

Clinical Engineering: It's Necessity, Present Status & Future Trends In Bangladesh-A Case Study

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ABSTRACT: This paper deals with the necessity of clinical engineering, its present status and future trends in developing countries such as Bangladesh. In 1992's the ACCE is defined that "Clinical Engineer is a professional who supports and advances patient care by applying engineering and managerial skills to healthcare technology". Moreover, we examine that clinical engineering is directly involved in health care management to ensure technical part of health care technology management as well as this professional relates with other health care technology management personnel for inservice education and training. Equipment operators , Intensivist, medical technologists, clinical engineering technologists, biomedical equipment technicians and so forth of this country could not reach in standard level about the safe use and primary level maintenance of medical devices. Clinical engineering practice is unknown to developing countries such as Bangladesh. As the result, more than 65% medical equipment in the public hospitals of Bangladesh could not be kept in safe functional condition. In this study, we make a comparison among clinical engineers and conventionally trained electrical / mechanical engineers for the life cycle management of medical devices as well as current practice of clinical engineers in our country. Finally, we describe the future trends of clinical engineers for the life cycle management of medical equipment in the health care services of Bangladesh. This research explores the necessity of clinical engineers in the hospitals of Bangladesh to keep the medical equipment in safe functional condition. Accordingly, a clear cut picture of necessity of clinical engineering professional will be detected. Present performance of conventionally trained engineers and clinical engineers will be differentiated. Finally future trends of this professional will describe in this paper.. This research will help to improve present unpleasant condition of life cycle management of medical equipment in the health care management. As the result a qualitative and quantitative health care services will sustain in Bangladesh which currently seem to be disputable. We get proven record that the developed and most of the developing countries establish standard HCTM by introducing the clinical engineering professional. But in this country this professional seems to be new and hence an unpleasant situation of life cycle management of medical equipment is seriously polluting health care services of Bangladesh. We firmly believe that our novel approach will be guided and encouraged to health care planners of developing countries such as Bangladesh to produce and introduce the clinical engineering professional for the standard operating of the life cycle management of medical equipment.

Keywords: Biomedical Equipment; Clinical Engineering; Health Care Technology; Hospital, Health Care Technology Management.

INTRODUCTION

OVER the recent years life cycle management of medical equipment comes under the clinical engineering professional and health care technology management. From computerized medical equipment as well as ethically they established a proper health care technology management through genetic biomedical and clinical engineers in their countries [1,2]. From Clinical Engineering Association of Japan, American College of Clinical Engineering and Clinical Engineering Association of South Africa, we have found that they have introduced clinical engineers in their hospitals as key technological management managers to sustain the life cycle management of medical equipment [2,3,4]. From ICEHTMC-2015, we are informed that more than 30,000 clinical engineering technologists are working in the Japanese health care management. According to the statement of Yadin David, President of ACCE and Mr. Azman Hamid, Managing Director of next level Technology Sdn company, Malaysia and so many that clinical engineers are the best human resources among the health care technology personnel in a hospital [4,5]. Moreover, the literature review results are showing that most of the developing countries such as Jordan, Malaysia, India, South Africa and so many in the globe established hospital in-house clinical engineering department. The Manager of this department is designated as Clinical Engineering Director, Clinical Engineering Manager, Health Care Technology Manager and so forth [5]. Thus, developed and most of the developing countries already introduced clinical engineering professionals in their health care

management since past 35 years and 15 years respectively [6]. As the result, they have established a pleasant health care management system in their hospitals for delivering safe and cost effective health services to the patients. From the journal, we observe that most of low- middle income countries have been searching the way to introduce the clinical engineering professional in the health care management. We have reviewed the publication of the FFACE-2012 and found that more than 400 participants have been participated in this program. Most of the participants were participated from south Asia and participants were presented their problems about clinical engineering management of medical equipment. They acknowledged that the health care technology management cycle could be not sustained without hospital in house clinical engineering department as well clinical engineers are the best solver to keep the life cycle management of medical equipment [6,7]. When health care management comes under the spotlight of health care technology management through clinical engineering professional in the globe then health care planners and health care management personnel of some economically fluctuating developing countries such as Bangladesh is totally unknown about the importance roles of clinical engineers for health care technology management cycle [8,9]. As the results, the health care services of Bangladesh is sloping down with increase of modern medical equipment [10, 11]. We seem that this phenomena is a continuously process for the economically fluctuating countries such as Bangladesh. We have overview the present and proposed health care

management plan up to 2017 of this country but we do not find any projection to develop the clinical engineering professional or any structure of clinical engineering department in any project [11,12]. From this practical scenario and percentage of breakdown of medical equipment, we think that health care services is turning toward horrible condition due to lack of awareness of the present health care planners, policymakers and present conventionally short term equipment base trainee electrical and mechanical engineers[12]. The authors seriously believe that excellent benefit can be obtained by this research work. We hope that this research will be guide to make understand to health care planners, policymakers, health care management personnel as well as it will be open the eyes of the conventionally short trainee electrical and mechanical engineers (self declared biomedical engineer with unethically). This paper will provide an idea regarding the performance of present condition of conventionally trainee engineers about health technology management with respect to genetically clinical engineers. As the result, present, HCS, HTM, HCP will understand the benefit from CEPs and they will be encouraged to produce and introduce CEPs and CED to improve the present unpleasant health care services in Bangladesh. The authors have identified that absence of skilled clinical engineers and biomedical engineering scientists are one of the cause for unpleasant life cycle management of medical equipment as well as the cause of unpleasant condition of health care services in Bangladesh [13]. Authors badly believe that the present unpleasant condition of life cycle management of medical equipment will improve subject to implement of our recommendation which will be shown in the suggestions section.

2 research Methodes and materials

2.1 Research Aim/Goal

The goal of the study is to prove that clinical engineering professional is most important health technology management personnel in a hospital to keep the equipment in safe functional condition.

2.2 Reserch layout

- ❖ We considered the Clinical Engineering responsibilities to ensure the Health Care Technology Management Cycle(HCTMC),Life Cycle Management of Medical Equipment(LCMME).
- ❖ We will find out the result of the conventionally trainee mechanical and Electrical Engineers for HCS .
- ❖ Let us the performance of CE and CEEP/CMEP are P_1 and P_2 .
- ❖ If $P_1 > P_2$ then we understand that CE is very necessary for the health services.
- ❖ For the evalaution the prsent status of CEs, we will quantify the number of clinical engineers for the health care technology management and prsent nubmer of engineers in the health care services of Bangladesh Government.
- ❖ The future trends will be depends on prsent trends

3 DATA COLLECTION

In order to evaluate anything, data collection are very prerequisite. Because, how much percentage of input of CEPs have present in the HCT for HCS and how much percentage of input CEPs will be required to sustain HCT for HCS. In this concerns, we collect data as theoretically and practically from the hospitals of Bangladesh.

3.1 Sample Data Collection and Tables

TABLE 1
HOSPITAL WITH CEP AND CEPT

Phase of LCMME	CEP	CTEP
Equipment Planning	10	3
Technology Assessment	12	2
Technical Specification	12	2
Incoming inspection	10	2
Acceptance Test	10	1
Skilled Develop	12	2
Performance of the use and monitoring the functional condition	12	3
Maintenance	12	3
Disposal and Discard	10	2

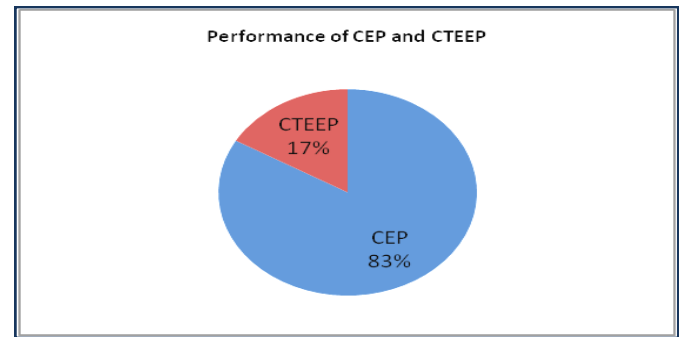


Figure 1. *Perfromance of CEP and CETP for the life cycle management of medical equipment.*

The Table 1 shows nine measuring parameters of life cycle management of medical equipment as per standard of world health organization. We evaluate the performance of CEP and CTEP. The base consider on the educational and skilled among two professionals. Here, we consider 10 score point of each parameter and finally we evaluate it in percentage. From Figure 1, It finds that the performance of CEP is 83% and CETP is 17% only. It means that the performance of CEP is 66% better than CTEP of Bangladesh. Due to less performance and lees numbers of CEPT, the life cycle management of medical equipment(LCMME) slopes down toward the base level.

3.2 Therapeutic Results from ICU Ventilator with CEPs & CEE/CME

From the publications of Japan, America, Malaysia, India and so forth we have found that ICU Ventilators, central monitoring station, multi parameter patient monitor, Syringe pump etc are being operated by the clinical engineering technologists because all equipments are more complicated. Operation, calibration, clinical settings were done by the clinical engineering and technologists[4]. From publications, we have observed that the risk factor of ICU patients from ICU ventilator is about 68%.Whereas, the rate in developed is 2 % only and the risk

factor is average 30% in the most of the developing countries such as Malaysia, South Africa, Jordan, India, Indonesia and so forth.

3.3. Technical Specification and Equipment Procurement.

We investigate the procurement methodes of two hospitals in Bangladesh for the procurement of two numbers of MRI machine. We find the following results which are shown in Table 2.

TABLE 1
PROCUREMENT OF MRI WITH CEP AND CETP

Phase of LCMME	CEP	CTEP
Equipment Planning	10	0
Technology Assessment	12	0
Technical Specification	12	5
Incoming inspection	10	0
Acceptance Test	10	0
Skilled Develop	12	0

Care The procurement Performance finds by CTEP is 5/66* 100= 7.58% only. MRI of NINS is running well and Maintenance is found ok as all the technical terms and conditions are insert by the CEP. But the MRI of NITOR Hospital is not running well as there was a conventionally trainee electrical engineers and he could understand the parameter of procurement.

3.4. Present Status of Clinical Engineers in Bangladesh.

Health Care Services of Bangladesh is not familiar with CEP. One Public Engineering University has been giving the Post Graduation Degree on Biomedical Engineering but as the degree has no good affiliation with Hospital and hence they have not enough idea on the clinical engineering practice. One private University is providing degree on medical engineering and medical physics but they could not give the good output in the health care technology management as they have no scope to learn practical. Most of the electrical, mechanical engineers and medical applied physics graduate as trainee are continuing their services in the health care services in Bangladesh but their is no in-house clinical engineering department or health care engineering department in hospitals or clinics. But health care planners and stakeholders could not indentify that who is clinical engineer. On the other hand conventionally electrical, mechanical engineers, applied physics graduate with short term trainee are claimed themselves as biomedical engineers and not only that diploma engineers are also claimed them as biomedical and clinical engineers. According to definition and responsibilities, they are equivalent to biomedical equipment technicians. We have taken interview of the government sector engineers of health care services and we have found that they have no idea about human body as well as health care technology. They are keeping the idea only for break down maintenance. From literature review results, find that only conventionally electrical and mechanical gradu-

ate engineers are maintaining the medical equipment and its impact factor is 15% of Clinical engineering professional in globe. From the publication of science directive of Elsevier 2015, volume no 9, we have found that CEP is 3 times better resource than that of conventionally trainee electrical/mechanical engineers for the HCTM and HCS . So, in this contexts we can say that CEP is cost effective and very safe for the health care services. From clinical engineering journal of medical engineering and biomedical engineering, we have found that health care technology management components and life cycle management of medical equipment will be matched with CEP.

3.5 Future Trends of Clinical Engineering in Bangladesh

Future trends of clinical engineering professional seems good although the present status is very poor in Bangladesh. From the publication of World Bank, World Health Organization and other developing agencies already recommend to establish health care engineering department in each level of public and private hospitals for the proper practice of health care technology to improve the present health care services. On the other hand some health administrators and health care planners understand the necessity of clinical engineers for the safe and cost effective medical equipment management. In this concern Biomedical Engineering Association are going to be establish in Bangladesh. Last year's Two Public and one Private Engineering Universities of Bangladesh open Biomedical Engineering Department for the undergraduate study. More than 100 candidates will be qualified in the 2018. Meanwhile, Public and private training center are creating hybrid clinical engineers to meet the demand of health care services of Bangladesh. Through national and international conferences, this country is receiving the massage regarding clinical engineers. From the national plan, we hope that the future trends of clinical engineers seem too good. Subject to leading of international partners and good affiliation with government within short interval CEPs are going to be introduced in this country like other developing countries.

4 RESULT AND DISCUSSION

From the data analysis, we found that there are basic relation among clinical engineering, health technology, life cycle management and health care services. We have observed in the Table I that the CEP is involved 52% in the HCTM and its corresponding HTM from is 16%(out of 48%). So, present only 18% CEP practice is meet up by the conventionally electrical/mechanical trainee engineers in health care services and remaining 34% CEP practice are absent from the health care service in Bangladesh. On the other hand, the remaining 48% health care technology is interacted with medical doctors, nurses, medical technologists, clinical engineering technologists, biomedical equipment technicians other health care personnel who operates and maintains the medical devices. But it is recognized that the said 48% health care technology is proportional to 52% health care technology from CEPs. So the performance or efficiency of HCTM is dependent on CEPs. According to data analysis, we get that the health care performance for the healthcare services is 34% only. The 34% HCT is very poor to maintain the present health care services. Therefore, the health care services of developing countries such as Bangladesh really problematic and unpleasant such as wrong diagnostic reports, more risk factors for the patient

from therapeutic equipment, breakdown rate of medical equipment is very high, new medical equipment procurement rate is very high, more currency draining out and which is affected our economy. As the result an unsafe health care services and expensive health care services are continuing in low/middle income/ developing countries such as Bangladesh. The research result is alerting that the health care services of developing countries such as Bangladesh is progressing towards horrible condition. We examine that present status of CEP is very poor but future trends seem to well.

5 CONCLUSION

From the case study it is reflected that the health care technology and health services are very inferior with respect to standard in Bangladesh. This situation is not arisen not in a day. The health care technology to ensure the safe and economical health care services were introduced in developed countries since more than 40 years past. Moreover, most of the developing countries such as Malaysia, India, Jordan, South Africa and so many started health care technology practice for the health care service since 1990's. As the results, they have established the safe and cost effective health care services in their countries through the CEPs. Whereas, Bangladesh could not developed standard HCT to ensure the HCS due to lack of CEPs. As, developing countries like as Bangladesh could not build up standard relationship among clinical engineers, health care technology and the health care services of Bangladesh has been sloping down day by day and in the near future this situation will be more problematic, if Bangladesh government will not take any initiative to build a standard HCTM through CEPs. We firmly believe that our proposal will be helpful to build up an excellent HCTM with interaction of CEPs. We submit some important recommendations/ suggestions in the section to produce and introduce of CEPs for the improvement of health care services in Bangladesh..poor but future trends seem to be well.

6 RECOMMENDATIONS/ SUGGESTIONS

To develop clinical engineering interaction with HCT to sustain HCS, the following recommendations are stated in below;

- To build a Biomedical/ Clinical Engineering Association in this Country with the help of development partners and developed countries
- A regulatory body is important to introduce and produce CEPs under the Ministry of Health and Family Welfare, Government of Bangladesh.
- To obtain a clear cut idea about CEPs and HTM some national seminar can be conducted.
- An International Workshop should be done by the Ministry of Health and Family Welfare and Ministry of Education of Bangladesh
- An initial project can be start to introduce and produce CEPs and CED in each level of Hospitals of Bangladesh.
- In this concerns, some experience person in this line can coordinate with World Bank, World Health Organization and Clinical Engineering Association of America, Japan, Malaysia, Jordan, South Africa, India and So forth.
- A Research Cell must be established in the Ministry of Health and Family Welfare with 3 numbers of Senior Biomedical Engineers and Clinical Engineering scientist.

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Abbreviation or Nomenclature

CTEP: Conventionally Trained Engineering Professional.
CMSD: Central Medical Store Depot.
DEMEW: District Electro-Medical Workshop.
GOB: Government of Bangladesh.
DGHS: Directorate General of Health Services.
HTM: Health Technology Management.
HCM: Health Care Management.
HCS: Health Care System or Health Care Services.
MoH & FW: Ministry of Health & Family Welfare.
NEMEMW & TC: National Electro-Medical Equipment Maintenance & Workshop & Training Center.
HCED: Health care Engineering Department.
GCEEE: Graduate Conventionally Electrical and Electronic Engineer.
GCME: Graduate Conventionally Mechanical Engineer.
BMET: Biomedical Equipment Technician.
CE: Clinical Engineer.
CEP: Clinical Engineering Professional.

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