ECRI Institute
The Discipline of Science. The Integrity of Independence.

BIOMEDICAL ENGINEERING COMPETENCY TRAINING (BECT®)

BECT® is a training programme to rapidly up-skill participants in the correct technology management, operation, maintenance and repair techniques of medical equipment through interactive learning and hands-on practice.

Who Should Attend:

- Biomedical Engineers
- Biomedical Technicians
- Biomedical Service Managers

Competency Training

The challenges faced by biomedical engineers and technicians are imposed by the proliferation of medical equipment technology, their growing cost and complexity, device related patient harm and a profusion of conflicting information about medical equipment. These challenges are faced by health professionals as well, but it is the biomedical engineer or technician who is usually called upon to sort out these issues and make sense of them. To do so requires skill upgrading, access to reliable up-to-date technical information and the ability to consult with competent peers with specialised experience and judgment.

With these in mind, the Biomedical Engineering Competency Training (BECT®) has a total focused approach with the specific objectives to rapidly up-skill participants in the correct technology management, operation, maintenance and repair techniques of medical equipment through interactive learning and hands-on practice.

In many countries, regulatory requirements are emerging to require competency of biomedical engineers and technicians to carry out the management, maintenance, and repair of medical equipment. This type of training can prepare biomedical engineers and technicians to fulfill that need.

The content of the BECT® will include:

- Principles of safe, efficient, and cost-effective management and maintenance of medical equipment
- In-depth theoretical and hands-on operational knowledge of the broad range of medical equipment used in healthcare environment
- Techniques in performing safety tests according to international standards, preventive maintenance, troubleshooting and addressing commonly encountered problems with medical equipment

Training Organiser

ECRI Institute is an international organisation dedicated to bringing the discipline of applied scientific research in healthcare to uncover the best approaches to improving patient care. ECRI Institute provides independent up-to-date publications and databases on medical equipment, medical equipment maintenance systems & software, and much more to assist healthcare providers to plan, procure, manage and maintain medical equipment in the most cost-effective manner. ECRI Institute also provides consulting support, education and training for healthcare providers such as administrators, procurement managers, risk managers, nurses and maintenance engineers.

www.ecri.org

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BIOMEDICAL ENGINEERING COMPETENCY TRAINING (BECT®)

Trainers & Materials

BECT® will be delivered by experienced biomedical engineers and medical equipment specialists from Malaysia and overseas. The course material provided during the training has been developed from extensive research on the topics and incorporating information from various international databases, which are continually updated. A certificate of participation will be provided to participants upon completing each programme.

Programme Outline

BECT® consists of 8 medical equipment programmes and 2 medical equipment technology management programmes. It is designed to fast track skill acquisition in technology management and medical equipment operation, maintenance and troubleshooting, through interactive learning and hands-on practice. A completely new approach has been taken in the design of this programme, with emphasis on hands-on practical sessions and introduction of a new '**Simulation-based Learning**' concept. Each programme is self contained.

Medical Equipment (ME) Programmes		Duration
ME 1	Infusion Pumps, Phototherapy Units & Resuscitators	2 days
ME 2	Pulse Oximeters, Electrocardiographs (ECGs), Non-Invasive Blood Pressure Monitors & Aspirators	2 days
ME 3	Centrifuges & Defibrillators/ Automated External Defibrillators (AEDs)	2 days
ME 4	Ventilators	2 days
ME 5	Infant Incubators & Electrosurgical Units	2 days
ME 6	Physiologic (Patient) Monitoring Systems	2 days
ME 7	Haemodialysis Units	2 days
ME 8	Anaesthesia Units	2 days

Medical Equipment (ME) Programmes will consist of

I) Theory Lectures

- Clinical Background
- Principles of Operation
- Commonly Encountered Problems
- Technology Guidance
- Technology Trends

The time allocated for this session will be 30% of the overall programme.

II) Demonstrations, Practice and Simulations

- Operations
- Planned Preventive Maintenance
- Troubleshooting
- Commonly Encountered Problems

The time allocated for this session will be 70% of the overall programme.

Medical Equipment Technology Management (TM) Programmes will consist of

I) Theory Lectures

II) Experience Sharing on Various Topics

Medical Equipment Technology Management (TM) Programmes			Duration
TM 1	• The Organisation of a Hospital • Acceptance Testing and Commissioning • Understanding Service Contracts • Biomedical Asset Management Systems I • Warranty Management • Managing Safety	• International Standards Relating to Medical Equipment • Understanding the Management of Spare Parts Inventory • Understanding the Management of Documentation • Planning and Implementing User Training Programmes I • Decommissioning and Disposing Medical Equipment I	2 days
TM 2	• Top 10 Health Technology Hazards • Managing Service Contracts • Managing Spare Parts Inventory • Managing Documentation • Biomedical Asset Management Systems II • Post-Warranty Management • Medical Equipment Planning, Procurement and Management • Medical Devices and IT Integration	• Medical Equipment Design and Electrical Safety • Medical Equipment Risk and Patient Safety • Managing Medical Device Hazards and Recalls • Planning and Implementing User Training Programmes II • Decommissioning and Disposing Medical Equipment II • Medical Device Accident Investigation and Management • Benchmarking Biomedical Engineering Practices • Communicatipn Tips for Biomedical Engineering	2 days

For programme schedule and registration details, please see separately attached pages.

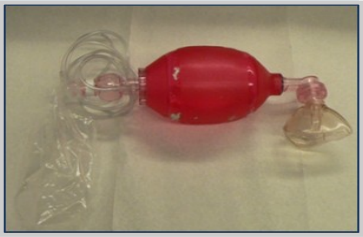
Content Coverage for Medical Equipment Programmes

ME 1

INFUSION PUMPS are used when the solution to be administered to a patient must be delivered with greater accuracy than can be provided through manually adjusted gravity administrations set. Because they allow more accurate fluid delivery, infusion pumps have proven to be useful in applications such as continuous epidural anesthesia, administration of IV cardiovascular drugs, chemotherapy, and autotransfusion, as well as in paediatric application and for home IV therapy. Blood infusion can also be performed with most pumps, although some pumps require a special administration set for this purpose.

PHOTOTHERAPY UNITS are used to treat hyperbilirubinemia, a condition characterized by high bilirubin concentrations in the blood. These units are also called: bilirubin lamps, bilirubin lights, fiberoptic phototherapy blankets, neonatal phototherapy units.

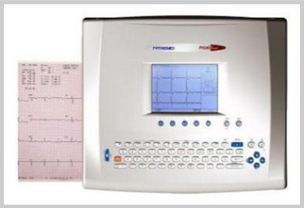
RESUSCITATORS are designed to restore or assist the physiologic function of a patient's cardiac and/or respiratory system for a short time when the performance of one or both of those systems is inadequate to sustain life or is completely absent. Resuscitators are typically used in emergency rooms, ambulances, patient care areas throughout the hospital, and in emergency rescue.



ME 2

PULSE OXIMETERS noninvasively monitor SpO_2 (generally expressed as a percentage [e.g., 70% to 100%]) of arterial hemoglobin SpO2 by measuring light-absorbance changes resulting from arterial blood flow pulsations. Their use allows continuous and instantaneous monitoring of oxygenation and pulse rate, can provide early detection of hypoxia before other signs such as cyanosis are observed, and may reduce the frequency of arterial puncture and laboratory blood gas analysis.

ELECTROCARDIOGRAPHS (ECGs) detect the electrical signals associated with cardiac activity and produce an ECG, a graphic record of the voltage versus time. They are used to diagnose and assist in treating some types of heart disease and arrhythmias. Electrocardiographs are used to diagnose cardiac abnormalities, determine a patient's response to drug therapy and reveal trends or changes in heart function.



NON-INVASIVE BLOOD PRESSURE (NIBP) MONITORS are used to non-invasively measure and display a patient's arterial blood pressure. Arterial blood pressure measurement is an essential indicator of physiologic condition. Blood pressure measurements can provide information on changes in blood volume, the pumping efficiency of the heart, and the resistance of the peripheral vasculature.

ASPIRATORS are designed to evacuate gas, fluid, tissue, or foreign materials from the body by means of vacuum suction. They are commonly used to remove blood and irrigation fluids during a surgery, remove secretion from patient's airway, and during dilation and evacuation (D&E) therapies.

ME 3

CENTRIFUGES use centrifugal force to separate suspended particles from a liquid or to separate liquids of different densities. These liquids can be body fluids (e.g., blood, serum, urine), commercial reagents, or mixtures of the two with other additives. In the clinical laboratory, centrifugation is a sample-preparation step commonly required before measuring analytes in a patient sample.

DEFIBRILLATORS/ AEDs are used to deliver a high-amplitude current impulse to the heart in order to restore normal rhythm and contractile function in patients who are experiencing ventricular fibrillation (VF), ventricular tachycardia (VT) or other shockable rhytm. AEDs differ from conventional manual defibrillators in that AEDs can analyze the ECG rhythm to determine whether defibrillation is necessary; this eliminates the need for the user to interpret the cardiac rhythm before delivering a shock. AEDs are designed to be used primarily by first responders to cardiac emergencies, who may not be fully trained in advanced cardiac life support (ACLS). Manual defibrillators are used with ECG monitor, to diagnose a cardiac condition (VF/VT/other shockable rhythm). The user then decide what charge (in Joules) to use based on guidelines and experience. Shock is delivered through pads/ paddles on patient's chest.

ME 5

INFANT INCUBATORS provide a closed, controlled environment that warms an infant by circulating heated air over the skin. The heat is then absorbed into the body by tissue conduction and blood convection. Ideally, both the skin and core temperatures should be maintained with only minor variations. Incubators feature better temperature control than radiant warmers (overhead heating units), which can overheat or underheat the infant.

ELECTROSURGICAL UNITS are used for surgical cutting and for controlling bleeding by causing coagulation (hemostasis) at the surgical site. They deliver high-frequency electrical current through an active electrode tip, causing desiccation, vaporization, or charring by resistive heating in the target tissue. Electrosurgery is useful for procedures such as laparoscopic tubal ligation and transurethral resection of the prostate (TURP).

For programme schedule and registration details, please see separately attached pages.

ME 4

VENTILATORS provide temporary ventilatory support or respiratory assistance to patients who cannot breathe on their own or who require assistance to maintain adequate ventilation because of illness, trauma, congenital defects, or drugs (e.g., anesthetics).

ME 6

PHYSIOLOGIC (PATIENT) MONITORING SYSTEMS measure and display waveforms and numerical data for various parameters, including ECG, respiratory rate, noninvasive blood pressure (NIBP) and invasive blood pressure (IBP) (systolic, diastolic, and mean), body temperature, arterial hemoglobin oxygen saturation (SpO2), mixed venous oxygenation (SvO2), cardiac output, end-tidal carbon dioxide (ETCO2), intracranial pressure, and airway gas concentrations (particularly during the administration of anesthesia).

ME 7

HAEMODIALYSIS UNITS perform extracorporeal dialysis to replace the main activity of the kidneys in patients with impaired renal function, such as those with end-stage renal disease. The kidneys maintain the body's fluid, electrolyte, and acid/base balance, counteracting the destabilizing influences of metabolic activity and a constantly changing external environment. Although hemodialysis does not restore renal function or promote healing of the kidneys, it restores a reasonable state of health by partially performing renal functions, thereby minimizing further damage to other organs and physiologic systems.

ME 8

ANAESTHESIA UNITS dispense a mixture of gases and vapors and vary the proportions to control a patient's level of consciousness and/or analgesia during surgical procedures. Anesthesia units primarily perform the following four functions:

- Provide oxygen (O2) to the patient.
- Blend gas mixtures, in addition to O2, that can include an anesthetic vapor, nitrous oxide (N2O), other medical gases, and air.
- Facilitate spontaneous, controlled, or assisted ventilation with these gas mixtures.
- Reduce, if not eliminate, anesthesia-related risks to the patient and clinical staff.