Bmed-H
e-ISSN: 2582-7405
Transaction on Biomedical Engineering Applications and Healthcare
Vol-3 Issue-2, October 2022

Role of Clinical Engineering in Hospitals

Dr.Rekha Kandula[1*], Dr P Hariharan[2]

[1] Dr V S Krishna Government Degree College, Visakhapatnam, India
[2] Assistant Professor, PSG College of Technology, India
*Corresponding Author Email: [1]rekhabiotech2000@gmail.com

Abstract

Clinical engineering is mainly facilitated with the advanced technological effects that can adopt safety process in hospitals. This engineering is considered as the logical process to maintain the procedure of health services. The engineers should form proper culture and regular check up of different instruments to form easy access at the time of operation. Health technology creates a positive impact on clinical engineering in hospitals for providing better treatments to patients. Modern equipment and services are used by clinical engineers for better services. Wellness programs play an indispensable role for maintaining a healthy lifestyle on a daily basis. Cancer, malaria and dengue viruses create a negative impact on the health and mental conditions of a person. Chemotherapy and radiation therapy are used to provide better treatments for cancer patients. Biomedical engineering is used as a segment of clinical engineering within hospital premises. Healthy behaviours are managed by every person with help of this clinical engineering. Chloroquine phosphate and artemisinin-based combination therapies are used for malaria viruses. These treatments can from betterment in healthcare activity to human being.

Index Terms

Clinical engineering, technology, hospitals, healthcare.

INTRODUCTION

Clinical engineering is mainly referred to as biomedical engineering that focuses on the introduction of several methods and theories related to medical activities. These aspects can deliberately improve the quality of health services. Clinical engineering is considered a logical choice that serves several medical devices for safety processes in the hospitals [1]. Clinical engineers are providing training for investigating and observing opportunities and challenges for improving healthcare delivery with the adoption of safe technological solutions. This engineering helps in awareness of education and training, details of accidents, investigation, analysis and observation that cause clear documentation and particular report findings. This engineering involves a coordinator of investigation that is specialized with device testing for taking proper technological support in any activity within a hospital. Clinical engineering is also required with the engineering works that consists of several medical equipment and doctors, technicians and patients on a daily basis. This engineering is especially directed towards the field of Healthcare Technology Management (HTM) that primarily works on the implementation of medical technology.

This engineering is a part of biomedical engineering that helps in getting better surgical robots, micro-implants, and pharmaceutical drugs that leverage major demand in hospitals to improve health conditions. Clinical engineers are chosen to serve better activity as the medical officer in a hospital and look after technical; investment of instruments for maintaining better operation [2]. Healthcare delivery systems are conducted with the help of clinical engineering that supports and gives advantage to patients with proper delivery systems. There are some instruments that are used in clinical engineering: cast saw, blood chemistry analyzers, anesthesia machine, centrifuge, Coagulation analyzer and sterilizers [3]. Moreover, several diagnostic equipments are used in the hospitals that are directed towards clinical engineering such as: stethoscopes, MRI scans, X-rays and CT scans and thermometers.

The primary objective of the clinical engineering department in the hospitals is to give “broad based engineering” that addresses healthcare technology. Supporting medical instrument objectives leads to systematic process in operation activity in hospitals. Clinical engineering department is required to measure the risks that include technological management, risk management, and technological assessment [4]. These facilities are designing processes for facilitating standard technological implementation for the patients. This activity helps in designing self-assessment tools that should perform reliable action in operating patients. This tool is the indicator of various standardization fulfillments in successive actions. In the tool, the color code mainly allows to determine success or failure, in which red color indicates failure to meet standardization. On the other hand, red color indicates the point of success to reach a minimum acceptance level.

MATERIALS AND METHODS

This article mainly depends upon the secondary data collection method which is particularly done with qualitative design. This creates a better effect on justification and drawing a conclusion. The qualitative research design allows the research to have secondary information based on clinical engineering that leads to a better approach throughout the article. The researcher should identify the major role of clinical engineering from several authentic books, journals which may help in proper consequences in this study. The secondary data are specifically gathered from authentic books, peer-reviewed journals, magazines and articles to

create proper alignment [5]. The secondary information should be collected from peer-reviewed journals which are published after 2019. The recess should not collect information from any other sources that are published before 2019.

The research approach also plays a major role in computing the entire study which makes clear about the way and category of gathering data or information. The researcher has chosen an inductive approach in this study that allows in depth investigation that forms proper alignment with certain topics. Hence, the researcher should not choose any other approach in this study. The ethical consideration is provided with maintenance of data collection in which clinical engineering is the major aspect to gather; in addition qualitative design accelerates this collection and also assists in evaluating the entire process.

RESULTS

Concept of clinical engineering

Clinical engineering is the term that is used biomedical to solve various problems regarding clinical aspects at the time of healthcare delivery. There are some first levels of clinical engineering that are based on the fundamental effects of bioengineering, fundamentals of clinical engineering, audit and technology management, medical devices, software [6]. In addition, biomedical instruments, evaluate technologies and systems and electrical medical systems can form huge differences with the technological management that lead to a high approach with application of innovative growth in hospitals with technology. Management tools in clinical engineering are helped in proper application with a high range of technological; appearances to gain an idea about the standardization.

Clinical engineers make proper risk management to detect any internal hemorrhages that need reliable appearances with the help of several testing investigations and observation. Any medical organization helps to foster the profession of clinical engineering such as: ASHE, ECRI, AAMI, HealthTech and more. These help in developing technological delivery with a standardization method that can maintain technological management within machines and internal action of the hospital during any operation. There are various technologies and management facilities in Clinical engineering that focus on safety and appropriate facilities in having a chance to get fruitful technical implementation [7]. Clinical techniques particularly cover the different aspects and quality management that help in exploring prevention of any issues related to technical issues from the instruments. In this concern, the instruments should be well prepared and developed with the proper touch of human beings.

There are some skills that include “patient care”, “preventative management”, “biomedical equipment” and “patients “. These should be required within a biomedical engineer which may form proper skill with solid works, product development, cad and project management [8]. These all can be recognized as better clinical engineers who can easily form better approaches with various healthcare support tools such as: Comedic, medical algorithm, tapa healthcare and RAMP medical.

“Biomedical engineering society (BMES)” is indicated as the section that is recognized as the perfect approval of clinical engineering to support reliable working in the hospitals. This engineering work helps patient’s care with application of a strategy which can make a better approach in future development of mechanisms in hospitals. Clinical engineering especially falls under biomedical engineering which is primarily attached with application of medical technological innovation within the “Healthcare Technology Management (HTM)”[9]. There is government regulation under the equipment of technological effects that is regulated from governmental policies for audits and it should consult with hospital staff on medical technology. A clinical engineer is supposed to do many jobs in which equipment testing is the major work that can be maintained on the basis of proper application of engineering works.

The clinical engineer testing equipment can form mobility with wheelchair and walkers that is high-tech for making speech synthesizers. The engineers mainly apply tests with the development of artificial limbs. This can be attached with the improvement of direct process in proper operation that can improve quality of life to form a huge amount of technological improvement. In this engineering, doctors mainly follow the procedure of new innovative surgery with the help of technological equipment and upgraded engineering works.

Role of clinical engineering in hospitals

Clinical engineering is the profession that deliberately makes a better approach with having proper patient care and this can make an application of healthcare technology. Clinical medicine can increasingly depend upon technologies and various complex equipments that are associated with clinical engineering which can cure any diseases [10]. Modern medicine and engineering equally depend upon healthcare with growth of technology and better processing of medicine which can cure any diseases at a less effective time bound. The clinical engineering education is based on classical engineering which helps in betterment of supplementary combinational courses in physiology, human factor and system analysis that can often maintain measurement of instruments.

Clinical engineering is commonly considered within a professional group in the hospital that performs different and valuable functions to support, service and repair with medical equipment which is directed to the well management of hospitals. The patients can get proper treatment with having proper value in the future. This engineering is the interdisciplinary field that makes better impact with the direct practices regarding medical healthcare [11]. This conducts with a variety of settings which can make a diversification effect with complex techniques. Sharing of devices, asset management is specifically supervised by the clinical engineers and these personnel play a major role as

technological managers [12]. There is huge responsibility in the way of financial budget management and in the data processing system which indicate better ability of clinical engineers which can happen with a with minute process that is relevant with the entire processing system of a hospital.

The medical equipment, coordinating services agreement and in-house operation are managed with the maintenance of internal programmers of hospitals. Hospital based clinical engineering is considering the dependence of skill set of engineers that can process the major structure of hospitals at the time of operation [13]. In this concern, all the medical equipment should be checked and should proceed with a safe and effective nature that assures reliable action. This involves the action of a proper mechanism with high resolution action that should be checked minutely at the time of operation. Any difficulties in the medical practices can fall into dangerous situations to the patients.

Hospital-based clinical development can happen with major planning processes and this happens with proper assessment of technological development. There should be proper action which has been taken for assuring technological compliances. In medical technological management, investigation of incidents and active participation is getting under the proper management and active participation of every employee [14]. In this concern, medical device design is an important aspect that can form huge implementations of the medical instruments that can make better approaches in medical processes and operations. These activities have particular scope that help in better management and particular training that can form better performance which is integrated into the system. This is the line between the medical communication and information system that can make proper continuation of technical upgradation.

Figure 1: Role of clinical engineering

Health technology (HT) plays an essential role to maintain a healthy lifestyle. HT helps to enhance dependence on health, wellness programs and rehabilitation for delivery of better services. Optimal and safe ways for better treatments are gained with help of this clinical engineering in hospitals [15]. Better responses to burden of diseases are managed by this particular engineering. A wellness program refers to an organized and coordinated framework, by which physical, emotional and mental health risks of a person are managed in a simple manner. Vocational and spiritual well being programs are promoted by this wellness framework. Several types of activities are included in this particular program such as: exercise, weight loss competitions, stress management, smoking cessation programs and wellness assessments. These activities are helpful for a person to eat better, improve their physical health, and lose weight and physical activity. A comprehensive health benefits are managed by this wellness program.

Workplace wellness must be maintained by hospital management team to provide a better environment. An unhealthy workplace creates a negative impact on employees by which a work process is maintained properly. A healthy workplace can easily decrease medical insurance and medical care costs significantly. Wellness programs play an essential role in clinical engineering to manage a healthy workplace [16]. A hospital can easily provide better treatment and services to patients by these wellness programs and a healthy workplace. Health behaviour of a hospital is enhanced with help of this particular program. Some individuals suffer from several types of unhealthy behaviours such as: alcohol consumption and smoking. Wellness programs of clinical engineering help to adopt and maintain healthy habits on a daily basis.

Development of healthcare facilities caused by clinical engineering

Clinical engineering has developed overall treatment procedures of healthcare institutions by accelerating usage of several emerging technologies like mobile technology, internet of things, robotics, and artificial intelligence. These technologies create a new hope to the mind of each patient and these individuals start to lead a better life which is fully recovered from certain diseases. Currently, biomedical engineers endeavour to learn different skills related to programming to quickly adapt the utilisation and application procedures of above-mentioned technologies [17]. Clinical engineers in the healthcare sector have basic responsibilities for assuring high-quality medical services provided to patients. Clinical engineering helps experts to ensure the safety of patient segments and maintain usage of several medical equipments.

Clinical engineers have technical expertise and basic engineering skills. Hence these facilities depend on clinical engineers during building and renovation projects. Clinical engineers must be degree engineers in healthcare facilities. For this reason, these individuals can provide better suggestions and treatment to patients. Designs and layout of special frameworks relating to medical devices are assisted by these clinical engineers [18]. Several types of electrical devices and instruments are used by clinical engineers to provide better treatments. Cancer is an effectively critical disease for each and every person. The necessary treatment process was not invented some years ago and many individuals die due to this particular disease. Hence clinical engineering helps to invent several types of modern techniques and machines to provide treatments for cancer patients. Chemotherapy and radiation therapy are used by clinical engineers to recover cancer patients in an organised way. In case growth of cells within a body increases, cancer occurs in a person's body. Growth of cancer cells increases rapidly on a daily basis. For this reason, chemotherapy plays an essential role to treat cancer. Clinical engineering helps to cure cancer without other treatments. A primary and sole treatment for cancer is chemotherapy.

Hidden cancer cells are killed with help of these chemotherapy treatments. Sometimes, cancer cells arise within a person's body after other treatments. Dengue viruses spread to people through bites of an infected Aedes species mosquito. Proper techniques related to clinical engineering were unknown before some years. In recent days, medical science enhances their performance in different sectors with help of this clinical engineering. Symptoms of dehydration process are the reason for dengue viruses. Clinical engineering helps to provide better treatments of dengue viruses. Malaria is also a life threatening disease caused by a mosquito. Clinical engineering helps to provide common ant malarial drugs such as: chloroquine phosphate and artemisinin-based combination therapies [19]. These common antimalarial drugs help to recover from malaria viruses. In recent days, clinical engineering has a great importance on mitigating any health related issue significantly.

Clinical engineering creates a positive impact on healthcare facilities within a hospital. Several types of facilities are given by a hospital such as: birth centres, ambulatory surgical centres, blood banks, clinical, medical offices, dialysis, radiology centres, urgent care, telehealth and orthopaedic centres. Clinical engineering plays an indispensable role in uplifting these facilities in different healthcare institutions. Outpatient surgical facilities are also known as ambulatory surgical centres. This facility allows patients to receive emergency surgical processes outside a hospital environment. Lower cost treatments are offered by this facility outside the hospital premises [20]. Sometimes, many individuals can not be able to take their necessary treatments from hospital due to lack of money. Ambulatory surgical centres help those individuals to receive proper treatment and services.

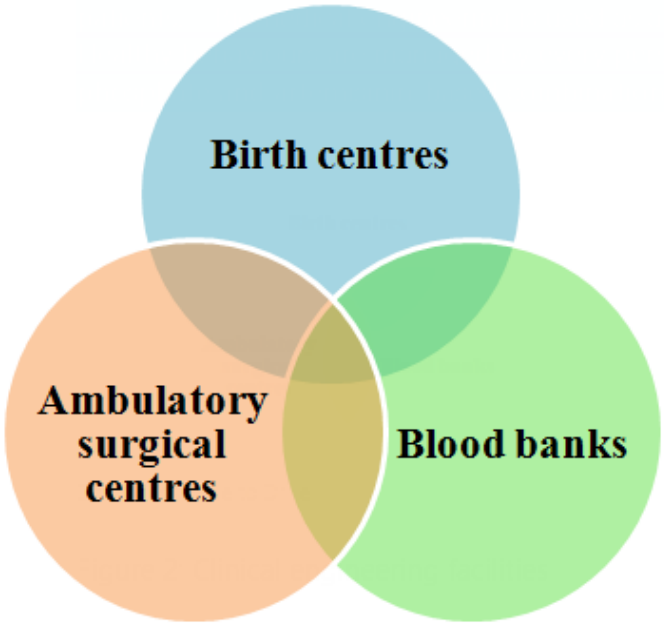

Figure 2: Clinical engineering facilities

Biomedical engineering is a part of this clinical engineering in medical science to provide better services and treatments to patients. A branch of biomedical engineering refers to operations of medical equipment within a hospital [21]. Academic institutes, research laboratories and manufacturing set ups are managed in an organised way with the help of this clinical engineering. Clinicians, surgeons and other staff who are engaged with direct patient care services within a hospital. Clinical engineering helps to maintain their work process and strategy significantly. Engineering and management skills are used by a clinical engineer to provide support and advance patient care services. Healthcare technology is helpful for clinicians and surgeons to understand proper usage of medical instruments. In case these individuals use modern machines and technologies in a simple manner, clinical engineering process plays an essential role for managing usage of those machines. Cost

control, utilisation, optimisation, regulatory requirements are maintained with help of this clinical engineering process.

A fully fledged engineering division is worked in hospital premises by role of clinical engineering. This clinical engineering helps to manage importance of engineering technology in medicine. The division of clinical engineering helps provide directions and guidance for using medical equipment significantly. In case an engineer knows proper usage of medical equipment, these individuals can provide better suggestions and treatments to patients. Clinical engineering helps to provide better diagnostics to complex diseases of patients within a hospital premises. Maintenance of electrical power, electrical substation and various medical equipments are used by clinical engineers for providing better treatments and services to patients.

DISCUSSION

Clinical engineering is the biomedical subject that leads to fostering better facilities in medical science. This engineering assists in technological improvement in hospitals which bring huge prosperous activity in operation. The first level of clinical engineering helps in healthcare delivery. In biomedical engineering, the technological management, highest application is recognized in the clinical engineering that makes a high range of technological appearances to gain an idea about standardization formation with advanced impact on the operation. Biomedical engineering and instruments, technological instruments, electrical equipment and a high range of management lead to betterment in operation facilities. Clinical engineering makes some risk management that can affect a huge variety that can detect any hemorrhage regarding internal aspects. There are standardization methods that have better chances in the technologies and management. Clinical engineering facilitates many patients with proper treatment in successful operation.

Clinical techniques particularly cover several aspects and make proper management that help to explore prevention of any problems related to mechanisms. This aspect helps in proper management and high approach in getting better performance in Operation Theater. There are various skills that should be aware of to clinical engineers which are patient care, prevention management, and biomedical equipment. These should require solid works, attention, and the knowledge of project management that create a specific strategy to form proper management. This engineering work should be vital with medical algorithms, tapa healthcare and RAMP medical. “Biomedical engineering society (BMES)” is a nether ascot in this engineering field that identifies as the major effects regarding reliable working activity which govern application of proper hospital mechanisms that regard reliable staff and engineers.

The clinical engineer testing equipment can form mobility with wheelchair and walkers that is high-tech for making speech synthesizers. This actively forms a better facility to handicapped patients to carry from one floor to another. In this engineering, many engineers are specifically using the Internet of Things to have better technological development, in which robotics mechanism is the vital thing [23]. This is mainly conducted with the application of innovative surgery processes and a high variety of engineering works. The engineering work is deliberately processed on the basis of technological equipment that forms a huge amount of advantage in operation. There are innovative upgrades that apply with testing of direct processes. The technological upgrades mainly processed with the application of major engineering works such as: ability to make new innovation, attentive nature of engineers and having a perfect facility in managing proper attachment with implementation.

The operation and treatment in the modern period are proceeding with medical innovation and development which create an advanced situation in the operation. Doctors mainly treat chemotherapy with the help of advanced medical mechanisms; radiation therapy is mainly based on certain engineering technology. This treatment is done with high resolution waves which can cure the disease permanently. Moreover, internal hemorrhage of the body can also be mitigated with the clinical efforts and ability of engineers with the assistance of technological growth.

CONCLUSION

Clinical engineering is referred to as the part of biomedical engineering that focuses on advancement of the treatment process with technological upgradation. This helps many patients at the tough time and even many patients get relief from dangerous diseases growing in the internal part of human beings. Human beings can assure advanced technological development as there are better approaches highlighted within the technological solution of engineering. The technological solution is mainly done with the help of clinical engineers that form a particular schedule of working out with various objects and mechanisms in the hospitals. Healthcare Technology Management (HTM) is a supportive activity that helps in proper management and a high variety of medical implementation.

The technological implication helps in betterment of medical science that helps in curing many diseases like cancer, malaria, tumor and any internal hemorrhage. These all are possible with the help of clinical engineering that make an impact on maintaining technological dependence with healthcare services. The technological investment makes a greater chance of having a good approach in medical facilities that help in health care delivery to gain positive development in hospitals. The environment of every hospital can specialize with various pharmaceutical drugs, high resolution mechanisms, and high yielding instruments that can perform best development in the major engineering services. The surgical robots and automation technology help in processing proper effects in the major technicians with usage of cast saw, blood chemistry analyzers, anesthesia machine, centrifuge, Coagulation analyzer and sterilizers.

Clinical engineering creates a better design with technological management, risk management, and technological assessment. This is mainly done with the ability and knowledge of engineers and this helps in successive growth in the facilities that are designed with proper activity in getting standard tools to get profit within hospitals. This article mainly highlighted the major process and application of clinical processes that make an advantage. There are some skills such as medical algorithms, preventative management, and awareness of biomedical equipment that can easily create reliable mechanisms in hospitals.

REFERENCES

[1] Albadr, Hamad. *Designing a decision support system for improving medical devices maintenance in Saudi Arabia*. Diss. Brunel University London, 2019.

[2] Iadanza, Ernesto, et al. "Evidence-based medical equipment management: a convenient implementation." *Medical & biological engineering & computing* 57 (2019): 2215-2230.

[3] Yang, Lei, et al. "Improved mechanical properties by modifying fibrin scaffold with PCL and its biocompatibility evaluation." *Journal of Biomaterials Science, Polymer Edition* 31.5 (2020): 658-678.

[4] Wahed, Manal Abdel, Khaled W. EL Kady, and Neven Saleh. "Automated Management System for Accreditation of Clinical Engineering Department in Hospitals." *Journal of Clinical Engineering* 44.1 (2019): 47-52.

[5] Healey, Mick, Kelly E. Matthews, and Alison Cook-Sather. "Writing Scholarship of Teaching and Learning Articles for Peer-Reviewed Journals." *Teaching & Learning Inquiry* 7.2 (2019): 28-50.

[6] Mishra, Priti, et al. "Life Science Engineering: Improving Human Health and Lifestyle." *Research and Innovations in Chemical Sciences: An Approach towards*: 105.

[7] Idrees, Sheikh Mohammad, et al. "Exploring the Blockchain Technology: Issues, Applications and Research Potential." *International Journal of Online & Biomedical Engineering* 17.7 (2021).

[8] Crosby, Jordan. "Development of a SolidWorks Simulation Toolkit for a Sophomore Level Biomedical Engineering Course." (2021).

[9] MOHAMED, HIBA FATHALRHMAN, MOHAMED OSAMA TAGELSER, and MOHAMED ALSIDDIG MOHAMED. *DEVELOP THE HEALTH REPORT SYSTEM FROM A PAPER SYSTEM TO A COMPUTER PROGRAM*. Diss. 2022.

[10] Dzobo, Kevin, et al. "Integrating artificial and human intelligence: a partnership for responsible innovation in biomedical engineering and medicine." *Omics: a journal of integrative biology* 24.5 (2020): 247-263.

[11] Aljamali, Nagham Mahmood, and Widad Hashim Yahya Almuhana. "Review on biomedical engineering and engineering technology in bio-medical devices." *Journal of Advances in Electrical Devices* 6.2 (2021): 18-24.

[12] Kumar, YV Pavan. "Overview on role of asset management systems for smart microgrids." *International Journal of Scientific & Technology Research* 8.11 (2019): 2082-2092.

[13] Bicudo, Edison, Alex Faulkner, and Phoebe Li. "Digital readiness in 3D bioprinting: software, governance and hospitals' proto-clinical interfaces." *Regenerative Medicine* 16.03 (2021): 237-252.

[14] Sheppard, Alexa, and Mary C. Broughton. "Promoting wellbeing and health through active participation in music and dance: a systematic review." *International journal of qualitative studies on health and well-being* 15.1 (2020): 1732526.

[15] Dzobo, Kevin, et al. "Integrating artificial and human intelligence: a partnership for responsible innovation in biomedical engineering and medicine." *Omics: a journal of integrative biology* 24.5 (2020): 247-263.

[16] Liu, Tianming, Eliot Siegel, and Dinggang Shen. "Deep learning and medical image analysis for COVID-19 diagnosis and prediction." *Annual Review of Biomedical Engineering* 24 (2022): 179-201.

[17] Yarali, Ebrahim, et al. "Magneto-/electro-responsive polymers toward manufacturing, characterization, and biomedical/soft robotic applications." *Applied Materials Today* 26 (2022): 101306.

[18] Antonini, Marc-Joseph, et al. "A crisis-responsive framework for medical device development applied to the COVID-19 pandemic." *Frontiers in digital health* 3 (2021): 617106.

[19] Arya, Aditi, et al. "Artemisinin-based combination therapy (ACT) and drug resistance molecular markers: a systematic review of clinical studies from two malaria endemic regions–India and sub-Saharan Africa." *International Journal for Parasitology: Drugs and Drug Resistance* 15 (2021): 43-56.

[20] McMullen, Kathleen M., Barbara A. Smith, and Terri Rebmann. "Impact of SARS-CoV-2 on hospital acquired infection rates in the United States: predictions and early results." *American journal of infection control* 48.11 (2020): 1409-1411.

[21] Yang, Hongxu, et al. "Efficient medical instrument detection in 3D volumetric ultrasound data." *IEEE Transactions on Biomedical Engineering* 68.3 (2020): 1034-1043.

[22] Dzobo, Kevin, et al. "Integrating artificial and human intelligence: a partnership for responsible innovation in biomedical engineering and medicine." *Omics: a journal of integrative biology* 24.5 (2020): 247-263.

[23] Bhat, Sameer Ahmad, et al. "A Novel Framework for Modelling Wheelchairs under the Realm of Internet-of-Things." *International Journal of Advanced Computer Science and Applications (IJACSA)* 12.2 (2021).