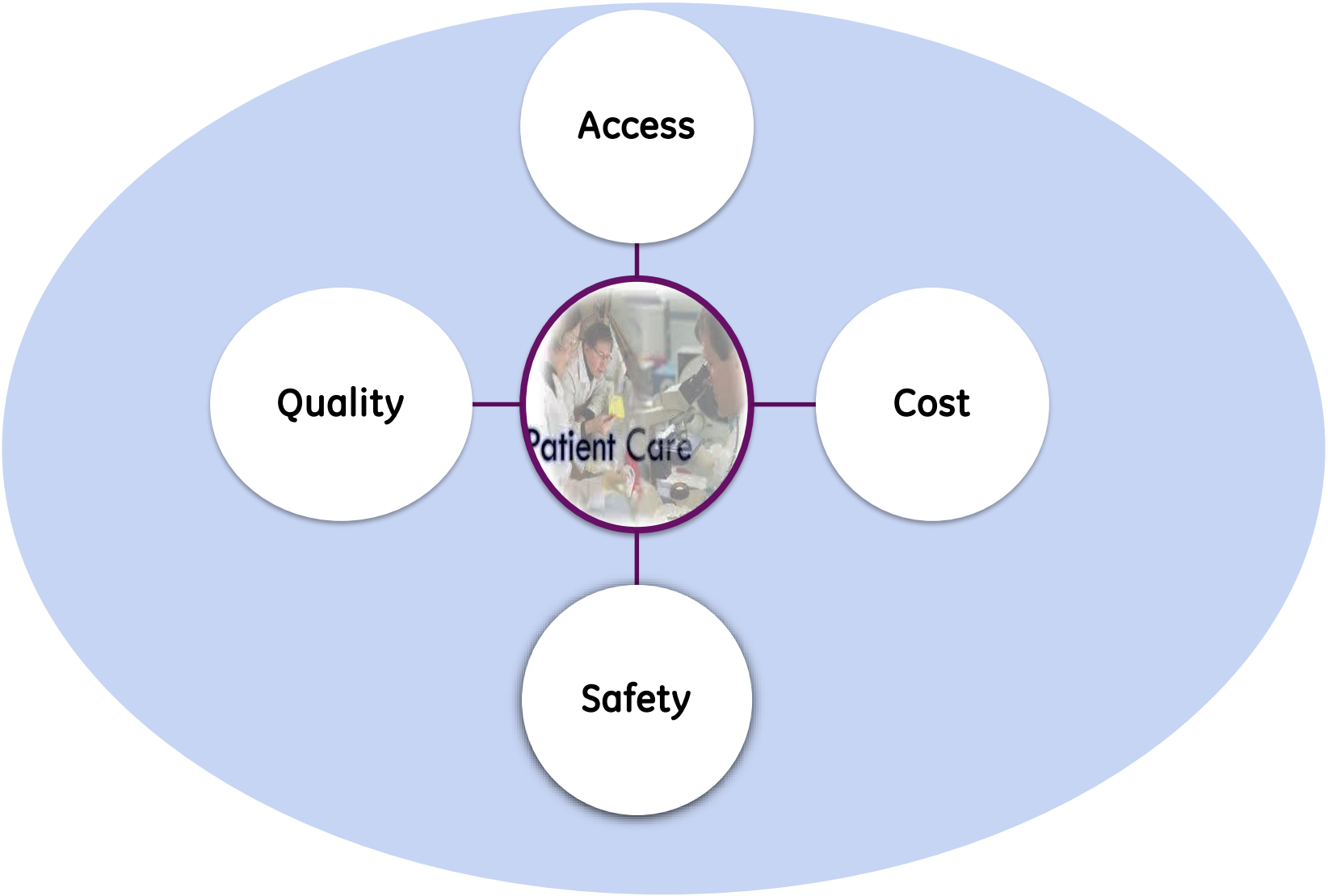
ARAB bioclinic 3
BIOMEDICAL & CLINICAL ENGINEERING

The 3rd International Conference
**ON Biomedical & Clinical Engineering**

# Main Elements of HTM System and Quality of Patientcare

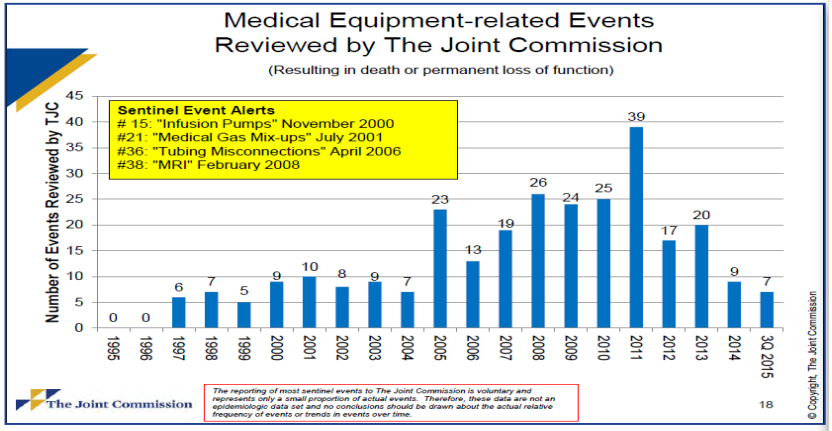
**Iyad Mobarek, Malkawi**

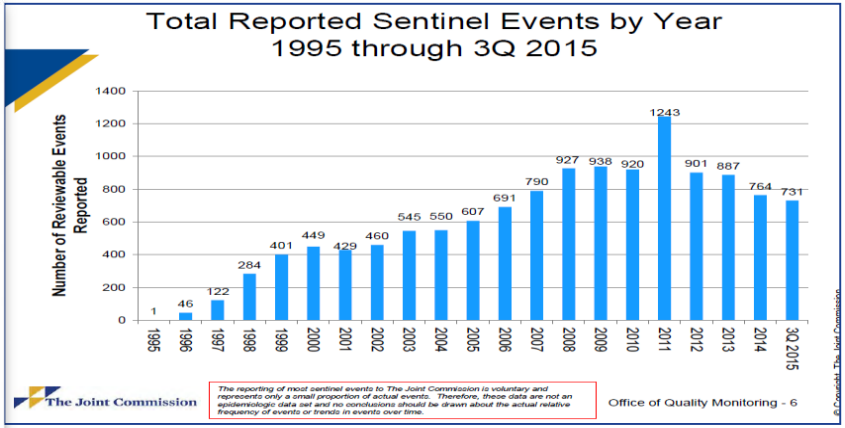
# Vision of healthcare institutions ?



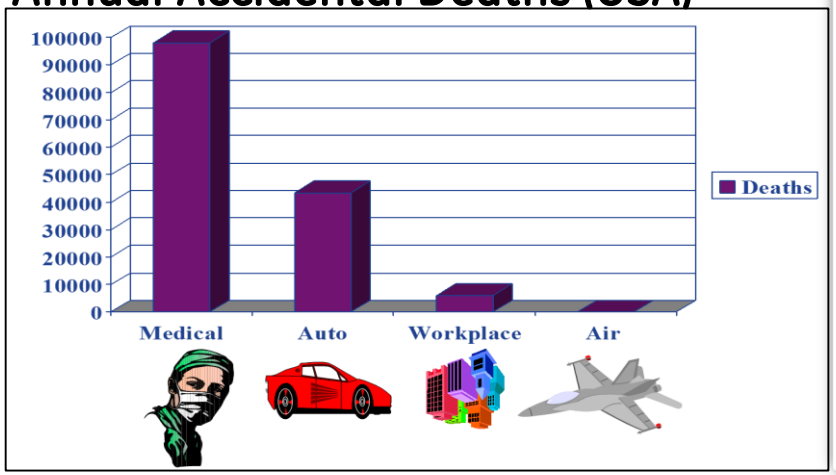
# Preventable Medical Errors

Up to 440,000 Americans are dying annually from preventable medical errors*



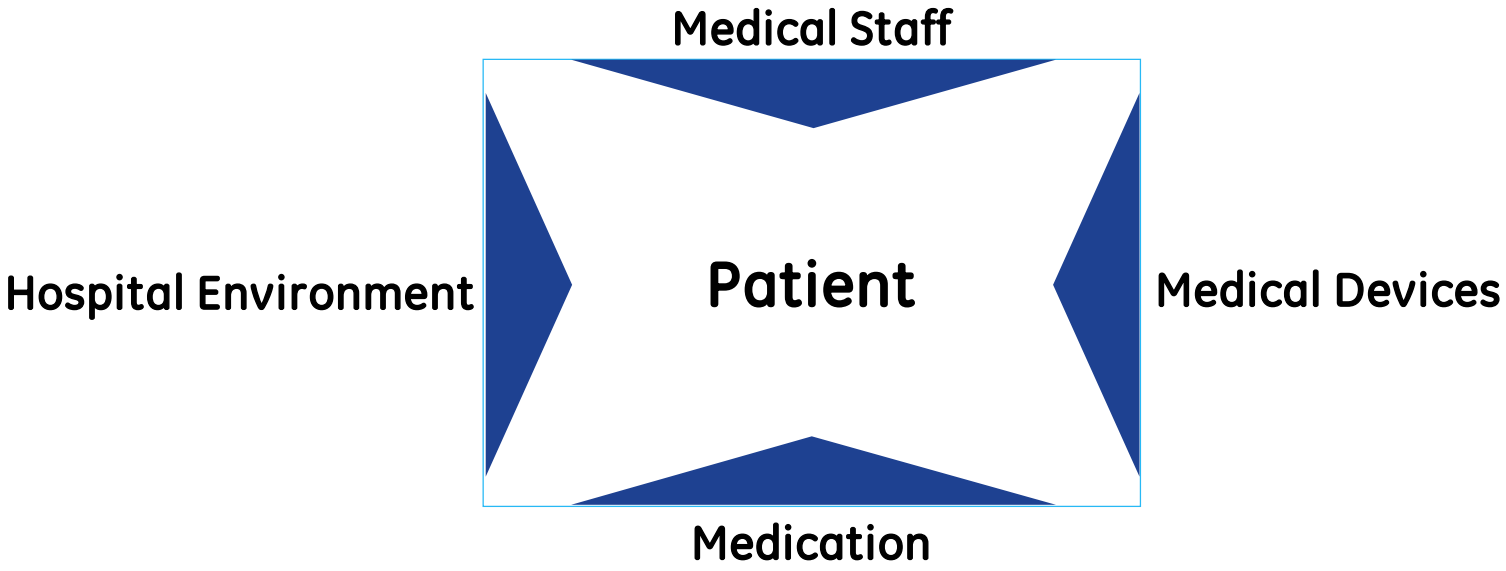

## Annual Accidental Deaths (USA)




- Healthcare is way behind aviation industry in terms of safety, incidents, errors and regulation
- Operating hospitals similar to airplanes ?
- Turkey MOH benefited from military for their PPP evaluation formula

* http://www.hospitalsafetyscore.org/newsroom/display/hospitalerrors-thirdleading-causeofdeathinus-improvementstooslow

# Patient Interactions




We need to build HTM system that minimizes incidents and adverse events

Causes of Medical-device-related Incidents

- Device failure
- Device interaction
- User error
- Maintenance error
- Packaging error

# Medical Equipment Function

**Medical Equipment**

*Direct Patient Use*

**Test Equipment**

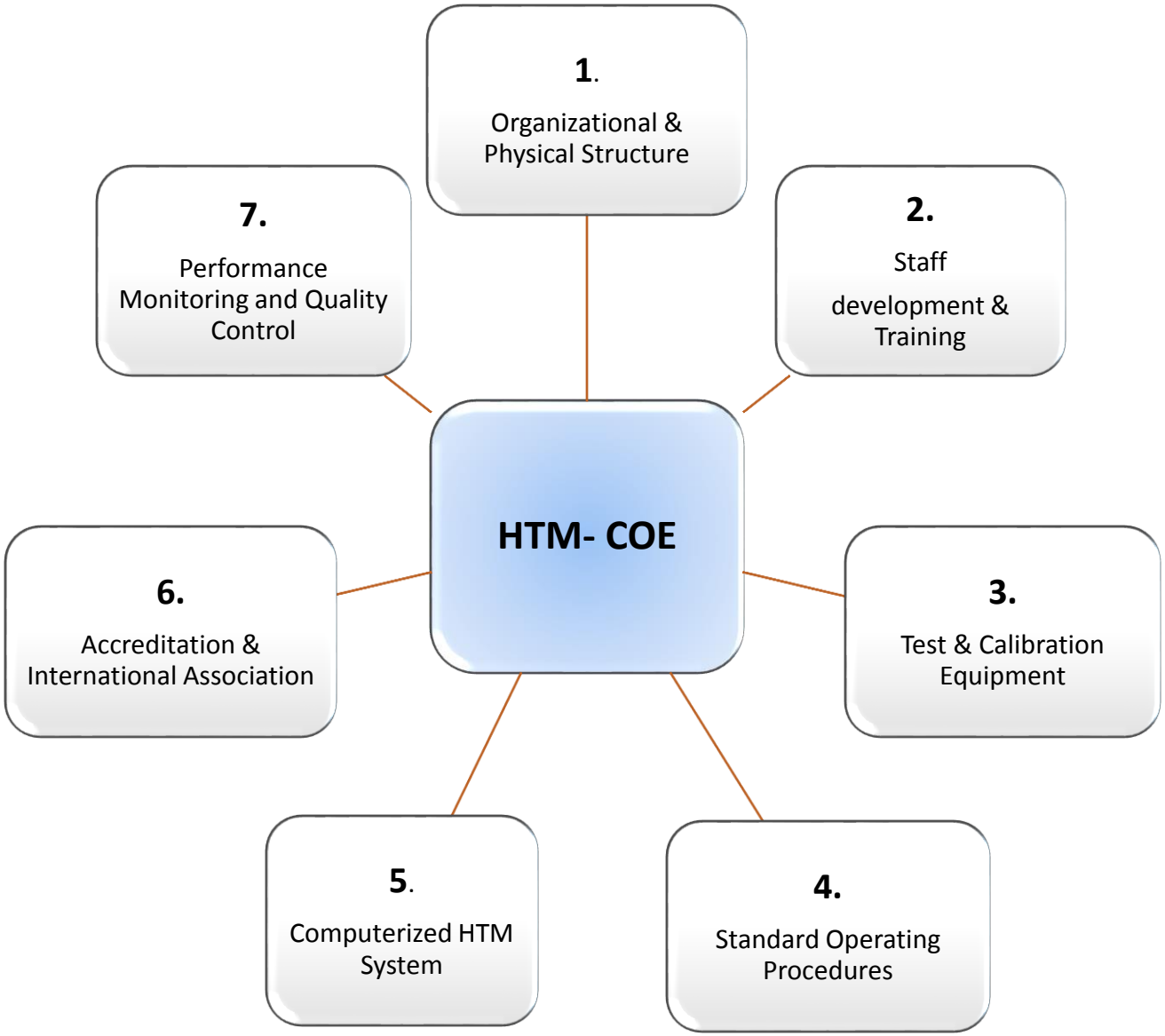
*Tests Medical Equipment*

**Calibration Equipment**

*Verifies Test Equipment Accuracy*

All type of equipment are critical to Patient Safety and Quality of Healthcare

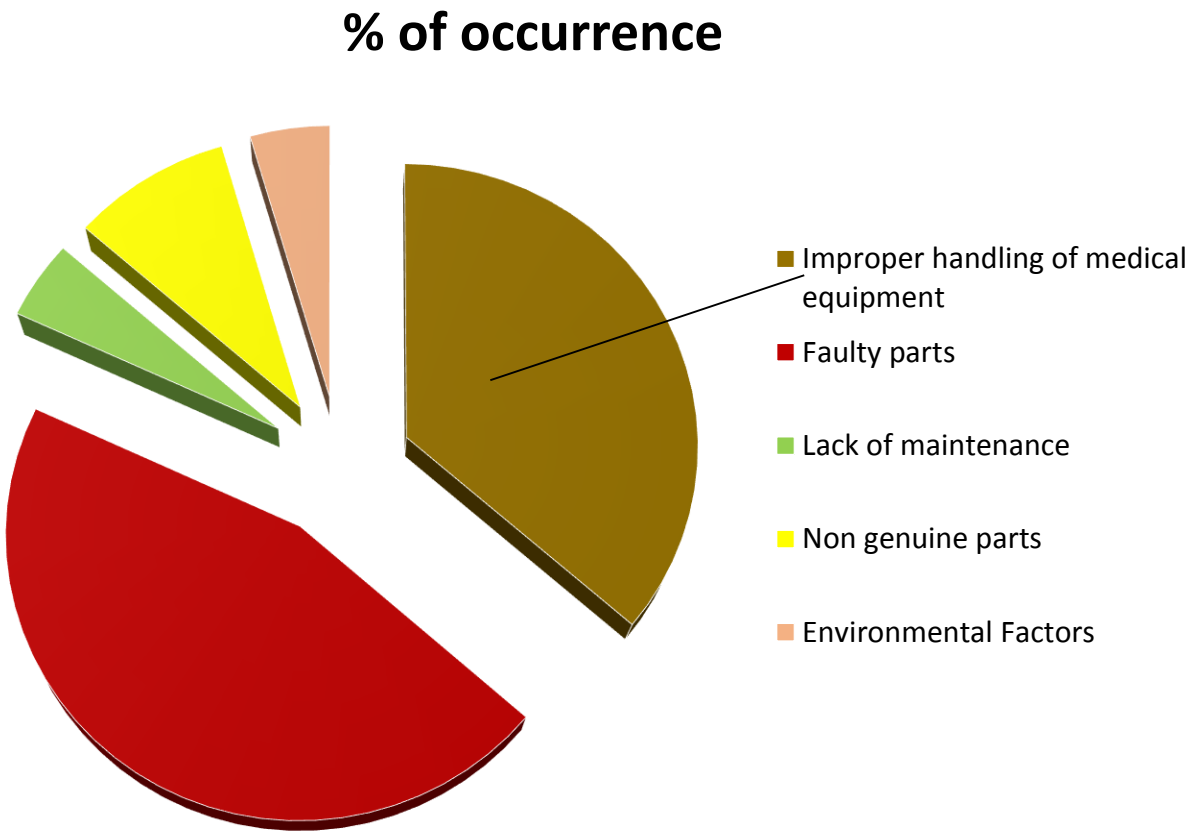
# Building the Components of the HTM



# User Training

## a Key component for successful Healthcare Technology Management

Studies on aspects that contribute to equipment breakdown

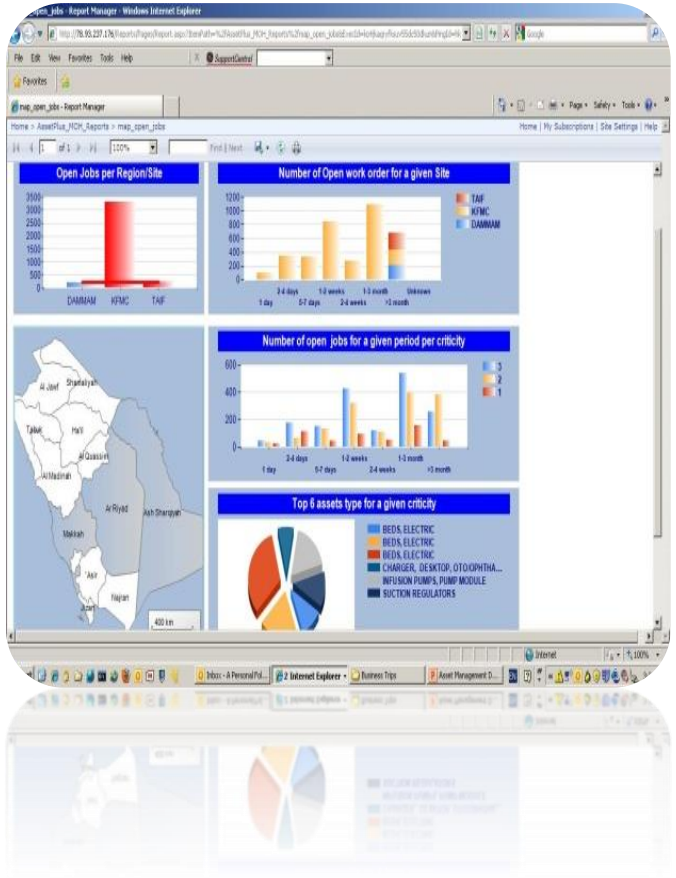



Source: ECRI Institute

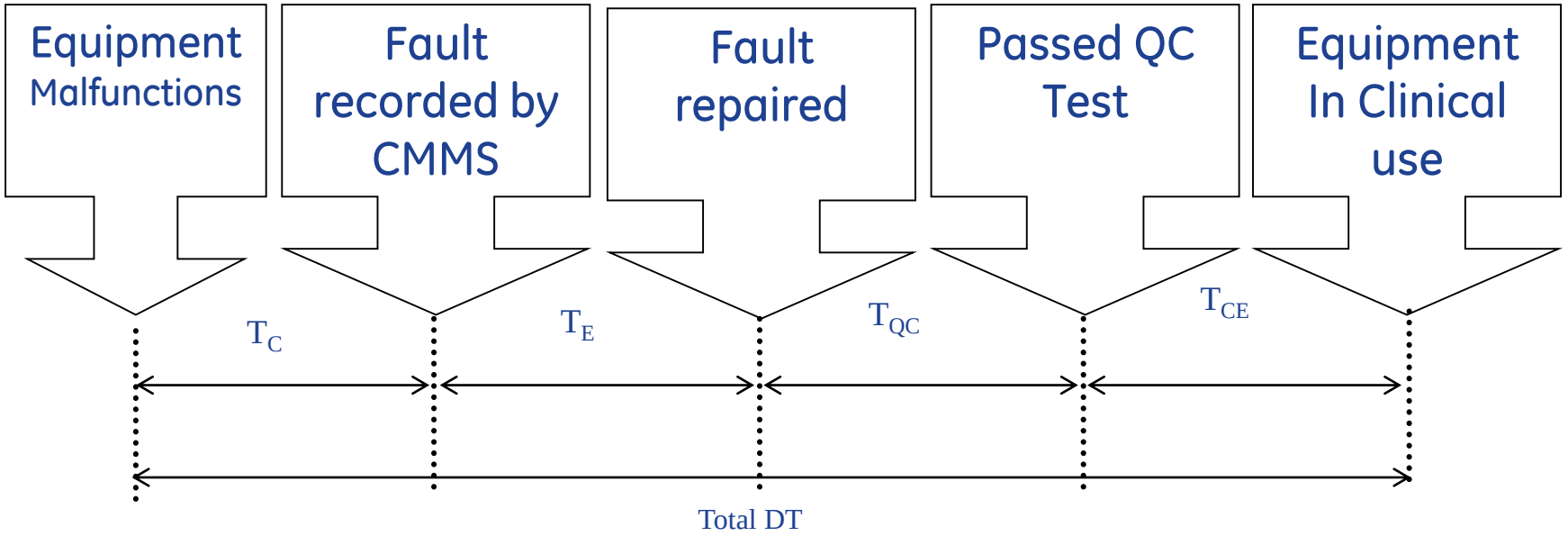
# Performance Monitoring and Quality Control

**Continuous improvement with KPI metrics**

- ✓ Incident frequency
- ✓ Recalls
- ✓ Down Time (DT)
- ✓ TBR (Mean Time Between Repairs) and MTTR (Mean Time To Repair)
- ✓ Repeated failures within a specified period
- ✓ PPM (Planned Preventive Maintenance) Compliance
- ✓ Response time
- ✓ Service cost ratio

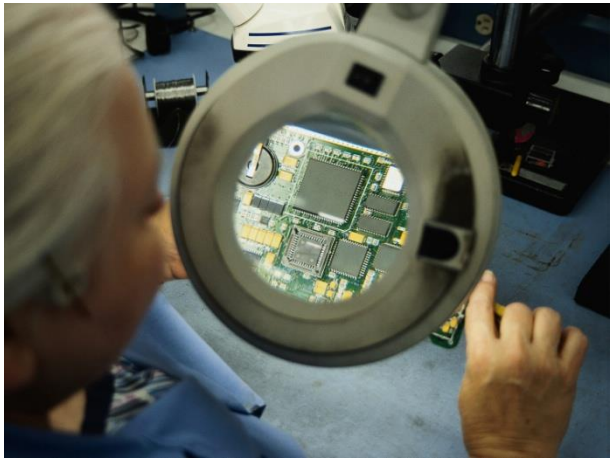


# Down Time (DT)




- True Down Time Cost (TDC)… difficult to estimate
- Total DT = **Σ**($T_{clinical}$ + $T_{Eng}$ + $T_{QC}$ + $T_{EC}$ +…)
- DT formula

$$DT = \frac{MTTR}{MTTR+MTBF}$$

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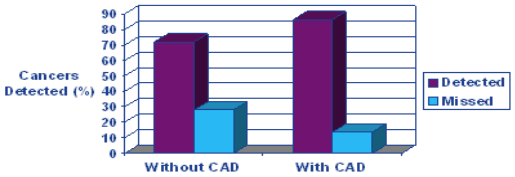
# Patient safety and health technology

# Safety in Preventive / screening technologies

## Screening and Early Detection of Diseases

Mammography & US screening for early detection of breast cancer

- Screening
- Care pathways
- CAD





## Diagnostic Systems

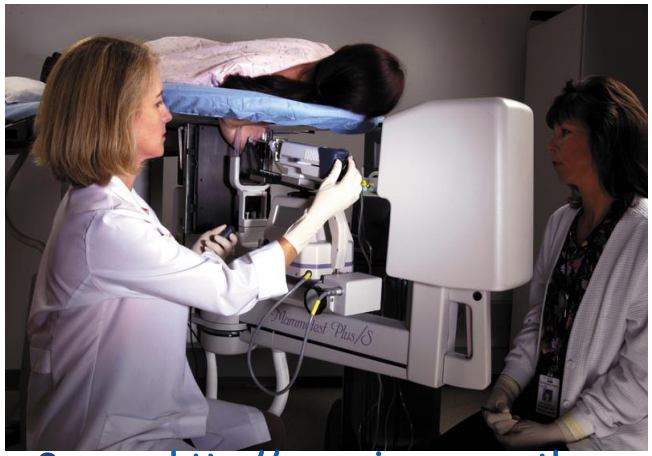
Stereotactic Biopsy

Promote use of technologies
Calibration is critical

Very accurate computerized needle positioning

Minimum clinical complications

Cost effective and quality impact



Source: http://www.imagenorth.org

# Diagnostic & radiotherapy systems

## Radiation protection

- **National requirements**

  Servicer versus operator requirements

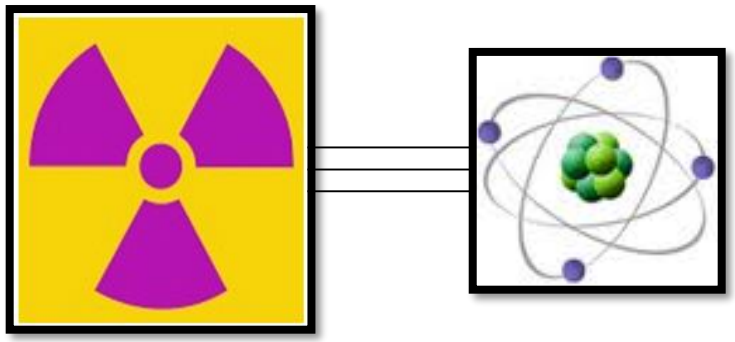
- **Control measures**

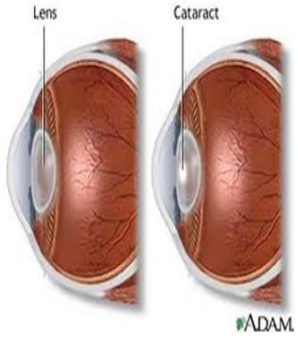
  PPE (shielding)

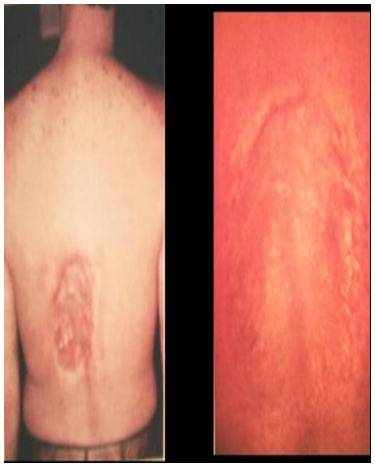
  Training for self protection

- **Optimization of protection** by keeping exposure As Low As Reasonably Achievable (ALARA) concept

- **Dose limits (ICRP 60)**





| | Occupational | Public |
|---|---|---|
| Effective dose | 20 mSv/yr averaged over 5 yrs. | 1 mSv in a yr |

# Treatment Systems

## Innovative Surgical Procedures

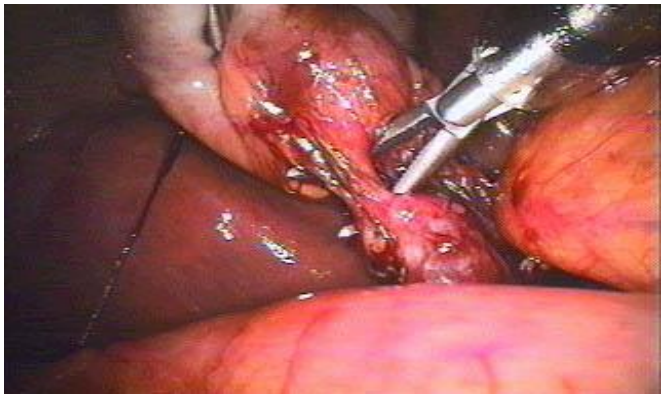
Minimum Invasive Surgery

Laparoscopic & Stereotactic guided surgery

Interventional radiology

Arthroscopy

laparoscopic cholecystectomy



A closer access to the different anatomic parts

Accurate biopsies

Avoiding major traditional surgeries

reducing patient stay

less risks of infection and post-op complications.

Oesophageal Mayotomy

Source: http://www.laparoscopy.com

# Sentinel Event Alert # 50
# Medical device alarm safety in hospitals

- **98 reported events  80 resulted in death and 13 in permanent loss of function**
  Example: Patient with head injury died because of failing to respond to oxygen loss alarm – brain damage
- **Major contributing factors**
- Absent or inadequate alarm system (30)
- Improper alarm settings (21)
- Alarm signals not audible in all areas (25)
- Alarm signals inappropriately turned off (36)

- **Other factors**
- Alarm fatigue –most common
- Alarm settings not customized to individual patient or patient population
- Inadequate staff training
- Inadequate staffing to support or respond to alarm signals
- Alarm conditions and settings that are not integrated with other medical devices
- Equipment malfunctions and failures
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http://www.jointcommission.org/assets/1/18/SEA_50_alarms_4_5_13_FINAL1

# Conclusions

*Our mission as biomedical engineers is support enhancing quality of patient care…*


# Resources


1. American Collage of Clinical Engineering (ACCE) www.accenet.org
2. World Health Organization www.who.int
3. Association for the Advancement of Medical Instrumentation (AAMI) www.AAMI.org
4. Emergency Research Institute documentations and website www.ecri.org
5. Health Information and Management System Society (HIMSS) www.himss.org
6. IEEE Engineering in Medicine and Biology www.ieee.org/embs/index.html
7. Iyad Mobarek, Computerized maintenance management system, WHO Medical device technical series, WHO 2011 www.who.int
8. Iyad Mobarek, et al, Fully Automated Clinical Engineering Technical Management System, Journal of Clinical Engineering: January/March 2006 - Volume 31 - Issue 1 - pp 46-60
9. Iyad Mobarek, et al, Fully Automated Downtime Protocol, Journal of Clinical Engineering: October/December 2010 - Volume 35 - Issue 4 - pp 195-214