducted at the Jackson Memorial Hospital / Ryder Trauma Center, Miami, FL, USA.

1. Post-Graduate, Medical Sciences, Universidade Estadual de Campinas (UNICAMP), Campinas, São Paulo State, Brazil; 2. Commercial Airline Pilot; Bachelor Aerospace Science - Pontifícia Universidade Católica do Rio Grande do Sul (PUCRS); 3. Anesthesiologist, Clinics Hospital, Universidade Estadual de Campinas (UNICAMP); 4. Assistant Professor, DeWitt Daughtry Family Department of Surgery, Leonard M. Miller School of Medicine, University of Miami / Jackson Memorial Hospital - Ryder Trauma Center, Miami, FL, USA; 5. Professor, Universidade Federal do Rio de Janeiro, School of Medicine and Surgery, Hospital Universitário Gaffrée Guinle, Rio de Janeiro, RJ, Brazil; 6. PhD, Coordinator Professor, Surgery of Trauma, Department of Surgery, Faculty of Medical Sciences, Universidade Estadual de Campinas (UNICAMP), Campinas, São Paulo State, Brazil.

laparotomy, laparotomy with damage control, exploratory laparotomy with repair of any intra or extra abdominal vascular structure, thoracotomy, thoracotomy with damage control, thoracotomy with vascular repair or a combination of them. Information regarding the type of injury (blunt or penetrating), Injury Severity Score (ISS) and mortality rate was also collected. This study was submitted to the Ethics Committee under number 08-0613.

Distraction was defined as the behavior observed when there was diversion of attention during the execution of a primary task and / or a verbal response to a secondary task related or not to the activity performed (i.e., responding to a question from a resident or quickly diverting attention to see who enters and who leaves the operating room). The interruption was defined as a distraction resulting in rupture of the main task in the activity.

To assist in the preparation of the protocol from the distractions and interruptions, a commercial jet pilot with 10 years of experience was interviewed and answered a questionnaire about safety and human error in aviation, translating the questions to the operating room environment.

Data collected were used to proceed to the sum of points, the analysis of the average, as well as other statistic variables, of each operation, expressing interruptions and distractions.

The measurement of the operating room noise was carried out by using a proper instrument (CR 150 - Noise Meters Inc., USA) of international standards and when 56 decibels (dB) were hit one point was assigned to the surgical team.

Six observing researchers followed the 12-hour shifts on that level I trauma center in the U.S. for a period of six months. Observers were deployed in pairs and accompanied the team to the operating room and recorded all observations relevant to the distractions and interruptions in the trauma operating room according to the variables in Table 1. Prior to the start of data collection and organization of the scales of the researchers observers were trained in

groups for a period of one week in the methodology desired by the authors in order to decrease possible confounding biases by the researchers.

For data collection a high level of concentration on the part of observers was required. Therefore, to maintain quality of the collected data, two researchers observed, together all surgical procedures of the shifts and their observations were subsequently compared. The discrepant cases between observers were excluded. The observation process of the sample began at the time of placement of the sterile field and finished with the synthesis of the skin or peritoneostomy, comprehending only the intraoperative phase of surgery.

During the observations the researchers remained isolated in a corner of the operating room and recorded events that distracted or interrupted the surgical team in the sterile field. The surgical team had no prior knowledge of the intention of the authors' research, co-authors and collaborators. Observers recorded a brief description and duration of each distraction or interruption according to the variables listed in table 1, noting also the start and end times of the procedures. For each interruption or distraction one point was recorded, resulting in a sum of points for each operation.

In parallel with the field work a research in the medical and aviation internet databases (PubMed, MEDLINE, Springer Link, Lilacs, Google, the Aviation Safety Information Analysis and System Share - Asia's) was carried out on works related to the theme .

We applied the Fisher test (GraphPad InStat ® Software, CA - USA) for analysis of statistical values.

## RESULTS

In this study the majority of patients were men (75%) and young (80% between 15 and 45 years old). Blunt trauma accounted for 70% of lesions, mainly including automobile accidents and falls.

**Table 1** - Sheet of evaluation of interruptions/distractions in trauma surgery.

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### Evaluation of interruption/distraction in the surgery of trauma

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Disruption unrelated to the surgical case (e.g. telephone calls)

Interruption related to surgical case (e.g. lack of material in the operating room)

Distraction not related to the case (ex: conversations about other subjects, background music)

Distraction-related case (ex: quick diversion of attention to observe the scrub nurse preparing material)

Opening doors/Personnel entering and/or leaving the operating room

Phone/Pager ringing

Alarms in the operating room inducing distraction/interruption

Noise level in the operating room > 56 dB

Long surgical procedure (eg: complex vascular repair of more than one hour, head down for more than one hour.

Fatigue (more than two hours of duration)

Interruption/distraction of team member outside of the operating field

Surgery stopped for period longer than 5 minutes (due to the interruption)

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Table 2 shows the types of operation, the value of N, percentage, mechanism of injury, average time, average number of interruptions, average events per minute and mean ISS for each type of operation.

The average total time of operation was 111 minutes ( $\pm 46.9$ ), with a maximum of 230 minutes and at least 39 minutes. The average total interruptions and distractions ranged from 5 to 192 and reached the average number of 60.8 ( $\pm 38.2$ ). The average total number of events per minute was 0.62 ( $\pm 0.41$ ) with a peak of 1.63 interruptions and distractions in a particular procedure. The major factors involved in disruptions and distractions were entering and leaving the operating room (2577 times), alarms equipment (2334 times), parallel conversation (1821 times), and phone or pager rings (1456).

The operations in critically ill patients (ISS > 45), with application of the technique of damage control, have shown high potential for interruptions and distractions of the surgical team and association with increased mortality ( $p = 0.0001$ ). Mortality was 12.5% and deaths occurred in less than 24 hours. This subpopulation of patients had a higher ISS and greater number of interruptions and distractions per minute on average. It was also observed that the incidence of interruptions and distractions per minute is increased in operative acts involving more than one anatomical cavity (thorax and abdomen), especially when applying the technique of damage control ( $p = 0.0001$ ), as shown in table 2 (1.18 events / minute).

The presence of noise in the operating room was high. In one surgical procedure we obtained a peak of 130dB, equivalent to the noise of a jet engine (130dB). The noise ranged between 40dB and 130dB. The average noise in the trauma operating room reached a level of 85 dB.

## DISCUSSION

Distraction is what attracts the eye, the mind or attention to a different object or, confusingly, it attracts the

subject to a direction other than to the implementation of the proposed task. Distraction as a human factor cannot, under any circumstances, be eliminated from the operating room environment. The human factor is the study of how people interact with their environments. In the case of surgery, it is the study of how the performance of surgeons is influenced by the effects of emotions, the environment in the operating room, interactions and communications, etc.<sup>13</sup>.

Interruptions and distractions are a major threat facing flight crews and cannot be different for the teams of trauma surgeons<sup>14-20</sup>. In the U.S., reports of the Programme of Action for Aviation Safety shows that 14% of the crew include reference to one interruption or distraction<sup>21</sup>.

Threat is a condition that affects or impedes the performance of a task or regulatory compliance. Threats are conditions created by the operating environment, which can be misleading (eg, omissions, inadvertent actions)<sup>22</sup>.

According to the Flight Safety Foundation, the omission of an action or inadequate action is the most common causal factor of accidents and incidents<sup>23</sup>.

Our study has shown that interruptions and distractions occur frequently in the trauma operating room and, in some cases, more than once per minute. Some interruptions and distractions can not be avoided, others can be minimized or eliminated.

In the method developed by the group, a researcher / observer recorded the distractions and interruptions of the sterile surgical team during a trauma surgery. The sample of 50 patients may seem modest, but it proved to be sufficient to represent the environment of the operating room during trauma surgery.

For this sample, the overall results showed a high frequency of distraction and interruption, mainly determined by the level of involvement of the sterile staff, and reflected by the high frequency of door opening recorded in the operating room.

It is important to recognize that the evaluation method used in our study obviously depends on the ability

**Table 2-** Summary of statistical analysis of the events observed by surgeries.

Type of Surgery	N (%)	Penetrating Trauma	Average time by surgery (min)	Average number of Interruptions / Distractions	Average events/min	ISS (Average)
LE	21 (42%)	4	116	58	0.42	42
LE + CD	9 (18%)	2	114	66	0.92	48
LE + CD + T	6 (12%)	3	89	46	1.18	51
LE + RV	6 (12%)	2	103	84	0.4	49
LE + RV + T	1 (5%)	0	189	38	0.83	36
LE + T	4 (8%)	3	104	59	0.56	51
T	2 (4%)	1	123	70	0.39	47
T + RV	1 (5%)	0	89	23	0.53	17

LE: Exploratory Laparotomy, CD: Damage Control, RV: Vascular Repair, T: Thoracotomy.

of the observer to interpret the events of distraction or interruption and this can vary from person to person, resulting in a potential bias. Observers may be biased in identifying some distractions rather than others, ; to control this behavior, however, is extremely difficult, even after the exhaustion of the training method. It would take further research to test the influence of an observer on the sample studied.

During evaluation of the results we observed that despite some provocative events of distraction are very frequent, such as side conversations and cell phone ringtones, they did not exercise much influence (causing interruptions) on the surgical team in the operative field. However, equipment failure or a lack of necessary materials, although less common, ended up generating a high incidence of interruptions, sometimes up to thirty minutes.

The noise exceeded acceptable limits in most cases. For satisfactory speech intelligibility, there must be a sound frequency of 10 dB difference between the ambient noise and noise from the voice (ISO 9921). The pronounced voice effort reaches 66dB under normal conditions <sup>24</sup>. In this line, it has been determined that the acceptable noise level in the operating room should be 56dB. The average total noise in the trauma room was well beyond, reaching 85dB. Our results were consistent with other studies showing high levels of noise in the operating room <sup>14-16</sup>. High levels of noise in the background have been described as negative factors in determining communication and cognition of the surgical team, and this study showed an association with increased mortality in trauma complex operations <sup>16,17</sup>.

Interruptions and distractions in the cockpit of the plane can be subtle or momentary, but all can be harmful to the crew. Interruptions or distractions usually result from three main causes, which could be applied directly to the trauma surgery <sup>3,25-29</sup>: communications (eg anesthesiologist informing or inquiring about the status of the patient, resident receiving the instructions in the next surgical step or a nurse entering or leaving the room frequently), Head-down activity (eg long period of time with the head down in a difficult vascular anastomosis), responding to an abnormal condition or an unexpected situation (eg, malfunctioning surgical devices, uncontrolled bleeding).

Other contributing factors that are often cited when discussing the topic interruption and distraction: ergonomics, noise levels, proficiency in the local language, fatigue and inadequate infrastructure. The failure of an equipment, for example, demonstrating poor organization of the infrastructure, may turn a routine procedure into a challenging event <sup>28,29</sup>.

The following aspects should be considered to develop prevention strategies and lines of defense to mitigate the effects of interruptions and distractions in the trauma operating room: recognize potential sources of interruptions and distractions; understand their effects on the surgical plan; reduce the interruptions and distractions;

and develop prevention strategies and lines of defense to minimize their risk of interruptions and distractions.

The main effect of interruptions or distractions is to break the continuous flow of surgical activities (example: stop actions or communications), which include standard operating procedures (surgical technique), communication (listening, processing, responding) and problem-solving activities (example: bleeding control, contamination control, proper adjustment of coagulation).

The diverted attention resulting from the interruption / distraction usually leaves the crew with the feeling that something is being done incorrectly or that tasks are being performed incompletely <sup>8,27-28</sup>.

When confronted with demands of concurrent tasks, natural human limitations result in the execution of one task over another, which can potentially lead to error.

Unless mitigated by proper techniques, disturbances and lack of attention in the context of trauma surgery can result in: lack of focus on the most important issues (eg, repair of the bowel prior to control bleeding or to repair the diaphragm in an unstable patient who needs urgent care), lack of information or misinterpretation of the surgeon or anesthesiologist (possibly resulting in a delay in the decision to apply damage control); omission of a corrective action of, or even missing, an abnormal condition; experiencing an overload of tasks.

In the field of aviation, numerous reports have been generated as a result of interruptions and distractions, including some that could compromise flight safety. (Examples: wrong configuration of the aircraft for takeoff, late retraction of the landing gear, premature flaps retraction, failure to start the anti-ice engine when necessary, failure in reprogramming the altimeter, failure to apply the parking brake on arrival at the gate) <sup>7,27,29</sup>.

Because some interruptions and distractions can be subtle and / or insidious, the first priority is to recognize and identify the disturbance. The second priority is to restore the situational awareness, as follows:

Identify: What was I doing?

Remember: Where I was interrupted?

Decide: What decisions or actions should I take to return to the primary task?

In the event of interruption of the primary task, the following decisions must be taken: prioritize actions to save the life of the patient, plan the actions (some actions may be postponed until the patient's condition becomes stable); check the postponed action (ensure that the action was later duly fulfilled).

The concept of "Sterile Cockpit" reflects the requirement of the Aviation Safety Agency of the United States (U.S. FAR - Part 121, 542): "No command pilot, and no flight crew member may allow any other activity during a critical phase of the flight, which may confuse any flight crew member from the performance of his/her duties or to interfere in any way in the performance of their duties."

For the purposes of this requirement, the word "activity" includes: "... engaging in nonessential conversations within the cockpit and nonessential communications between the cockpit and cabin crews ...". The term "critical phases of flight" includes: "... all ground operations involving taxi, takeoff and landing and all flight operations below 10,000 feet, except cruise flight."

The "sterile cockpit rule" can be applied in critical moments of trauma surgery, such as damage control or when the patient is unstable. Data based on evidence from the field of aviation show that adherence to the "sterile cockpit rule" can greatly reduce interruptions and distractions<sup>27</sup>. The "sterile cockpit rule" should be applied with common sense, so as not to break the line of communication between the surgical team, anesthesiologists, nurses and scrub nurse.

It is recognized in aviation that distraction and inefficient management of concurrent tasks may compromise security. The work interrupted in the cockpit may lead pilots to quickly forget the planned activities and lead to error or deviation in the standard protocols<sup>28,29</sup>.

Rules and conditions for safe functioning of the trauma operating room exist, but are mainly geared toward the concept of sterility, nursing protocols, as scores of instruments, bandages and surgical anesthesia protocols. There are no explicit rules to control interference during an operation.

The institution of courses similar to the Crew Resource Management (CRM) from aviation and applied to medicine changed behavior with respect to patients' safety with the acceptance of perioperative checklists and an increase in self-assessment, including the identification of more unsafe conditions. However, it is difficult to isolate the effect of the CRM program on the overall performance

and patient safety<sup>28,29</sup>. Human factors (errors) are still identified as a common problem that brings its own characteristics and consequences, including increased morbidity and mortality<sup>3,6,11,30</sup>.

Numerous scientific papers demonstrating the application of CRM training is available in the medical literature, although CRM training is focused on leadership, personnel management and management error. Human factors (distractions), specifically, are usually presented with an overview, sometimes underestimating their influence in the event of errors<sup>8,19,31</sup>.

The need to direct our attention to distractions and interruptions that occur in the trauma operating room of is imminent. What in the past proved to be a harmless behavior is now demonstrating that has negative effects on the prognosis and patient safety. However, little attention and few studies are devoted to the subject. It became important to know that there are errors, but more important than knowing how to avoid them is to be prepared, to manage and to recover from the error.

Human factors should be considered in the medical field as they are in aviation. Stress, fatigue, distractions, interruptions, personal problems, interpretation, communication, misjudgment and inattention to detail are some powerful examples of influence to error<sup>32</sup>.

Finally, one can conclude that the interruptions and distractions are a reality and should be studied by the trauma surgeon; prevention strategies and lines of defense must be designed to minimize interruptions and distractions and reduce its effect; recovery techniques, such as identifying, asking, deciding, acting, prioritizing, planning and checking, should be considered when managing interruptions and / or distractions.

## R E S U M O

**Objetivo:** Compreender o fator humano como ameaça à segurança do paciente vítima de trauma no centro cirúrgico, traduzindo para a sala de operação algumas regras importantes já aplicadas no campo da aviação. **Métodos:** A amostra incluiu 50 casos de cirurgia de trauma coletados prospectivamente por observadores em plantões de 12 horas, durante seis meses, em um centro de trauma nível I nos Estados Unidos da América. Informações quanto ao tipo de trauma, escore de gravidade e mortalidade foram coletadas, assim como, determinantes de distrações/interrupções e o volume de ruídos na sala de cirurgia durante o ato cirúrgico.

**Resultados:** Ocorreram, em média, 60 interrupções ou distrações durante o ato cirúrgico, na maioria das vezes desencadeado pelo movimento de pessoas na sala. Em pacientes mais graves (ISS > 45), submetidos ao controle de danos, a incidência de distrações foi ainda maior. A média de ruídos na sala de cirurgia do trauma foi muito elevada, com barulho próximo ao de um secador de cabelos.

**Conclusão:** Interrupções e distrações são frequentes e devem ser estudadas pelo cirurgião do trauma a fim de desenvolver estratégias de prevenção e linhas de defesa para minimizá-las e reduzir seus efeitos.

**Descritores:** Erros médicos. Medidas de segurança. Pacientes. Centro cirúrgico hospitalar.

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#### Address correspondence to:

Dr. Bruno Tavares Pereira Monteiro

E-mail: [bpereira@med.miami.edu](mailto:bpereira@med.miami.edu)