The 3rd International Conference
ON Biomedical & Clinical Engineering

Implementing Health Technology Management (HTM) in Lebanon

Riad FARAH C.E, cHTM

Implementing Health Technology Management (HTM) in Lebanon

Riad FARAH

Clinical Engineer

cHTM

HTM certified by ACI

Medical Engineering Department
2017

Implementing Health Technology Management (HTM) in Lebanon

- Objectives:
- Hospitals in Lebanon
- Biomedical Engineers in Lebanon
- Biomedical Engineering, Clinical Engineering and HTM
- HTM at Saint George Hospital
- HTM Implementation Projects; examples
- Project: Repair / Replacement Algorithm
- 5 min exercise

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Hospitals in LEBANON

- **GNP (Gross National Product) (USD)** **50,000,000,000**
  GNP = GDP + NR (Net income inflow from assets abroad or Net Income Receipts) – NP (Net payment outflow to foreign assets).
- GDP = consumption + investment + (government spending) + (exports − imports).
- **Hospitalization Bill (USD)** **1,500,000,000**
- **Number of Admissions /year** **700,000**
- **Number of registered Physicians** **12,827**
- **Number of registered Nurses** **10,079**

Reference: Mr. Sleiman HAROUN – 2014; Syndicate of Hospitals

Hospitals in LEBANON

- Private Hospitals:
  - Short and Medium Stay: 117
  - Number of Beds: 10,045
  - Long Stay: 19
  - Number of Beds: 3,496

- Public Hospitals: 28
- Number of Beds: 1,354

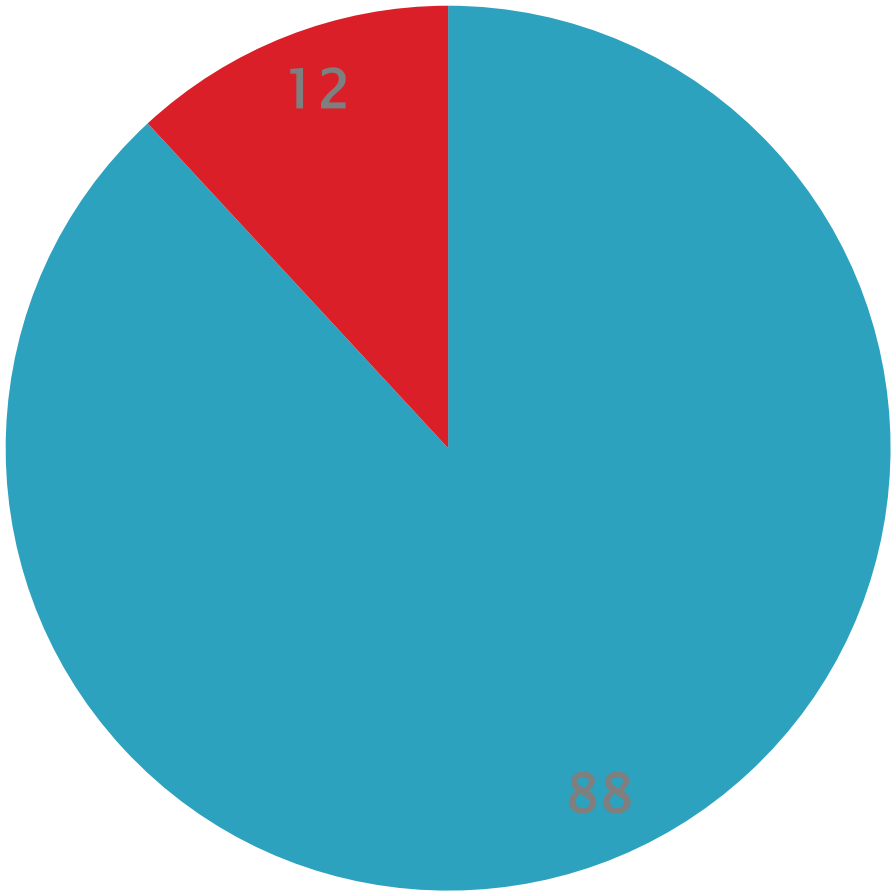
Reference: Mr. Sleiman HAROUN – 2014; Syndicate of Hospitals

Geographic Distribution of Beds – Lebanese Hospitals

Region	Private	%	Public	%	Total	%
Beirut	1,921	19.12	346	25.55	2,267	19.89
Bekaa	1,472	14.65	150	11.08	1,622	14.23
Mount Lebanon	3,626	36.10	381	28.14	4,007	35.15
North	1,578	15.71	202	14.92	1,780	15.62
South	1,448	14.42	275	20.31	1,723	15.12
Total	10,045	**100**	1,354	**100**	11,399	**100.00**

Reference: National Hospital Database 2012 – Syndicate of Hospitals

Percentage of Beds in Hospitals



Reference: National Hospital Database 2012 – Syndicate of Hospitals

Hospitals in LEBANON

- **Private Hospitals:**

✓ 83% are Private Hospitals (long/med/short stay)

✓ Distribution of Beds correlates with distribution of Inhabitants

✓ Even distribution of Beds in the peripherals (North, Beqaa, and South)

✓ Mount Lebanon 36% of Beds

✓ Beirut 19% Beds

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Biomedical Engineering - Lebanon

- Biomedical Engineers and **Order of Engineers**
- Biomedical Engineers and the **Ministry of Health**
- Biomedical Engineers and the **Syndicate of Hospitals**
- HTMA; New Society for Healthcare Managers

Biomedical Engineering - Lebanon

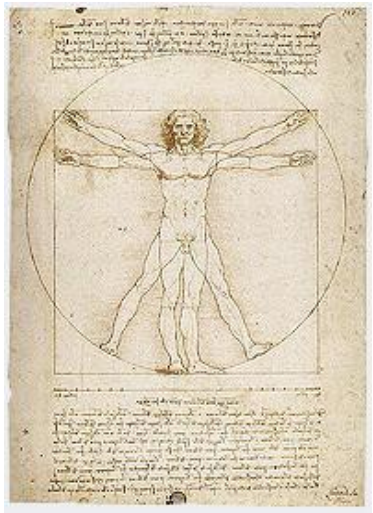
- Biomedical Engineers and Order of Engineers
- Two Sections: Beirut and Tripoli
- Total registered Engineers (5 years University degree; B.E or M.S) (2016; Beirut section) 40,810
- Biomedical Engineers are part of 4th branch; Employees; (2016; Beirut section) 3,500
- Chair (Nakib) of Order of Engineers promised us to open a Chapter for Biomedical Engineers
- There is no clear Biomedical Engineering registry yet (WHO Survey)

Biomedical Engineering - Lebanon

- Biomedical Engineers and Order of Engineers
- Tripoli Section
- Total registered Engineers (5 years University degree; B.E or M.S) (2017; Tripoli section) 10,491
- Biomedical Engineers are part of 4th branch; Employees; (2016; Beirut section) 1,207

- (WHO Survey)

Biomedical Engineering – Lebanon



Ministry of Health MOH:

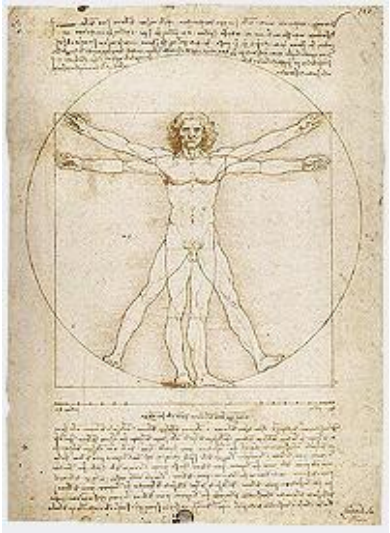
– WHO and MOH promoted HTM/HTA in 2014. (Need for Biomedical Engineers).

- MOH launched HTA in 2017 and started assessing Hospital readiness
- Medical Devices registry and tracking

– Promotes need for a Biomedical Engineer at every Hospital

- Biomedical Engineering in Hospital Accreditations
- Biomedical Engineering input in Hospital Architecture and licensing standards

Biomedical Engineering – Lebanon

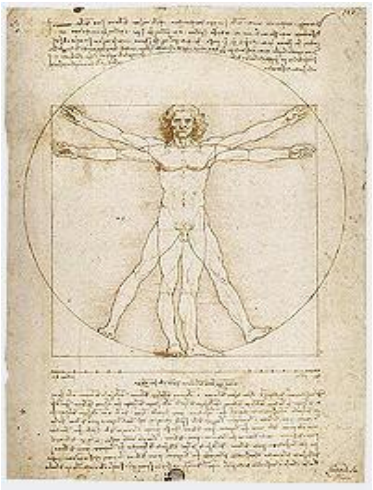


Syndicate of Hospitals:

-Promotes need for a Biomedical Engineer at every Hospital

- Biomedical Engineering in Hospital Accreditations
- Biomedical Engineer at LIBNOR Lebanese Norms Institute
- Biomedical Engineering input in Hospital Architecture and licensing standards

Biomedical Engineering – Lebanon



HTMA: Health Technology and Management Advancement committee of the LHMA (Lebanese Hospitals Management Association) October 2015.

New group for Biomedical Engineers and Professionals working in the HealthCare Technology (Professors, Radiology / Quality Managers…).

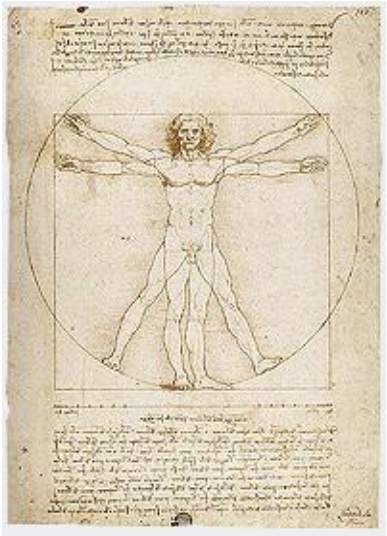
Shall be the nucleus for proper Biomedical Engineering Society.

Still in the infrastructure Phase.

All are **free to join** and participate.

Elections shall soon start

Biomedical Engineering – Lebanon



HTMA: Health Technology and Management Advancement committee:

To promote Biomedical Engineers to establish a new committee in the Order of Engineers

To promote Biomedical Engineering and specialties in the Syndicate of Hospitals, and highlight benefits

To promote Biomedical Engineering in the Ministry of Health through active participation in setting the National Accreditation standards

To assist all who works with Healthcare Technology

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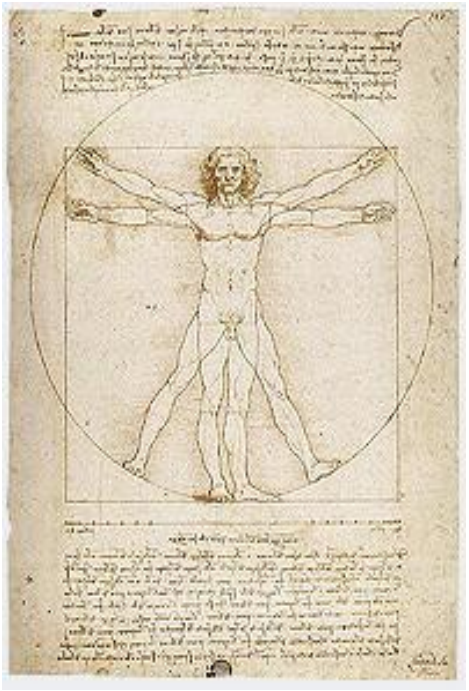
Health Technology Management (HTM)

- Need Clarifications:
- Differences and relation between:
  - Biomedical Engineering
  - Clinical Engineering
  - and HTM

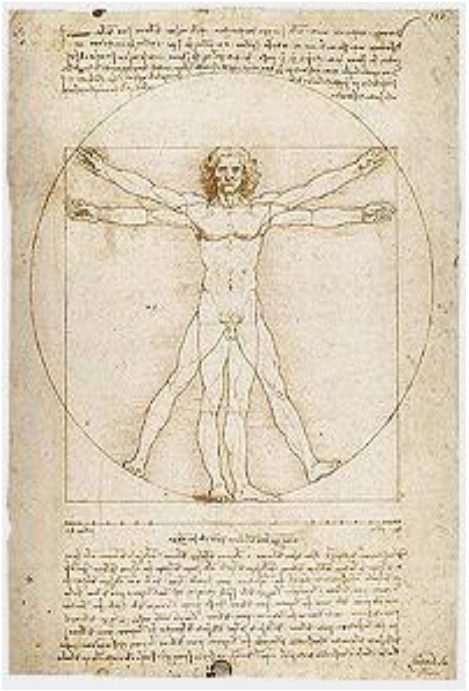
Definition of Biomedical Engineering



Biomedical Engineering integrates physical, chemical, mathematical, and computational sciences and engineering principles to study biology, medicine, behavior, and health. It advances fundamental concepts; creates knowledge from the molecular to the organ systems level; and develops innovative biologics, materials, processes, implants, devices and informatics approaches for the prevention, diagnosis, and treatment of disease, for patient rehabilitation, and for improving health.

Reference: www.bmes.org NIH working definition of bioengineering – July 24, 1997

Definition of Biomedical Equipment Technician BMET

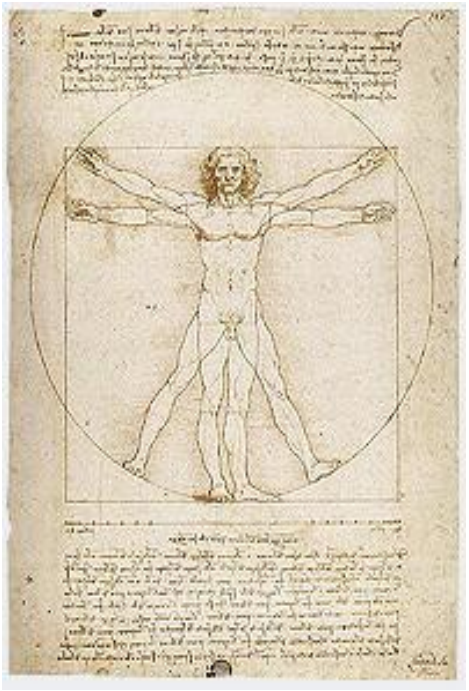


Biomedical Equipment Technician **BMET: Biomedical Equipment Technician I**—An entry-level or junior BMET. Works **under close supervision**. Performs skilled work on preventive maintenance, repair, safety testing, and recording functional test data. Usually has **less than four** years of experience.

BMET: Biomedical Equipment Technician II—A BMET who usually has an AS (2-year) degree or higher and several years of related or equivalent experience. Has good knowledge of schematics and **works independently** on repairs, safety testing and planned maintenance (PM). Maintains records, writes reports, and coordinates outside repairs. Average experience is eight years.

Reference: Career Planning Handbook; AAMI 2014; www.aami.org

Definition of Biomedical Equipment Technician BMET



Biomedical Equipment Technician

Sr. BMET: Biomedical Equipment Technician III—A highly experienced or specialized BMET usually having an AS (2-year) degree or higher. Has substantial experience and may be certified (CBET). Does highly **skilled work of considerable difficulty**. Has comprehensive knowledge of practices, procedures, and types of equipment. Average experience is twelve years.

Reference: Career Planning Handbook; AAMI; www.aami.org

Definition of Clinical Engineering

Clinical Engineering is a branch of biomedical engineering for professionals responsible for the management of medical equipment in a hospital. The tasks of a clinical engineer are typically the acquisition and **management of medical device inventory**, supervising biomedical engineering technicians (BMETs), ensuring that **safety** and **regulatory** issues are taken into consideration and serving as a technological consultant for any issues in a hospital where medical devices are concerned.

Reference: ACCE; American College of Clinical Engineering

Definition of HTM Health Technology Manager

HTM Health Technology Manager; Supports the HealthCare Community in the development, management, use of safe and effective technology.

- TMC: **AAMI's** Technology Management Council launched in 2013.
- **3 Levels of HTM**: Fundamental, Progressive and Advanced
- Each Level contains requirements and defined in several aspects: scope, compliance, management, equipment maintenance, Personnel and staff development, tactical and strategic planning, performance monitoring and improvement, patient and staff safety, work with other departments

Reference: AAMI HTM Levels Guide 2014, www.aami.org

HTM list of responsibilities

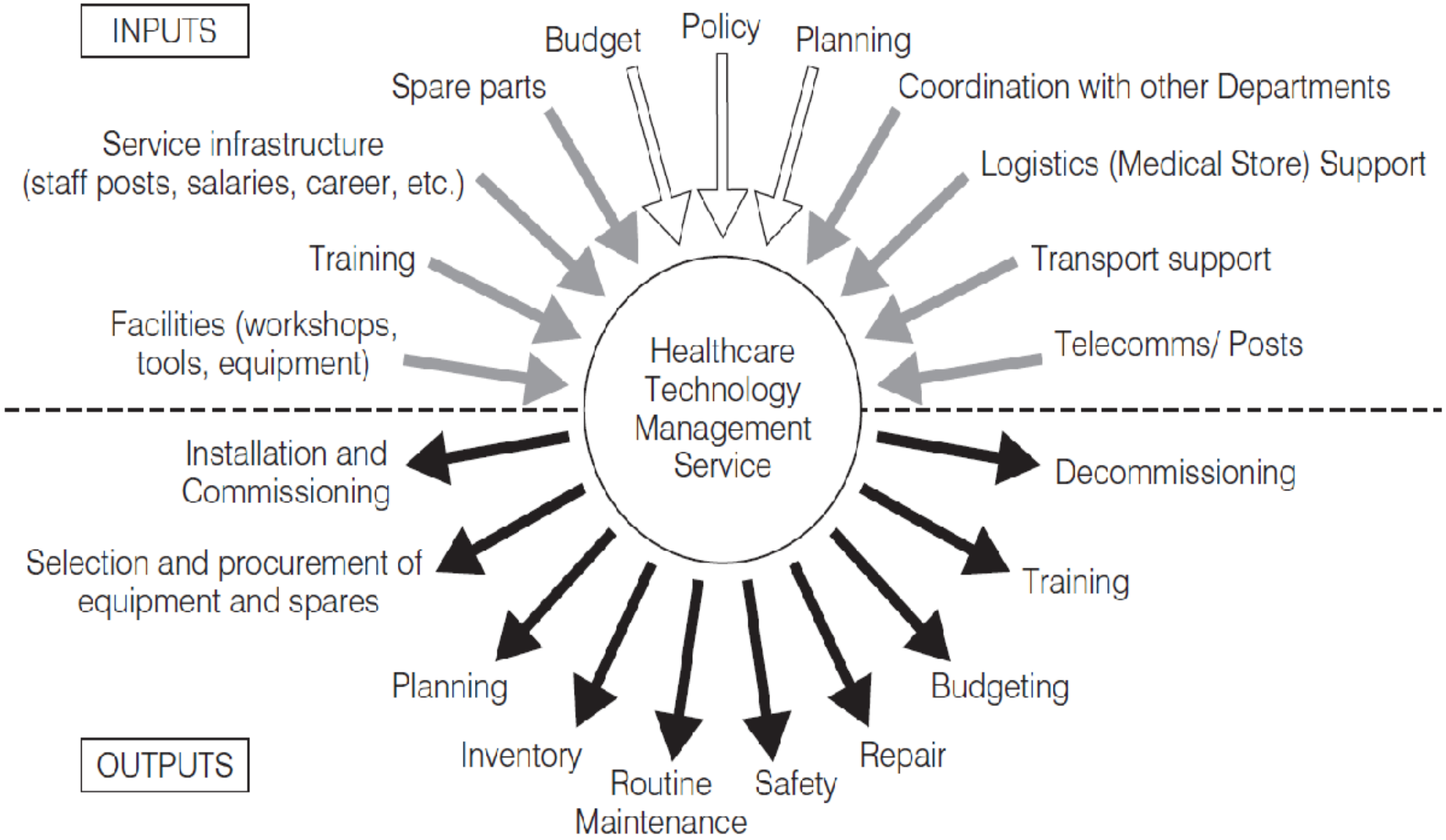
Responsibilities of the HTM include the following:

- Development/management of the dept. **annual goals**
- Development and management of the medical equipment **service business plan**
- Development and management of the medical equipment **management plan**
- Development and management of the **operating budget**
- Development and management of the **capital budget**
- **Contract management**
- Management of the in-house operational program
- Medical equipment **technology planning**
- Medical equipment selection and **acquisition**

HTM list of responsibilities

Responsibilities of the HTM include the following:

- Medical equipment **acceptance testing**
- Management of the medical equipment planned maintenance program
- Medical equipment **performance** assurance evaluations
- Medical equipment safety inspections
- Management of the medical equipment repair program
- Management of medical equipment **hazard alerts** and recalls
- Medical equipment management trending and analysis
- **Training** of BMETs and supervisors
- **Incident investigation** of medical device related injuries


INPUTS
Budget
Policy
Planning
Spare parts
Coordination with other Departments
Service infrastructure
(staff posts, salaries, career, etc.)
Logistics (Medical Store) Support
Training
Transport support
Facilities (workshops,
tools, equipment)
Telecomms/ Posts
Healthcare
Technology
Management
Service
Installation and
Commissioning
Decommissioning
Selection and procurement of
equipment and spares
Training
Planning
Budgeting
OUTPUTS
Inventory
Routine
Maintenance
Safety
Repair

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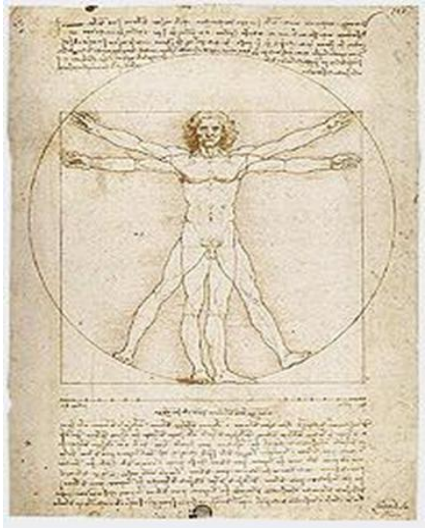
HTM Implementation at Saint George Hospital – Lebanon

- SGH-UMC Established in 1878
- General University Teaching Hospital
- 380 beds
- 23,343 patients/year
- (84% are private Hospitals in Lebanon)

Medical Engineering Department	
medical devices	1,769
acquisition cost $	$25 Millions
devices serviced In-house	77.5%
devices av. Age	8.46 yrs
#Services /yr	8,762
working hours /yr	7,015
#purchasing Studies /yr	122
#installations /yr	169
Full Time Equivalent FTE staff	16
application Trainings /yr	60
adv. Trainings at Factory /yr	7
av. CEU	47.85
Cost of Service Ratio COSR*	4.6%

*: must be <6% (Cohen et al, AAMI2015)



- Medical Engineering 20 years of services
- **1,769** medical devices served (May 2017)
- **24,748,753**US$ purchase cost
- **8.46** year is the overall average Age of equipment (vs 7 years guide number in USA)

- **95%** of the number of medical devices serviced in-house (vs 70% int'l) (77.5% of the $ value)
- 5% #equipment under Service Contracts
- **8,762** Services a year
- 122 Purchase Studies a year
- 169 Installations a year (varies with years)

Indicators (benchmarked)

- Yearly Financial; compares Service expenses versus outsourcing
- Cost of medical devices; by Dept., by specialty
- AGE of medical devices; by Dept., by specialty
- Service Contracts; coverage % and $
- Suppliers; distribution, %, and $
- Others …

Indicators (benchmarked)

- **COSR; Cost of Service Ratio**
- COSR= $\frac{\text{Total Cost of Expenses}}{\text{Total Cost of purchased Equipment}}$

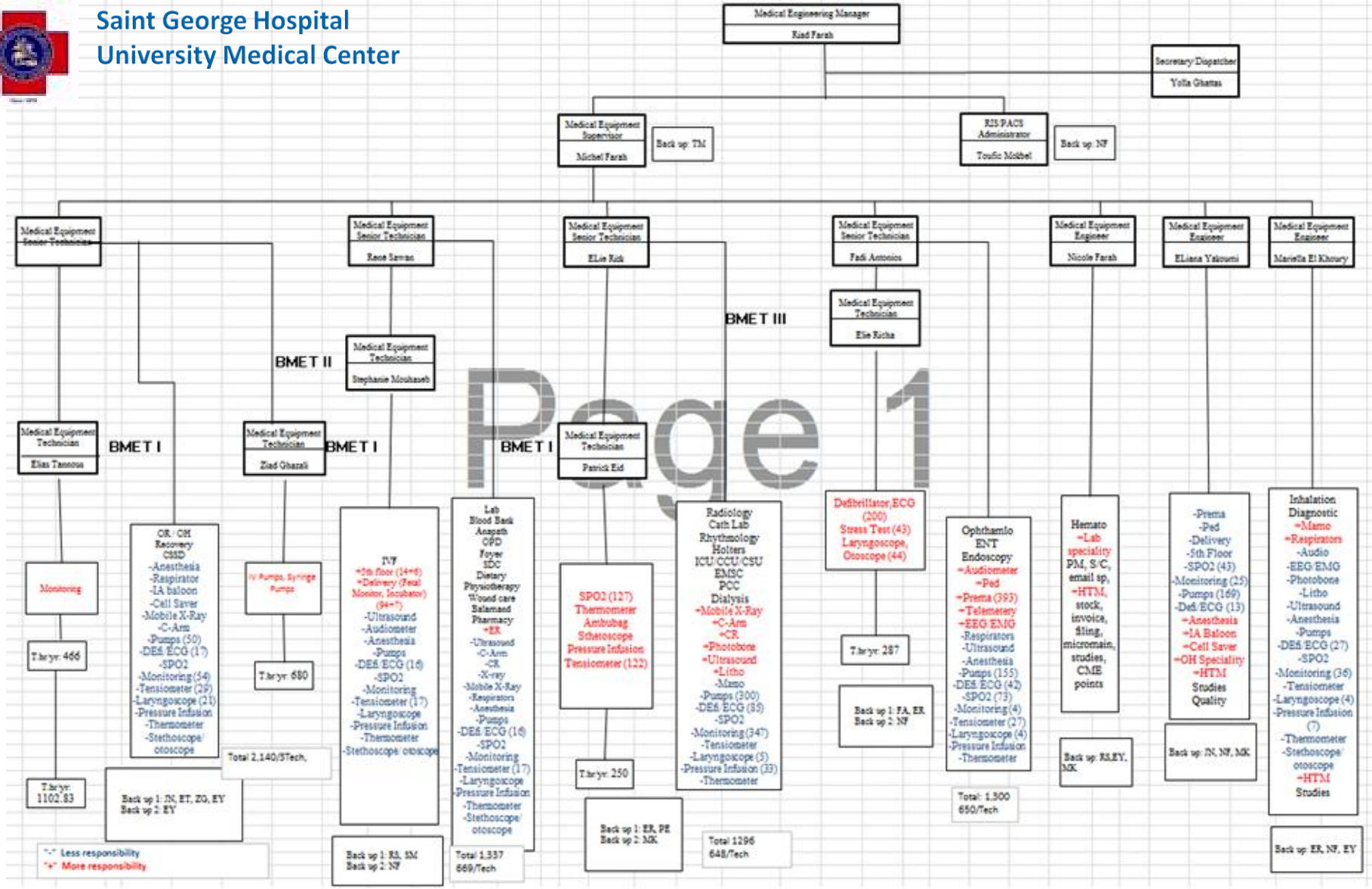
- Should be <**6%** (according to study Cohen et al, AAMI2017)
- SGHUMC **COSR=4.6%**

Indicators (benchmarked)

- **COSR; Cost of Service Ratio**

- Expenses = Salaries + Benefits + Dept. consumption + Trainings + Tools + Service Contracts & Labor charges+ Spare Parts

- 16 FTE full time employees
- 10 direct Repairs, 3 Repairs & Studies
- Grouping / back up by other 3
- JCAHO compliant (2006) (W.I. re-engineered, simpler, only 2 forms)
- Continuously Trained
- 60 Application Training / year
- 7 Advanced Factory Training / year
- 43 Internal Training / year
- 47.8 average certified contact hours



Medical Engineering Department
2017

WHO 2014

HTM to be implemented in Lebanon

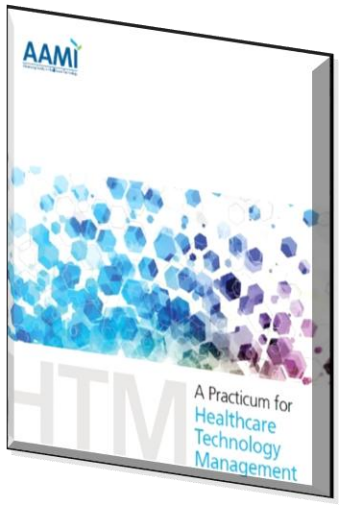
"45% of purchased technology NOT needed by Patients in 3rd World Countries"

WHO & AAMI implementation guidebooks

HTM Benchmarking guide – AAMI

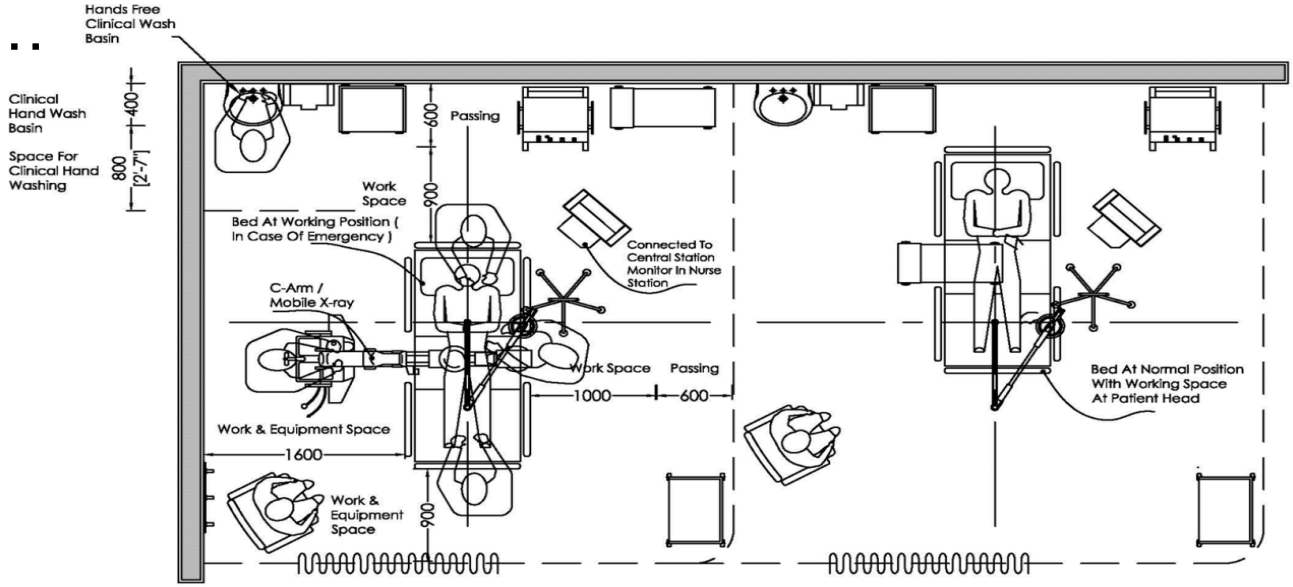
Guidebook: HTM a practicum for Health Technology Management; by AAMI

- **What HTM should be**
- HTM Implementation
- Replacement / Repair
- Reliability-Centered Maintenance RCM
- Incidents investigations
- needs Assessment HTA
- Min specs (Evaluation, Studies, Reception, Safety & Quality checks, Calibration, PM check sheets, FEATURES used)



Guidebook: HTM a practicum for Health Technology Management; by AAMI

- What we can also do
- Benchmarking, KPIs, vs international peer hospitals
- Project and Healthcare Facility management
- Room Schedule RS, Bill of Quantity BOQ
- Medical planner, Loaded Drawings, hospital Architecture (FGI), standards…



Medical Engineering Department
2017

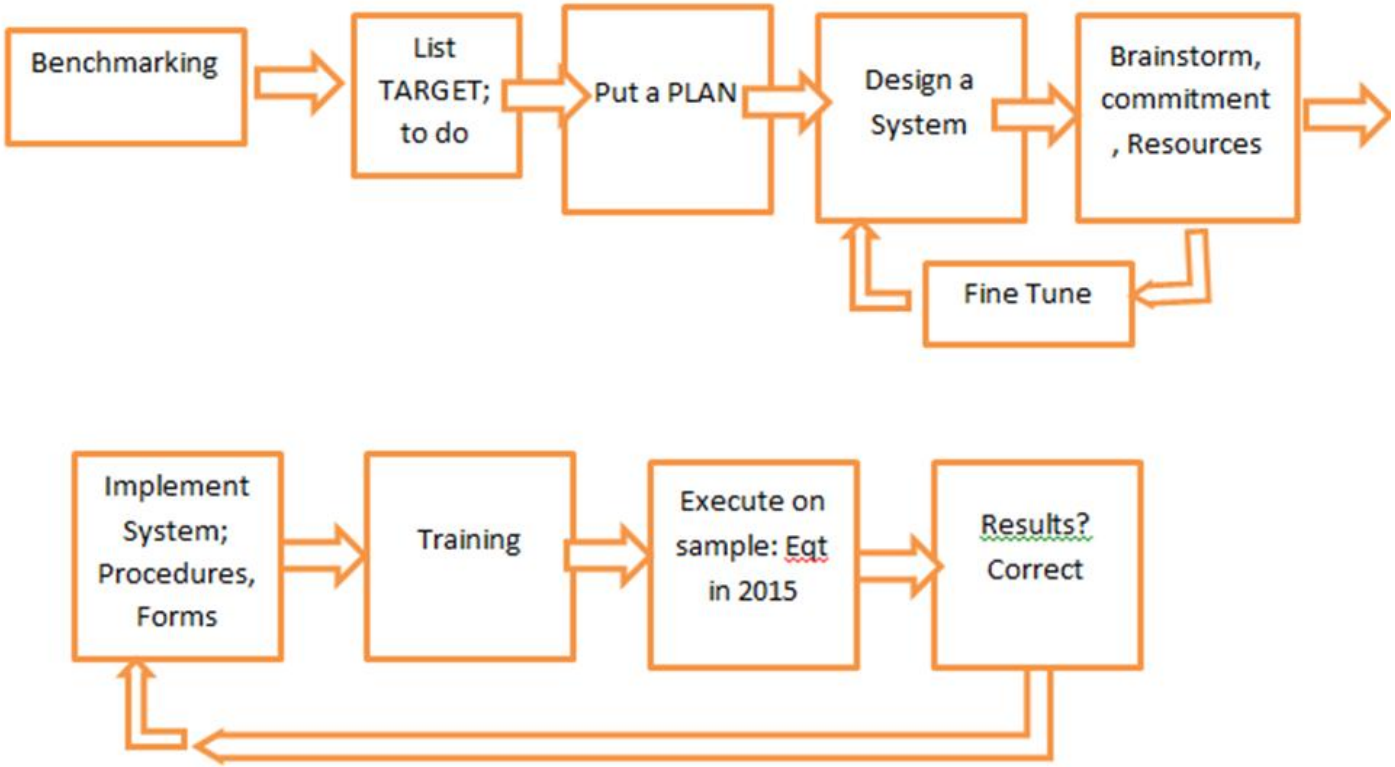
- 2015: Staff commitment in HTM
  - Tabulate HTM requirements
- **Gap Analysis**
  - Table of Lists to do
  - Plan for 2020 achievements
  - Change responsibilities by Specialty
  - Need to reduce activity wastes (LEAN)
  - (e.g.: Features purchased vs used)

FUNDAMENTAL	
Standards and Regulations	MED Compliancy
The HTM program maintains most of the general biomedical equipment in the organization	✓
The HTM program has a current, written medical equipment management plan (MEMP)	To complete
The HTM program achieves compliance with accreditation standards and government regulations	✓ ✓
The HTM program has an equipment control program in place with a risk-based inventory	
The HTM program uses a Computerized Maintenance Management System (CMMS) for inventory, maintenance scheduling, and maintenance history	To replace software
The HTM program has the ability to readily obtain repair parts	✓
The HTM program has written procedures for safety and functional testing and for preventive maintenance	Partly available, to do reference to ECRI
HTM program personnel have appropriate education, experience, credentials, and values	✓

- Top Management commitment
- Committees; Purchasing, Safety, CSR, Sustainability Design and Facility Management, Accountability / Matrix (Just Culture)

Saint George Hospital
University Medical Center

20/20 HTM Implementation Project – SGH UMC



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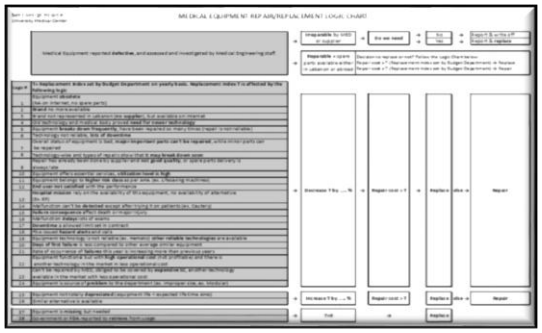


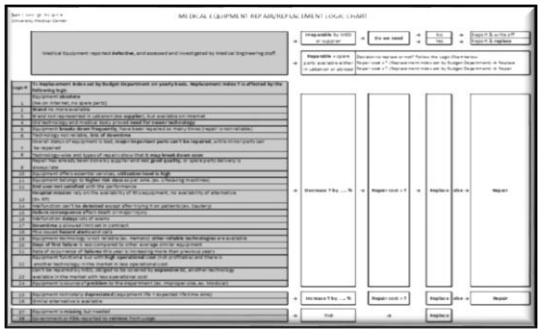
PROJECT 1

Replace / Repair Algorithm

Now: we Repair if Repair cost<25% of its Purchase Cost

This doesn't reflect the quality, reliability, and performance of the defected equipment

- Need for a Formula:
- Systematic
- Objective not subjective
- Standardized
- Reflects technically the status of the defected equipment in question
- Input from top Administration
- Reported to Administration / Purchasing Department / Budget



Workshop

Replace / Repair Algorithm

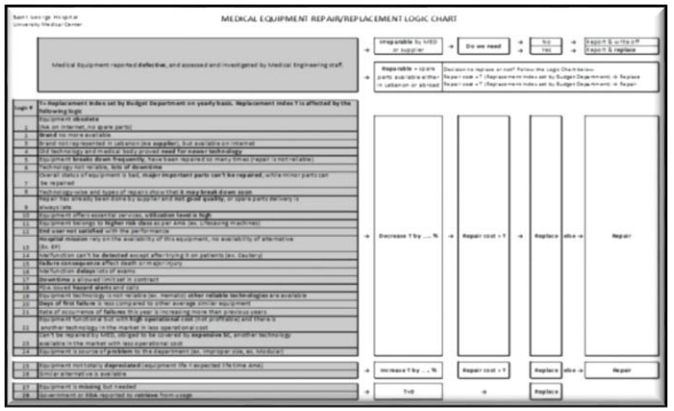
5 min exercise; group of 3

(Just write down notes)

(we learn from each other's experiences)

WHAT ARE THE LOGICAL RULES YOU NORMALLY REFER TO DECIDE WHETHER TO REPAIR OR TO REPLACE?

- Need for a Formula:
- Systematic
- Objective not subjective
- Standardized
- Reflects technically the status of the defected equipment in question
- Input from top Administration
- Reported to Administration / Purchasing Department / Budget



PROJECT 1

Replace / Repair Algorithm

Based on K coefficient

K ⇧ or ⇩ based:

- Availability / quality of support
- Reliability
- Failure consequences
- Financial / depreciation
- No equivalent backup
- Need for new Tech or service
- . . .

Repair / Replacement Algorithm

- The concept formula
- $K = \Sigma(Wn*Ln)*R$

- If $K \leq T$ ⟹ Repair

- If $K > T$ ⟹ Replace

Repair / Replacement Algorithm

- T is the Repair or Replace Threshold
- T is by default 25%
- T is set by the hospital Administration and Budget Department, based on the availability of funds and/or related operational budget
- T is set once a year, one month before the fiscal year
- If shortage in operational budgets, then T is increased meaning more repairs
- Otherwise, when budget is available, T is decreased.

Repair / Replacement Algorithm

- R is the Repair Cost Percentage, which equals to the Total Repair Cost over the Replacement Cost

Repair / Replacement Algorithm

- Ln is number nth Logical Rule for Repair or Replacement (i.e.: L1 is for logic rule # 1).
- L is TRUE, FALSE, or Not Applicable

- Wn is the Weight of importance of number nth Logical Rule.
- The current 26 logical rules do not carry the same weight of importance.

Repair / Replacement Algorithm

- l1 Logical Rule number 1 is equipment **obsolete**. The Equipment is very old, is no longer under production (end of life), and spare parts and support are no longer available (end of support).
- l2 Logical Rule number 2 is related when the **brand** name of the equipment is no more available; the manufacturer is either closed, sold out, or merged with other company and changed products. Therefore the manufacturer support and spare parts will not be available for the equipment.

Repair / Replacement Algorithm

- I5 is related to when the equipment **breaks down** frequently. It has been repaired many times but it is still frequently getting defective. Therefore the equipment is no longer reliable, expects to break down again, and better not to use it on patients.

Repair / Replacement Algorithm

- I10 is when the equipment is important, offers essential services, and its **utilization level** is high. In that regards the equipment should be classified as such, and repair/replace logic should consider the importance.
- I11 is when the equipment belongs to higher **risk class** as per International references, like American Hospital Association AHA or others (ex. Lifesaving machines).

Repair / Replacement Algorithm

- I14 is when the malfunction **can't be detected** except after using it on patients (ex. Some types of Electro-surgery devices). Its usage may sometimes be dangerous and may threaten patient's life. Some equipment does not have self-test on booting up.
- I15 is when **failure consequence** affects death or major injury like the case of life saving machines, or electrotherapy devices... Therefore machine is not reliable and better not to use it on patients.

Repair / Replacement Algorithm

- I18 is when FDA issued hazard alerts and **recalls** on this device.
- I21 is when indicators show that the **rate of occurrence of failures** this year is increasing more than previous years.
- I23 is when the equipment can't be repaired in-house by the Medical Engineering Department, obliged to be covered by **expensive Service Contract**, and another technology available in the market with less servicing cost.

Repair / Replacement Algorithm

- I25 is when the equipment is not totally **depreciated** (equipment life < expected life time).
- I26 is when similar alternative **back-up** equipment is available. Replacing a defected equipment which does not have a back-up is more serious than another one with back-up available. This logic varies between hospitals, and is device dependent.

Repair / Replacement Algorithm

- Moreover, there are other logical rules, but affect the formula differently. If the government or any other reference bodies like FDA reported to **retrieve** the equipment from usage, then K=0 and machine will be replaced.
- If the defected equipment is judged irreparable and is needed, then it will be replaced. Otherwise, if it is not needed, then it will be **written off**.

Reliability Centered Maintenance

RCM, (and Failure Mode & Effects Analysis):

Started in Aviation

Reduced PM costs by 70%

RCM

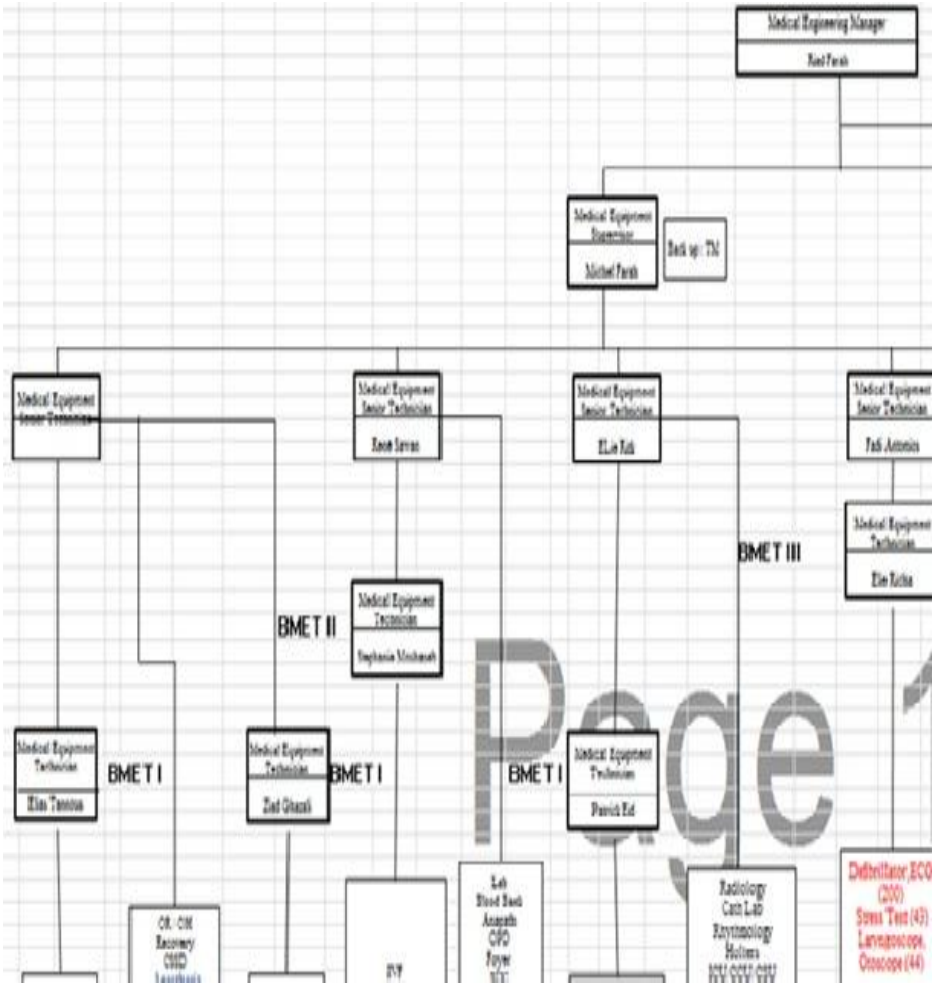
- Functions / failure mode
- Events leading to failure / quantify
- What to prevent / hidden failures
- Factory recommendations / check list
- Reduce steps

PROJECTS

- Digitizing the whole Hospital
- Digitizing Diagnostics Dept. – ready
- Digitizing Endoscopy Dept.– ready
- Medical Database Center – ready
- Back-up Plan – ready
- Emergency Plan – under improvement
- Equipment Life Cycle
- Unify Assets definition, and Assets books – ready
- OR Instruments management – ready

Need to introduce two extra levels of Technicians

- Three levels of Technicians
- BMET I, BMET II, BMET III as per International HTM scales
- Assignments by experience, knowledge, degree, and skills
- Maintaining current HR scale for all other staff
- Salaries suggested in between current technicians and Senior Technicians

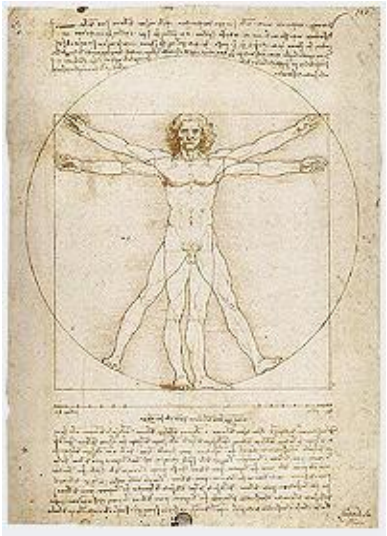


Technicians skills

Computer
Operation
Anatomy / physiology
Electronics
Non scale
Special Tools
Networking and IT software
Connectivity with other devices
Storage management
Pre-installation requirements
Application training
Training and teaching skills

	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
1	TAG #	Item	FDA Nomenclature	computer setting	electronics troubleshooting	operation	technical repair	technical training needed	service keys	special service keys	service manual	special tools for repair	testing tools	special calibration requested	patient safety	network connectivity	connectivity to other units	pre-installation requirements	application training needed	special software application
2	3	ASPIRATORS, SURGICAL	Apparatus, Suction, Patient Care	-	√	√	√	-	-	-	√		-	-	√	-	-	-	-	-
3	2708	TELEMETRY, REVIEW STATION	Telemetry, review station	√	√	√	√	√	√	-	√		-	-	-	√	√	√	√	√
4	1038	INCUBATORS, INFANT	Incubator, Neonatal	-	√	√	√	√	-	-	√		-	-	√	-	-	√	√	-
5	1883	PHOTOTHERAPY UNITS, HYPERBILIRUBINEMIA	Unit, Neonatal Phototherapy	-	√	√	√	-	-	-	√		√	-	√	-	-	-	-	-
6	1543	RESUSCITATORS, BABY	RESUSCITATORS, BABY	-	√	√	√	-	-	-	√		-	-	√	-	-	-	-	-
7	1756	ULTRASOUND	ULTRASOUND	√	√	√	√	√	√	√	√		√	-	-	√	√	-	√	√
8	1788	HUMIDIFIER	Heater, Perineal, Radiant, Non-Contact	-	-	√	√	-	-	-	√		-	-	√	-	√	-	-	-
9	2062	SCALES, INFANT, DIGITAL	Scale, Patient, Infant, Digital*	-	√	√	√	-	-	-	-		√	-	-	-	-	-	-	-
10	2151	VIEWER, VEIN	VIEWER, VEIN	-	-	√	√	-	-	-	-		-	-	-	-	-	-	-	-
11	2152	TRANSILLUMINATOR, NEONATAL	TRANSILLUMINATOR, NEONATAL	-	√	√	√	-	-	-	√		-	-	-	-	-	-	-	-

Biomedical Engineering – Global



World Health Organization WHO – Medical Devices
http://www.who.int/medical_devices/en/

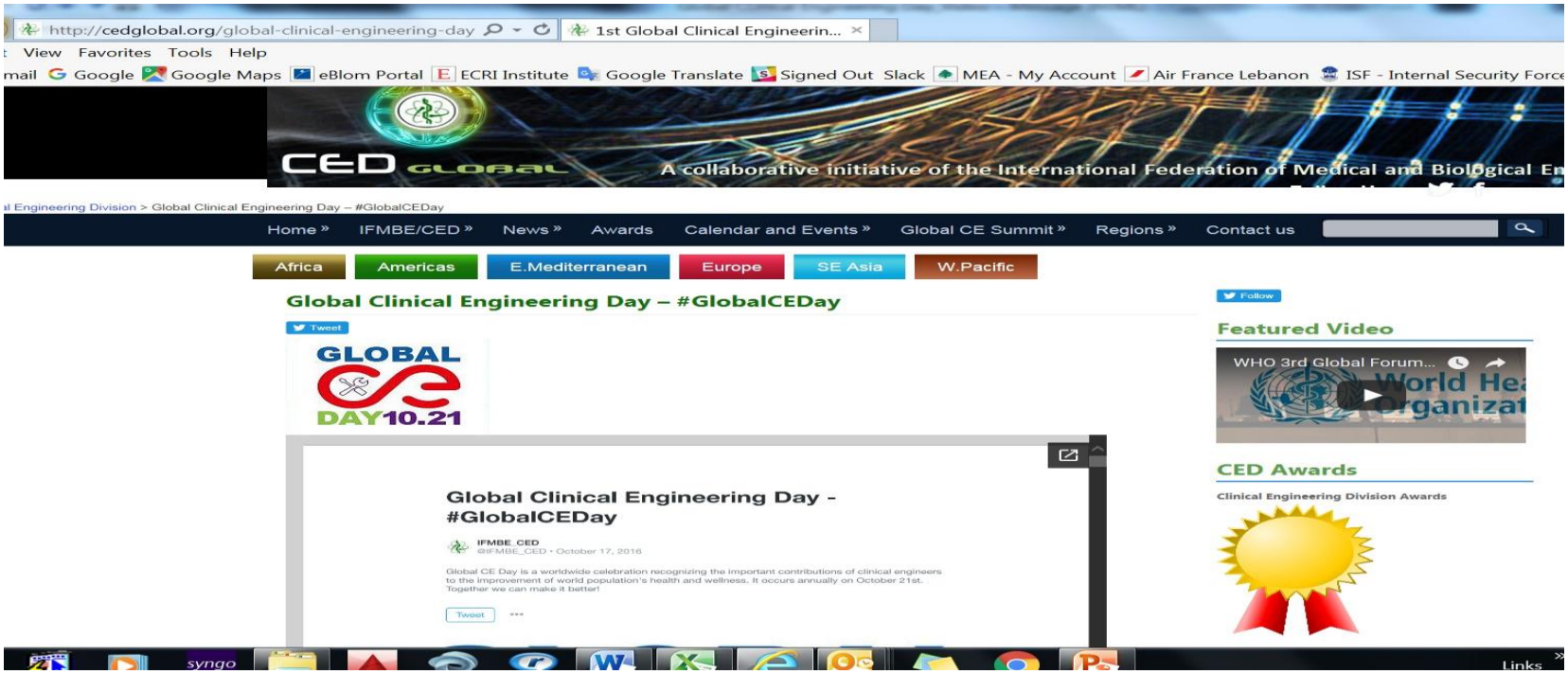
International Federation for Medical and Biomedical Engineering IFMBE
http://2016.ifmbe.org

American College of Clinical Engineering
http://accenet.org

Association for the Advancement of Medical Instrumentation AAMI
http://www.aami.org/

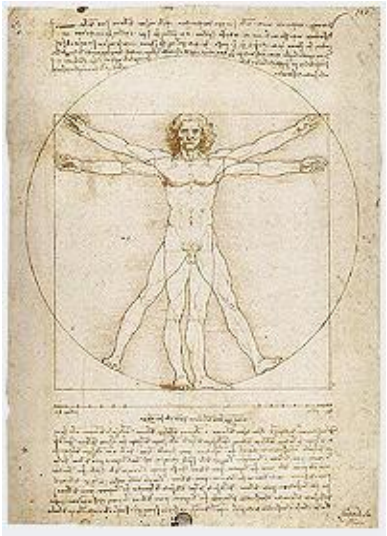
2nd International C.E & HTM Congress Sao Paulo Brazil

Global Clinical Engineering Day- OCT 21



http://cedglobal.org/global-clinical-engineering-day-globalceday/

Biomedical Engineering – Global



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SURVEY
https://docs.google.com/forms/d/e/1FAIpQLSfvtucVwuhQrALeGw_Ia4VoXKvRU03KHuQb9RxVaAUH9cLlKw/viewform?usp=sf_link

Medical Engineering Slogan

WE GLADLY SERVE BEFORE YOU ASK

QUESTIONS?