Job Hazards Analysis Among A Group Of Surgeons At Zagazig University Hospitals: A Risk Management Approach

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ABSTRACT

Background: Innovative trail used qualitative job hazard analysis model as a part of hospital wide safety program.

Methods: A cross section study was don upon a random sample of surgeons working at Zagazig University teaching hospitals evaluated to their job hazards using quantitative hazard assessment questionnaire and calculating job steps total hazards score by standardized risk assessment score followed by expert panel discussion and proposal to reduce hazards score by correction action plan. Total hazards score percentage of change was used to evaluate of corrective action plan.

Results: Total hazards mean score was high concerning; needle sticks and stab injuries 38.63±27.6, inhalation of anesthetic gases 38.6±21.19, exposure to scattered radiation 38.63± and highest score was for biological contamination 52.61±9.61. All these score should be decreased by applying corrective plan with expected change of previous hazards total score by; 82%, 90%, 90% and 75% respectively.

Conclusion: Job hazards analysis model was effective in assessment, evaluation and management of occupational hazards concerning surgeons and should considered as part of hospital wide quality and safety program.

Key Words: Job Hazard Analysis, Risk Management, Occupational Health Safety.

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INTRODUCTION:
Health care facilities present workers with a myriad of potential health and safety hazards. Compared with the total civilian workforce, hospital workers have a greater percentage of workers' compensation claims for sprains and strains, infectious and parasitic diseases, dermatitis, hepatitis, mental disorders, eye diseases, influenza, and toxic hepatitis(1).

Until recently, safety and health policies in hospitals were developed mainly for patients not worker, except for infectious diseases and sharp injuries which recognized by hospital administrators' as potential occupational risks (2).

Early attempts to protect patients against hospital infections also was by Florence Nightingale who introduced basic sanitation measures such as open-window ventilation and fewer patients per bed; and the Austrian surgeon, Semmelweis, initiated routine hand-washing more than a century ago. New hazards began to appear in the 1900's when physicians experimenting with X-rays were exposed to radiation, and operating-room personnel faced possible explosions during surgery involving anesthetic gases. These hazards finally called attention to the many dangers facing hospital workers, and hospitals began to monitor their workers for tuberculosis and other infectious diseases (3).

In 1958, the American Medical Association (AMA) and the American Hospital Association (AHA) issued a joint statement in support of worker health programs in hospitals., they stated that “hospitals should serve as examples to the public at large with respect to health education, preventive medicine, and job safety(5).

NIOSH Subsequently developed criteria for effective hospital occupational health programs. Now occupational health program is a major component of hospital environment risk management and safety program including general safety concerns to all patients and workers and special concerns as injuries and sentinel events (5) . Hospitals quality and safety program define occupational hazard as: a risk or danger as a consequence of the nature or working conditions of a particular job. Surgeons are exposed to a number of occupational hazards in their professional work (6). These hazard include sharp injuries, blood born pathogens, latex allergy, laser plumes, hazardous chemicals, anesthetic gases, equipment hazards, static postures, and job related stressors(7-9).

Work-site hazard analysis is a systematic approach to identify, evaluate, and control hazards on a job site. This prospective hazard analysis should be the centerpiece of any risk management occupational safety program. It identify basic job steps and their associated hazards then evaluate and develop safer operating procedures (10).

The objectives of this study are to:

develop a system that support hazards recognition, and analysis which considered as proactive safety occupational risk management program at zagazig university hospital through the following objectives:
1-identify occupational hazards for surgeons.
2-assess and evaluate occupational hazards that jeopardize surgeons' safety.
3- prioritise hazards weights by prioritization matrices.
4-propose health and safety measures that shall reduce risk weight through proactive hospital wide safety management program.

SUBJECT AND METHODS:

The study population consisted of accessible sample of surgeons working in Zagazig university hospitals, inpatient section, zagazig city, Sharkia Governorate, Egypt.

- Cross section study was conducted through 3 months period with voluntary response

-study population were 75 different specialty surgeons present on duty during 3 month study period from which 30 responded, giving a response rate of 42.85 %.

The data was obtained using a self-administrated questionnaire that included questions on personal data, occupational hazards exposure frequency, likelihood of occurrence and severity of exposure consequences as evaluated by surgeons.

<table>
<thead>
<tr>
<th>Point value parameter</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>Once/year</td>
<td>Once/month</td>
<td>Once/week</td>
<td>Once/shift</td>
<td>Once/shift</td>
</tr>
<tr>
<td>Severity</td>
<td>First aid only</td>
<td>Medical treatment</td>
<td>Lost time</td>
<td>Partial disability</td>
<td>Death or permanent disability</td>
</tr>
<tr>
<td>Likelihood</td>
<td>Very unlikely</td>
<td>unlikely</td>
<td>possible</td>
<td>probable</td>
<td>multiple</td>
</tr>
</tbody>
</table>

As a basic approach for more effective assessment of potential safety threats, we used Standardize risk assessment matrix to calculate risk score and prioritize high risk areas for future hospital safety program intervention (4).

Total Risk score calculated = Frequency x severity x likelihood.

Risk score was calculated through following steps:
Identify hazards that cause injury, assess and evaluate their seriousness with prioritization, decide what action is needed., assign persons responsible for the action, Suggest the solution and re-evaluation method over time( 10).

Suggested prevented action formulated through group discussion of hospital safety team formed by 7 experts.
Research team, hospital administrator, senior anesthetist, senior surgeons, senior safety occupational consultant. Evaluation of proposed risk calculated through total hazards score mean value according to surgeons’ point of view, then expert team weighted the risk mean score after remodeling in hazards frequency, likelihood and consequence score. These changes were due to preventive and protective measures added by expert. Study depended on risk calculation matrix in evaluating occupational hazards, and then it used the same risk matrix in developing safety measures and evaluating its future feasibility and effect. This study will give possible design of quantitative risk assessment and evaluating operational process, and will help hospital quality and risk management staff in assurance staff and patient safety.

**Statistical analysis** using spss11, mean score calculated to 30 surgeons each alone for frequency, likelihood and consequence and the total hazards scores was calculated by multiplying all and the mean was then extracting. Also the same was done for expert team. To keep statistical integrity no further significant test made on total mean score due to high standard deviation that may refer to abnormal data distribution or magnification of total score due to tri multiplying in risk calculation equation.

**Ethical consideration:** Before administration of questionnaire, orientation about study’s objectives was carried out. Confidentiality was maintained through the study.

**RESULT:**
29 male and one female surgeon respond to the study, 34% from general surgery, 34% orthopedic surgery, 13% opthalmic surgery, 13% ENT surgery and 3% from both urology and obstetric surgery departments. Fig (1) Their qualification were; 77.5% specialist, 15.5% consultant and 6.6% residents

**Figure (1): Distribution of the study population**

Exposure to stab injuries recorded high hazard score 38.63 with 27.68 SD proposed preventive measures as staff’s safety education session, double
gloving and vaccination against hepatitis B and post examination and follow up should lower hazard score up to 6.83 with 3.06 SD. same preventive measures plus PPE, should be applied to cut wounds hazard and it should decrease hazard score from 29.26 with 21.43 SD to 18.33 with 5.39 SD. Exposure to burn and scald and electrical shock from used medical devices preliminary was 16.2 with 5.39 SD and should reduces after safety education and insulators use to 4.66 with 2.44 SD for burn and 7.33 with 6.18 and should reduced to 2.33 with 2.87SD regarding electrical shock

Using co2 laser in surgery had total hazard score of 6.93 with 5.69SD should reduced up to 1.5 with 0.547SD after safety education and PPE use. Hazard score of radiation exposure for operative ionizing radiation exposure was 38.63 with 14 SD and should reduced to 3.66 with 2.10 after application of safety education, PPE, film badge monitoring, occupational examination, and segregation measurements. Exposure to operative laser total score was 7.44 with 6.18 SD should change to 0.83 with 0.75 SD.

Table (1) Physical Risks Reduction by the proposed measures

<table>
<thead>
<tr>
<th>Physical hazards</th>
<th>Frequency exposure Mean +SD</th>
<th>Likelihood Mean +SD</th>
<th>Consequences* Mean +SD</th>
<th>Mean Total score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stab wound&amp; Needle sticks</td>
<td>A  3.06 ± 1.16</td>
<td>2.86 ±1.35</td>
<td>4.23±0.23</td>
<td>38.63±27.6</td>
</tr>
<tr>
<td></td>
<td>B  1.33±0.51</td>
<td>2.33±0.816</td>
<td>2.33±0.81</td>
<td>6.83±3.06</td>
</tr>
<tr>
<td>Cut wounds</td>
<td>A  2.80 ± 1.27</td>
<td>2.2 ±1.32</td>
<td>4.67±0.45</td>
<td>29.26±21.4</td>
</tr>
<tr>
<td></td>
<td>B  1.33±0.51</td>
<td>2.33±0.816</td>
<td>2.66±0.81</td>
<td>18.33±5.39</td>
</tr>
<tr>
<td>Burn or scald</td>
<td>A  2.13 ±1.14</td>
<td>1.73±1.50</td>
<td>3.17±0.15</td>
<td>15.2±13.10</td>
</tr>
<tr>
<td></td>
<td>B  1.33±0.516</td>
<td>2.16 ±0.752</td>
<td>1.66±0.51</td>
<td>4.66±2.422</td>
</tr>
<tr>
<td>Electrical shock</td>
<td>A  2.13 ±1.33</td>
<td>1.80 ±1.40</td>
<td>2.34±1.01</td>
<td>7.33±6.81</td>
</tr>
<tr>
<td></td>
<td>B  1.16±0.40</td>
<td>1.00 ±0.63</td>
<td>1.66±0.51</td>
<td>2.33±2.875</td>
</tr>
<tr>
<td>Surgeons using a CO2 laser</td>
<td>A  1.66 ±0.97</td>
<td>2.33 ±1.25</td>
<td>1.98±0.67</td>
<td>6.93±5.69</td>
</tr>
<tr>
<td></td>
<td>B  1.16±0.408</td>
<td>1.16±0.408</td>
<td>1.166±0.40</td>
<td>1.50±0.547</td>
</tr>
<tr>
<td>Exposure to scattered radiation</td>
<td>A  2.66 ±1.71</td>
<td>2.66 ±1.43</td>
<td>3.12±0.56</td>
<td>38.63±14.0</td>
</tr>
<tr>
<td></td>
<td>B  0.83±0.752</td>
<td>2.33+0.816</td>
<td>1.66±0.51</td>
<td>03.66±2.10</td>
</tr>
<tr>
<td>Exposure to ionizing and non-ionizing radiation</td>
<td>A  1.66 ±0.81</td>
<td>2.00 ±1.30</td>
<td>2.19±0.19</td>
<td>7.44±6.18</td>
</tr>
<tr>
<td></td>
<td>B  0.83±0.752</td>
<td>1.166±0.408</td>
<td>0.83±0.40</td>
<td>0.83±0.757</td>
</tr>
</tbody>
</table>

*group A: estimated job risk.  *group B: estimated job risk with proposed correction.
Table (2)
Anesthetic gas inhalation hazards recorded high score 38.63+21.19SD will reduced up to 3.66+0.29SD through education closed circuit anesthetic apparatus and PPE, disinfectant inhalation had 10.98 +8.92 SD total score will reduced to 0.83+0.75 SD with use safer disinfectant and PPE , also disinfectant irritation to both eye, nose and throat scored10.91+9.9.4 SD and

Table (2) Physical Risks Reduction by the proposed measures

<table>
<thead>
<tr>
<th>Chemical biologic hazards</th>
<th>Frequency exposure Mean +SD</th>
<th>Likelihood Mean +SD</th>
<th>Consequences* Mean +SD</th>
<th>Mean Total score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inhalation anesthetic gases</td>
<td>A 2.93 ±1.57</td>
<td>3.46 ±1.45</td>
<td>2.34+1.10</td>
<td>38.63+21.19</td>
</tr>
<tr>
<td></td>
<td>B 1.66±0.516</td>
<td>2.33+0.86</td>
<td>0.83+0.752</td>
<td>3.66±0.294</td>
</tr>
<tr>
<td>Ethylene oxides</td>
<td>A 2.33 ± 0.89</td>
<td>2.73 ± 1.70</td>
<td>1.54±0.51</td>
<td>10.98 ±8.92</td>
</tr>
<tr>
<td></td>
<td>B 1.66+0.516</td>
<td>0.833+0.40</td>
<td>0.666+0.516</td>
<td>0.83±0.75</td>
</tr>
<tr>
<td>Skin defecting, irritation</td>
<td>A 2.13 ± 1.25</td>
<td>2.20 ± 1.37</td>
<td>2.87 ±0.07</td>
<td>15.88±15.2</td>
</tr>
<tr>
<td></td>
<td>B 1.166+0.40</td>
<td>1.0+0.6325</td>
<td>0.83+0.752</td>
<td>1.116±0.98</td>
</tr>
<tr>
<td>Irritation of the eyes</td>
<td>A 2.33 ± 1.29</td>
<td>2.33+1.28</td>
<td>1.67+0.73</td>
<td>10.91±9.9.</td>
</tr>
<tr>
<td></td>
<td>B 0.83+0.752</td>
<td>0.66+0.51</td>
<td>0.83+0.752</td>
<td>0.83±0.752</td>
</tr>
<tr>
<td>Latex allergy</td>
<td>A 2.13 + 1.12</td>
<td>1.86+1.35</td>
<td>1.87+0.12</td>
<td>9.10+9.92</td>
</tr>
<tr>
<td></td>
<td>B 1.0+0.635</td>
<td>1.0+0.635</td>
<td>0.66+0.516</td>
<td>0.33+0.16</td>
</tr>
<tr>
<td>Biological hazards</td>
<td>A 2.0+1.55</td>
<td>3.0+1.67</td>
<td>4.67+0.05</td>
<td>52.61+39.64</td>
</tr>
<tr>
<td></td>
<td>B 2.166+0.752</td>
<td>2.33+ 0.81</td>
<td>2.33+ 0.816</td>
<td>13.166+6.62</td>
</tr>
</tbody>
</table>
Figure 2 percent reduction in physical hazards

Figure 3 percent reduction in chemical hazards
DISCUSSION:
Health care industry carries high occupational incident rate among other industries; 7.4/100 employer. Which challenging health care organizations toward hazards control and initiation of pro-active risk management programs (11-12). Job hazard analysis approaches considered as a central piece of any occupational risk management program. It identify basic job steps ,their associated hazards and risk then develop safer operated procedures which will decrease hazard score and support further hazards recognition ,allowing risk management process to move mere compliance to proactive risk management approach(10) .We apply job hazard analysis approach for working surgeons at zagazig university teaching hospital, we drew and analyzed job steps flow chart and made proactive estimation of hazards at every task step.
Surgeons themselves evaluate hazards occurrence likelihood, frequency of exposure and hazards consequence on score form 1-5. Proactive job hazards management approach was recommended by expert team.
Considering needle stick , stab injuries ,cut wounds and exposure to body fluids mean of severity of consequences of these health hazards were (4.23),(4.76) and (4.67)respectively with exposure frequency mean ranged from 2-3. table 1 These result among the studied surgeons is confirmed by NIOSH which found previous injuries as most frequent among surgeons than other workers (1) proposed corrective action should reduce total risk score for needle stick injuries ,cut wound and ,exposure to blood up to 82.3%,37% and 74.9%respectively and this measure includes safety education ,use of PPE as double gloving and googols with vaccination and post exposure follow up by treatment figure (2) ,which find matched with study in THIA tertiary care hospital with improvement change in needle and cut injuries occurrence rate up to 24%after educational intervention program(13)

Surgeons in operating room exposed to burns and scald from hot water ,hot equipments and steam, also they exposed to electrical shock from faulty grounded equipments(8)in our study exposure frequency were 2.13 for both and severity of consequence ranged from 2.34 to 3.17 with total hazard score 13 for burn and 7.33 for electric shock.

These hazard total score should reduced by proposed corrective action by focusing on safety education and proper maintenance by 64.3% for burn and 94% for electric shock .this prospective hazard analysis methodology was recommended by Cambridge engineering design center to identify high risk area and manage risk prospectively (13).

Surgeons exposed to scattered radiation while carrying out intra operative x-ray ,fluoroscope and exposed to ionizing and non-ionizing radiation from laser based instruments(8) ,exposure frequency as
reported by surgeons was 2.66. thus radiation safety education program should included in hospital wide safety program (14) also ,PPE, film badge assessment and occupational investigation program which if implemented will make change in total risk percent up to 90%. Conducting same action will reduce ionizing and non ionizing radiation hazard score by 88.8%.

Occupational exposure to anesthetic gases had wide range of health effects, including neurological, renal and hepatic disease also reduction in mental performance and mental dexterity (15). National institute of occupational safety suggest that operative theater team are at risk of anesthesia exposure even when operative theater provided with scavenging equipments, which matched with our study findings as exposure frequency was 2.93 ±1.5 giving high hazard score. This high score will reduced by 90% after installing efficient ventilation system and scavenging equipments with proper maintenance.

Latex gloves cause skin allergy to some surgeons and this can avoided easily by changing natural latex gloves to non allergic synthetic ones but this may be add cost to hospital budget(1).

Biological hazard total score is very high reaching 52, a lot of blood and body fluids splashes occurs in operative theater, gloves turns off exposing bare hands to bloods, even just operative room air carries high risk of inhalation of organisms if case are septic (19) but if regular inspection for leak, good anesthetic technique and should be supported by staff safety training (16).

Ethylene oxides used in sterilization carry risk of male infertility. Hazard mean score was 10.98 ±8.92SD will be decreased by 92% after safety education, using guidelines which limit hazard likelihood also limitation of use, substitution by alternative to decrease exposure frequency, well ventilated theater and using PPE (17) also surgeons exposed to high risk of contact with iodine, iso propyle alchol, tricreso and phosphate causing skin irritation and defecting. Formaldehyde exposure also associated with nasopharyngeal tumors. Chemical disinfectants associated hazard score was 15.88±15.2SD decrease by 93% by same preventive measures as above (18) these measures will be used also to decrease chemical irritation to eye nose and throat which annoyed surgeons at operates theater by disinfectant and will decrease hazards mean score by 92%.

surgeons probably educated about hazards and how to limit exposure to it by using good PPE as eye goggles, thick gowns and even double gloving with emphasis on gloves change if operation extended beyond 3 hours or when gloves seems to be contaminated all with good ventilation of operative theaters and frequent removal of contaminated body fluids from operative area by using strong non irritant disinfectant (8). this high score may be decreased to 13.166±6.62 SD.
Surgeons experienced low back pain higher than other hospital workers they involve in bending, awkward static posture during operation plus exposure psychological stress for long time(21) total hazard score for back pain will be changed by 88.5%. After proposed safety training sessions, ergonomic design for operative rooms and decrease work shift times.

Mental stress hazards prevalence is high among surgeons (17) total score for mental stress is not so high 15.21±11.75 but it affect clinical outcome and surgeons health,. Simply by developing psychological support program for surgeons and periodic psychological screening (22) this score will be reduced by 89%.

Surgeons hazards related to fall and trips in operative room has low exposure frequency 1±0.6, if operative theater kept clean and dry (18) total score will decrease by 78.64%. Surgeons also facing stress in their family relation due to impact of loaded shifts and job stressors (10) hazard exposure frequency were 1.833±1.169 and if employee social support program provide family support plus work shift adjustment total hazard score will decrease by 79%.

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