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Review Article

INSTRUMENTATION: BASIC CONCEPTS AND CURRENT REGULATORY FRAMEWORK

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ABSTRACT

Medical device or instrument means any machine, implement, appliance, apparatus, implant, calibrator or in vitro reagent, material, software made by its manufacturer to be used for the human beings for multiple purposes. Instrumentation encompasses the science of measurement, calibration, validation and regulation pertaining to instruments within a production or manufacturing area. Knowledge of instrumentation is required in clinical pharmacology for standardization of data, accuracy, reliability, reproducibility, minimization of human error and therapeutic drug monitoring. WHO has come out with detailed guidelines for procurement, use, maintenance and operation of medical devices in a safe manner. The different stakeholders in health area like government, manufacturer, vendor, user and public have got their own responsibilities in the safe and accurate use of medical instruments. Although the regulations are in place for medical instruments in USA and European countries, the scenario in India is still a developing one. Once these regulations are implemented rigorously, it will lead to streamlining the procurement, use and operation of medical instruments. Patient's safety should be the only consideration.

Keywords: Instrumentation, Clinical Pharmacology, Procurement, Medical devices

INTRODUCTION

Since ages tools have been a part of the human civilization contributing to its evolvement, development, and prosperity. These instruments came in picture for various needs where human body fell short or proved to be inadequate. The bronze metallic archeological finds and representations of the medical tools, in stone and in paint, on the walls of the tomb and on papyrus suggest that these medical devices or instruments have been present since untraceable antiquity [1]. Years thereafter have witnessed rigorous development of these equipments and introduction of various regulations in their designing and use leading to a whole new arena of science of instrumentation.

Concept of medical instrument and instrumentation

According to WHO [2] medical device or instrument means any machine, implement, appliance, apparatus, implant, calibrator or in vitro reagent, material, software made by its manufacturer to be used for the human beings for the purposes of:

- Diagnosing, preventing, monitoring, treating a disease
- Diagnosing, monitoring, treating, alleviating or compensating for an injury
- Investigating, replacing, modifying, or supporting the anatomy or a physiological process
- Sustaining or supporting life
- Control of conception
- Disinfecting medical devices
- Dispensing information for any medical purpose

The literature until now has more or less failed to define the term instrumentation. The concept of instrumentation doesn't stop at the mere science of installation or manufacture of an instrument but also encompasses the science of measurement, calibration, validation and regulation pertaining to instruments within a production or manufacturing area. In Clinical Pharmacology, it further implies the use of instruments to screen the activity of the drug and to assess its effects. The instruments are also essential to measure the adverse effects of the drug. Clinical Pharmacology is a well-established branch which attempts to connect the gap between medical practice and laboratory science. Hence, instrumentation with all its components is an integral part of clinical pharmacology. Thus, instrumentation can even be considered as a subdivision of clinical pharmacology.

Need of Instrumentation in Clinical Pharmacology

Like medicines, medical instruments have become an indispensible part of the patient health care – at the bedside, at rural health clinics and also at large, specialized hospitals. They include a vast range of equipments, from simple tongue depressor to haemodialysis machines. In other words instruments have become ubiquitous in the health care and research and especially in clinical pharmacology where they are required for the various purposes such as standardization of data/results/observation, accuracy, reliability, reproducibility, minimization of human error and therapeutic drug monitoring.

Any technology comes at a cost and instrumentation in clinical pharmacology is no exception as these devices cost governments a substantial amount of money. If reports are to be believed, there are around one and a half million different medical devices available on the market representing over US$200 billion [3]. With such huge capital, innovation and the rapid advancement of technologies, medical devices are no doubt one of the fastest growing sectors. However the developing nations' scenario is a bit different [4]. These countries with their meager resources mostly attain these devices by importing them from the developed countries. To add to it, these nations do not have proper health technology assessment boards and have very little regulatory control over the importation of these devices. As a result of these, the sub-standard equipments make entry, which fall short of satisfying the specific epidemiological needs of the nation.

Government should frame policies that address different concerns regarding medical devices. These concerns are access to high quality devices, affordability of products, proper use and safe disposal [5]. However, we can't expect changes unless policies are supported by regulations and their strict implementation.

WHO guidelines on safe medical devices

In the absence of proper guidelines at national levels and also due to lack of knowledge about the existing regulations, many manufacturers are still unaware about minimum standards of medical devices. The developing countries can make use of the regulations prepared by big device manufacturing countries or various guidelines issued by international organization. World Health Organization has come up with guidelines pertaining to the use of medical devices.

These WHO guidelines include the following areas of thrust:

- Establishing national policies on medical devices after thorough consultation with all stakeholders

- Following recommendations on global harmonization for different regulations and procedures.
- Maintaining quality standards at all levels of manufacturing
- Collaborating with other players that those monitor medical devices and take part in post market surveillance.

The manufacturer usually manages the first four phases of the medical device's life span i.e. concept and development, manufacturing, packing & labelling. The Vendor can be one who imports, distributes, retails and manufactures and sells medical equipments. The User is usually a person who runs a health care facility and can also be a patient. In addition to the above three categories of stakeholders, the Government and the patient/public are also the key parties which are involved with the various phases of medical devices. The ultimate beneficiary of medical instruments is the public.

The government should ensure that medical devices sold are effective and safe. In the whole scenario of instrumentation Manufacturer, Vendor, User, Public and Government are key players who have to ensure safety and efficacy [6]. Important aspects of regulatory mechanisms are registrations, education, training and regular assessments of the medical instruments in use. It is necessary to have an accessible system for informing and collaborating with all the stakeholders and relevant international organizations of various issues or hazards pertaining to medical devices.

Responsibilities of different players in the safe use of medical devices

1. **Government:** The government has to show commitment and support to ensure adherence to different local and world standards. They should develop and implement various policies which are customized to the local user. They should make efforts to link themselves with various international alert systems. Overall they should establish a proper regulatory authority on medical devices.
2. **Manufacturer:** The responsibility of the manufacturer lies with proper compliance with recommendations regulatory procedures and requirements. They should make sure that the devices have undergone proper testing and clinical trials to substantiate intended benefits and finally to ensure labeling and packaging requirements.
3. **Vendor:** Even the vendor should comply with regulatory requirements and avoid making misleading claims. They should maintain a device distribution record and fulfill all after-sales obligations including user support.
4. **User:** The user of the device is not free from obligations. He should follow adequate training, monitor safety and performance of device on continuous basis, ensure regular calibration and maintenance, share information and problems and also assure proper waste disposal.
5. **Public:** Last but not the least even a vigilant public should be well informed and should insist on safe, effective, quality, affordable and sustainable instruments.

National and international standards for quality standards for medical devices

The international quality standard for medical device manufacturing is ISO 13485. While certain technical standards can be specified by specialists, there can be some difference in local and international quality standards [6]. These standards should be monitored by a recognized body without any conflict of interest. They should include the views of all the players and aim at overall community benefits. These standards should be available for scrutiny at regular intervals.

Calibration and Validation of Instruments [7]

After extensive literature search which revealed different facets of calibration and validation, it is clear that these two processes are different but inter-related. Calibration is a method to compare two different medical instruments to ensure their equality within a permissible difference range. Out of these two instruments, the one which is held as a comparator is called as standard. Validation is a process to ensure that product, service or a system meets its specifications and requirements. These definitions were not a part of any scientific journals available to us.

After the procurement of the equipment, it is the responsibility of the vendor and user to assure proper calibration and validation of the medical device. It is the process of establishing the relationship between a measuring device and the units of measure and checking if a certain instrument matches or satisfies particular criteria. It is called for when the device is new or when the specified time period has lapsed or when the observations appear questionable. To make the results of calibration more acceptable to all the major players, calibration and its measurements should be compared with internationally defined units. One example of such standard is one by NIST in the USA. Overall it is essential for ensuring measuring accuracy and meaningful comparison of data from multiple instruments. In India ISO 9001-2000 certified national facility for medical instruments calibration has been established at Delhi Centre (Address- CSIR Complex , 2nd Floor, Library Avenue, PUSA, New Delhi)

Developing countries perspective

In developing countries the situation is entirely different from the industrialized nations where most of the medical devices are invented, manufactured and used. In developing countries the priorities are different. Here the stress is more on the clinical diagnosis rather than the laboratory one. Other factors that make the difference can be different climate conditions, different quality of water, the power supply and the roads. The medical devices operators might lack the appropriate technical skills, information, resources and proper maintenance facilities.

What to do?

Considering the above mentioned problems with respect to the developing nation's scenario, following aspects should be considered regarding medical devices.

i) *Compliance with international safety and performance standards at the pre-market stage*

World Health Organization (WHO) and various health bodies recommend that countries should ensure legislations regulating procurement and use of medical devices. Special emphasis is to be given on preventing substandard, repackaged or counterfeit devices [8]. Such legislations can protect citizens from becoming human guinea pigs of clinical trials.

ii) *Need for Health Technology Assessment (HTA)*

Cost effectiveness/ benefit of newly adopted expensive technologies and devices have become important concerns. HTA is an attempt to address this concern in a systematic manner [9]. HTA associations provide a forum for sharing information between those who have it and those who don't which helps to reduce the time and cost of technology assessment [10]. It is important to consider socio-economic, cultural, ethical and political factors before making a decision.

iii) *Patient Safety*

The purpose of all these assessments and regulations is to ensure maximum possible patient safety. All the laid down procedures before the use of an instrument for clinical use should be followed. This deals with following regulatory requirements, education and training of qualified operators, maintenance and calibration of the devices and safety measures to prevent cross infection and electromagnetic and radiation hazards [11].

iv) *Education and Training in Medical Device operation*

The safety and health outcome of medical devices depends on how the devices are managed and maintained by the operator [12]. The training of the operator by the manufacturer/vendor is a continuous

process and should continue at regular intervals. It should be done at a local level in a locally acceptable language. The issues of importance in this aspect are availability of experienced professionals, capacity and cost.

v) *Further management and budgeting*

Once the instrument is purchased and put to use, there should be a proper management mechanism to ensure training and proper budgeting for recurring expenses [13].

Current regulatory scenario of medical instruments in India

The Central Drugs Standard Control Organization (CDSCO) is the main regulatory organization in India. It regulates import, commerce and manufacturing of medical devices. The medical devices are mentioned as Drugs and Cosmetics Act under Section 3(b)(iv). The function of CDSCO is to prepare standards for drugs, cosmetics, diagnostics and medical devices. It also grants licenses to drug manufacturing companies and importers. It also regulates new drug trials in India. There is a separate division in CDSCO named Medical Device Division which deals with all the matters pertaining to medical devices. The Medical Equipment and Hospital Planning Division Council (MHDC) of Bureau of Indian Standards **(**BIS) also deals with Medical Devices [14].

The different fields which need standardization as updated by Sectional Committee on 1/03/2012 are surgical and medical instruments, surgical dressings, prosthesis, equipments for rehabilitation, diagnostic kits, veterinary devices, dental equipments, laboratory equipments and others. This document will provide a very efficient and handy tool for all the knowledge about medical equipments [14]. This program also mentions the list of Indian standards under BIS.

Gazette Notification S.O. 1468 (2005) (http://www.cdsco.nic.in /html/Notification/not1.pdf) applies to certain medical devices in India. The notification declares ten categories of sterile devices to be considered as drugs under Section 3 (b) (iv) of the Drug and Cosmetic Act (DCA) and, therefore, subject to registration [15]. DCGI has prepared an expanded list of medical devices which require registration.

The list now includes over 160 medical devices. Government of India in consultation with DCGI and an expert committee has finalized following 11 devices which require registration [14].

AV fistula needle Insulin syringes Cochlear implant Introducer sheath

Spinal needleThree way stop cock for i.v. perfusion set Close wound drainage set

Cath lab kit Flow regulator of infusion sets Extension line for infusion set Measure volume set.

The Government of India has started work on regulatory framework to ensure safety, quality and performance of medical devices. A good regulatory set up can help India's domestic industry to improve and develop in future [14].

National Accreditation Board for Testing and Calibration Laboratories (NABL)

National Accreditation Board for Testing and Calibration Laboratories which is abbreviated as NABL is a board which works under DST, Government of India. NABL's sole objective is to provide neutral assessment of quality related and technical matters regarding calibration and testing of laboratories.

In India, NABL has been awarded with the discretion of being the only accreditation body for testing and calibration. Any laboratory that performs test or calibrations in line with NABL criteria can be awarded NABL accreditation. This accreditation is available for all the laboratories in India and outside. NABL follows internationally accepted standards like ISO/IEC 17025, APLAC MR001.

The NABL accreditation for a specific test, calibration parameters performed by a laboratory is valid for up to 2 years with annual surveillance [16].

CONCLUSION

Medical device or instrument means any machine, implement, appliance, apparatus, implant, calibrator or in vitro reagent, material, software made by its manufacturer to be used for the human beings for multiple purposes. They include a vast range of equipments, from simple tongue depressor to haemodialysis machines. Any technology comes at a cost and instrumentation in clinical pharmacology is no exception as these devices cost governments a substantial amount of money. Hence there is an urgent need to have a proper regulatory framework for the manufacturing and importing of medical devices. Many developed countries have put in place the requisite regulations while others are in the process of developing it. WHO has come up with clearer guidelines and the words of advice while developing such regulations. The safe and effective use of instruments is a responsibility of government, manufacturers, users, vendors and the public. The Indian scenario has started to develop with ICMR, DCGI, BIS and CDSCO coming out with their own guidelines and regulations. Their authorities are overlapping and need some streamlining. An apex body which takes care of all the above mentioned regulators will definitely help in providing safe and effective use of medical devices in India.

REFERENCES

1. Topic Priority Setting for research on patient safety Operational Definitions Available at: http://www.who.int/patientsafety/research/activities/topic_priority_setting_definitons.pdf [Accessed on 9/02/2013]
2. Fargen KM, Frei D, Fiorella D, McDougall CG, Myers PM, Hirsch JA, et al. The FDA approval process for medical devices: an inherently flawed system or a valuable pathway for innovation? J Neurointerv Surg 2013 Jul;5(4):269-75
3. Lister M. Transfer of Medical Technology to Developing Countries. IJPD 2004;1:69-74.
4. George B. Registration of Medical Devices. Perspect Clin Res 2010;1(3):90-3.
5. World health Organization: Safe medical devices. AIDE-MEMOIRE for national medical device administration. Available at http://www.who.int/medical_devices/publications/en/AM_Devices_EN.pdf (Accessed on 19/12/ 2012).
6. Federal Register, Current Good Manufacturing Practices - Medical Devices, Vol. 61, Number 195: Oct 7, 1996. Available at: http://www.fda.gov/downloads/MedicalDevices/DeviceRegulationandGuidance/PostmarketRequirements/QualitySystemsRegulations/MedicalDeviceQualitySystemsManual/UCM122806.pdf
7. Lamph S. Regulation of medical devices outside the European Union. J R Soc Med 2012;105:S12-S21.
8. O'Reilly D, Campbell K, Goeree R. Basics of health technology assessment. Methods Mol Biol. 2009;473:263-83.
9. Sivalal S. Health technology assessment in Malaysia. Int J Technol Assess Health Care 2009;25:224-30.
10. Rall M. To err is human - a summary of the IOM-Report. European Journal of Anaesthesiology 2000;17:520.
11. Mykityshyn AL, Fisk AD, Rogers WA. Learning to use a home medical device: mediating age-related differences with training. Hum Factors 2002;44:354-64.
12. Keller JP Jr, Walker S. Best Practices for Medical Technology Management: A U.S. Air Force-ECRI Collaboration. In: Henriksen K, Battles JB, Marks ES, et al., editors. Advances in Patient Safety: From Research to Implementation (Volume 4: Programs, Tools, and Products). Rockville (MD): Agency for Healthcare Research and Quality (US); 2005 Feb. Available from: http://www.ncbi.nlm.nih.gov/books/NBK20607/.
13. Rudy M, Margaret JB. Estimating the True Costs of Disposable and Reusable Instruments. AORN J 1995;62:39-48.
14. Rajdutt Shekhar Singh. A brief overview of regulatory framework for medical devices in India. Lexology September 29 2012
15. Medical device regulatory profile for India. Available from: http://www.ita.doc.gov/td/health/indiaregs.pdf (Accessed on 9/02/2013)
16. National Accreditation Board for Testing and Calibration Laboratories. Available from: http://www.nabl-india.org/index.php (Accessed on 9/02/2013)