Medical Technology Integration in Healthcare

by Dr. Salah Alkhallagi
Director, Clinical Engineer at King Abdulaziz Medical City, Jeddah

There are a variety of definitions for Technology; the Merriam-Webster dictionary offers a definition of the term: "the practical application of knowledge especially in a particular area" and "a capability given by the practical application of knowledge". Ursula Franklin gave another definition of the concept; it is "practice, the way we do things around here". Bernard Stiegler defines technology in two ways: as "the pursuit of life by means other than life", and as "organized inorganic matter." The term can either be applied generally or to specific areas: examples include construction technology, medical technology, and information technology.

Medical technology refers to the use of new technology to develop and advance very sophisticated electronic medical products and/or medical devices for clinical application in healthcare fields. Medical technology covers a wide variety of healthcare products and is used to diagnose, monitor and/or treat diseases or medical conditions affecting humans. Such technologies (applications of medical science) are intended to enhance the quality of healthcare delivered and patient outcomes through earlier diagnosis, less invasive treatment options and reductions in hospital stays and rehabilitation times.

Billions of patients worldwide depend on medical technology at home, at the doctor’s clinic, at hospital and in nursing homes. Medical technology and instrumentation have always been used in healthcare environment. As the time is advancing the medical technology is developing and growing rapidly and the number of new and complicated medical devices and systems in recent years is very enormous.

The term medical technology may also refer to the duties performed by clinical laboratory professionals in various settings within the public and private healthcare sectors. The efforts of these professionals encompass clinical applications of chemistry, genetics, hematology, immunohematology (blood banking), immunology, microbiology, serology, urinalysis and miscellaneous body fluid analysis. These professionals may be referred to as Medical Technologists (MT) and Medical Laboratory Technologists.

As the healthcare institutes demand the medical technology bring up to date, it requires an ongoing technology assessment process to be an integral element of an ongoing technology assessment, planning, development and management program, focus on the requirements of the patient, the user, and the support team. As the medical technology is expanding and increasing rapidly as the need for the clinical engineering professionals are desired. The demand for clinical engineering professionals is increasing. Typical pursuits of clinical engineers, therefore, include:

- Acts on all activates relating to medical technology assessment, planning and development.
- Provides short-term and long-term equipment replacement and programs expansion plans.
- Provides medical equipment requirements for new healthcare expansion and new facilities within healthcare institutes.
- Establishes all standards relating to medical equipment replacement and acquisition.
- Writes specifications for all approved equipment purchases.
- Evaluates equipment quotations and tenders for the proper selection of equipment.
- Pre-purchase evaluation and planning for new medical technology.
- Input to the design of clinical facilities where medical technology is used, e.g., operating rooms (ORs), intensive care units, etc.

When hospital leaders start strategic planning process for their hospitals, they analyze or endorse what clinical services they would like to offer to the community, the hospital can then conduct efficient technology strategic planning. Key elements of this planning involve:

1. Performing an initial audit of existing technologies,
2. Conducting a technology assessment for new and emerging technologies for fit with current or desired clinical services,
3. Planning for replacement and selection of new technologies,
4. Setting priorities for technology acquisition, and
5. Developing processes to implement equipment acquisition and monitor ongoing utilization.

Medical technology enables practitioners to intervene through integrated interactions with their patients in a cost-effective, efficient, and safe manner. As medical technology continues to evolve, so does its impact on patient outcome,
hospital operations, and financial resources. The ability to manage this evolution and its subsequent implications has become a major challenge for all health care organizations.

Many of the problems confronting health professionals are of extreme interest to engineers because they involve the design and practical application of medical devices and systems processes that are fundamental to engineering practice. These medically related design problems can range from very complex large-scale constructs, such as the design and implementation of automated clinical laboratories, multiphasic screening facilities (i.e., centers that permit many clinical tests to be conducted), and hospital information systems, to the creation of relatively small and “simple” devices, such as recording electrodes and biosensors, that may be used to monitor the activity of specific physiologic processes in either a research or clinical setting.

Medical devices range from simple tongue depressors and bedpans to complex programmable pacemakers with micro-chip technology and laser surgical devices. In addition, medical devices include in vitro diagnostic products, such as general purpose lab equipment, reagents, and test kits, which may include monoclonal antibody technology. Certain electronic radiation emitting products with medical application and claims meet the definition of medical device. Examples include diagnostic ultrasound products, x-ray machines and medical lasers.

As medical technology is developing and advancing enormously, there has been a rapidly growing integration and interconnection of disparate medical (and information) technology devices and systems where medical data is being increasingly exchanged. Medical devices are integrated with the information technology (IT) to facilitate patient data throughout the hospital and beyond that for physicians’ diagnosis and treatment.

At most hospitals, the sole method of connectivity between Electronic Medical Record (EMRs) and medical devices was through the use of a wired local area network (LAN) connection. And, while a number of organizations are using wireless connectivity in conjunction with wired LAN connectivity. There is tremendous potential for healthcare organizations to connect their existing medical devices to their EMRs. The integration of data directly from a medical device into the EMR offers one area to improve efficiency, freeing nurses to focus on other areas of care.

Access to, comparison and analysis of these clinical data (information) from variety of sources through the hospital network can be used to provide patient care such as:

- Automatic charting of data to the electronic medical record (EMR)
- Clinical data from diagnostic devices (e.g., heart rate monitors & pulse oximeters) affect inputs on therapeutic devices (e.g., infusion pumps)
- Patient alarm management
- Remote device management
  - monitoring data flow integrity & continuity
  - error code monitoring & remote diagnostics
- software upgrades

The automatic transfer of this type of data has a number of potential benefits to healthcare organizations, including a reduction of medical errors, improved workflow for clinicians, and additional data analytics opportunities, all of which will lead to improved quality of care. Networking & Internet bring healthcare resources to any near or remote location and to facilitate medical data and personal (voice & video)
communications between a combination of patients, providers and payors. Medical device and information technology are converging to create an Environment of Information that extends outward from the patient, carrying signals, statistics, and identifiers to all corners of the hospital and beyond. Clinical engineers are being charged to extend their scope as communicators, problem solvers and experts in integrating high technology systems. With increasing frequency, they depend on and interact with their information technology counterparts to pave the way for the newer technologies. Clinical engineering and information technology collaborate in areas such as planning, standards, safety, and security, to improve patient care.

Future clinical engineer role can only be predicted by understanding:
- The future developments in healthcare and the forces likely to bring that future about.
- Clinical engineering's ability to contribute to future needs with respect to these developments.

References:
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About the Author

Dr. Alkhallagi holds PhD in Health Administration from USA, MSc in Medical Electronics and Physics from UK. He is a certified Consultant Engineer (CE) from Saudi Council of Engineers. He has more than twenty five years of experience in Biomedical Engineering.

Dr. Alkhallagi is a Member of Consultation Group and Liaison Officer of Saudi Food and Drug Authority (SFDA), Medical Device Committee, Chairman of the Central Board for Accreditation of Healthcare Institutions (CBAHI), Biomedical Professionals Assessor for Saudi Commission for Health Specialties (SCHS). He is also the founder member of the Saudi Scientific Society for Biomedical Engineering (SSSBE) and Facilities Management and Safety (FMS), and working group leader of Joint Commission International Accreditation (JCIA). He has participated and presented several Papers/presentations at different national/international meetings and training courses.

Dr. Alkhallagi is a member of many associations and organizations such as AAMI, ACCE, ASHE, IEEE, ECRI, ASQ, SQC and SCE.