Dedication

To the spirit of my father,
As well as my mother, wife,
brothers, sisters and My SON.

I dedicate this Research

Acknowledgments

Thanks and gratitudes to those who cooperated to complete this study,
and in particular, the main supervisor Professor; Dr. Alnazer Osman
Mohammed Hamzah, for his follow up, encouragements, advice and
guidance
I would like to extend my thanks to engineers in Khartoum Hospitals, for their helps and support. I also do not forget to thank the staff of the selected Khartoum Hospitals, who facilitated the data acquisition.

Thanks also are extended to my colleagues; especially Rashad Abdullah, Isam Othman, and Abdullah Hassan for their cooperation in the statistical study and language review, also thanks, love, and gratitude to my lovely wife for her support and patience with me. Finally I thank my dear friends for their encouragements.

Abstract

The Importance of this study is presented in discussing the availability of electrical safety requirements at the healthcare facilities according to the directions and recommended standards by organizations and associations in field of electrical safety such as NFPA, IEC, NEC, and AMMI, because the not available of electrical safety...
requirements and absence of awareness, and knowledge about the electrical safety lead to electrical hazards (burns, electrical shock, misdiagnosis, inadequate therapy) which effect on patient, medical equipment, and medical staff.

The main purpose of study is evaluation of electrical safety implementation in medical departments (ICU, operating room, medical imaging, and hemodialysis) in Khartoum Hospitals, and investigates if the level of safety is different between departments according to the priority. The number of surveyed departments is 41 in 15 Hospitals (state, military, and non-state).

The data was collected by many methods which include direct visits to Hospitals, visual inspection for electrical installations by using electrical safety checklist, as well as making interviews with engineers and technicians.

SPSS program is used to analyze the results. The results indicated that the level of electrical safety in Khartoum Hospitals was middle in terms of power system and power distribution, grounding system, and application of electrical safety program. The level of electrical safety was low and may be absent in terms of using testing and protective devices, and the safety level was high in terms of electrical cords and extension cords. Also, the results revealed that the level of electrical safety doesn't differ between the medical departments in Khartoum Hospitals according to the priority.
المستخلص

تأتي أهمية هذه الدراسة كونها تناقش توفر متطلبات السلامة الكهربائية في مرافق الرعاية الصحية بناءً على التوجيهات والمعايير العالمية الموصى بها من قبل المنظمات والجمعيات في مجال السلامة الكهربائية مثل NFPA , IEC, NEC, AMMI، حيث ان عدم توفرها وغياب الوعي والمعرفة ينتج عنه أضرار ومخاطر كهربائية (حروق، صعقات كهربائية، تشخيصات خاطئة، والعلاج غير المناسب) والتي تؤثر سلبًا على كل من المرضى والطقم الطبي والعاملين في المستشفى.

الغرض من هذه الدراسة هو تقييم تطبيق السلامة الكهربائية في الأقسام الطبية (العناية المكثفة، العمليات، التصوير الطبي، وتفصيل الكلوي) بمستشفيات ولاية الخرطوم، والتحقق فيما إذا كان مستوى السلامة الكهربائية متفاوت فيما بين الأقسام الطبية بالمستشفى حسب الأولوين للقسم. وقد تم معالجة أدوات لجميع البيانات تمثلت في الزيارة الميدانية إلى المستشفيات والقيام بالفحص المرئي للتركيبات الكهربائية وجمع المعلومات عن السلامة الكهربائية باستخدام قائمة فحص من تصميم الباحث، إضافة إلى إجراء بعض المقابلات الشخصية مع المهندسين والتقنيين والموظفين. وقد تم تحليل النتائج بإستخدام البرنامج الإحصائي SPSS.

أوضح النتائج أن مستوى السلامة الكهربائية كان متوسطاً فيما يتعلق بأنظمة الطاقة الكهربائية وتوسيعها وتنسيق التأريض وتطبيق برنامج السلامة الكهربائية في الأقسام الطبية بالمستشفيات. وكان المستوى ضعيفًا ويكاد يكون معدوماً بالنسبة لاستخدام أدوات الحماية الكهربائية وادوات اجراء اختبارات السلامة. بينما كان المستوى عالي ومقبولاً فيما يتعلق بالاسلاك والوصلات الكهربائية ولكن ليس بالشكل المثالي. و أوضح النتائج أن مستوى السلامة الكهربائية لا يتفاوت بين الأقسام الطبية في مستشفيات الخرطوم حسب الأولوين ونوع الإجراءات الكهربائية في القسم الطبي.
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<td>American National Standards Institute.</td>
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<td>AWG</td>
<td>American Wire Gauge.</td>
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<td>ANOVA</td>
<td>Analysis of Variance.</td>
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<td>AAMI</td>
<td>Association for the Advancement of Medical Instrumentation.</td>
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<td>ATS</td>
<td>Automatic Transfer Switch.</td>
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<tr>
<td>CCU</td>
<td>Coronary Care Unit.</td>
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<td>CI</td>
<td>Confidence Interval.</td>
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<td>ESPIME</td>
<td>Electrical Safety Priority Index for Medical Equipment</td>
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<td>ECG</td>
<td>Electrocardiogram.</td>
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<td>EPSS</td>
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<td>FDA</td>
<td>Food and Drug Administration.</td>
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<td>GFCIs</td>
<td>Ground Fault Circuit Interrupters.</td>
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<tr>
<td>IEEE</td>
<td>Institute of Electrical and Electronics Engineering.</td>
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<td>IPEM</td>
<td>Institute of Physics and Engineers in Medicine.</td>
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<tr>
<td>IMD</td>
<td>Insulation Resistance Monitoring Device</td>
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<td>ICU</td>
<td>Intensive Care Unit.</td>
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<td>IV</td>
<td>Intravenous.</td>
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<td>JCAHO</td>
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<td>kVA</td>
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<td>mA</td>
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<td>MCBs</td>
<td>Mini Circuit Breakers.</td>
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