:

Principali norme e linee guida per la valutazione tecnica e clinica dei dispositivi medici in Europa

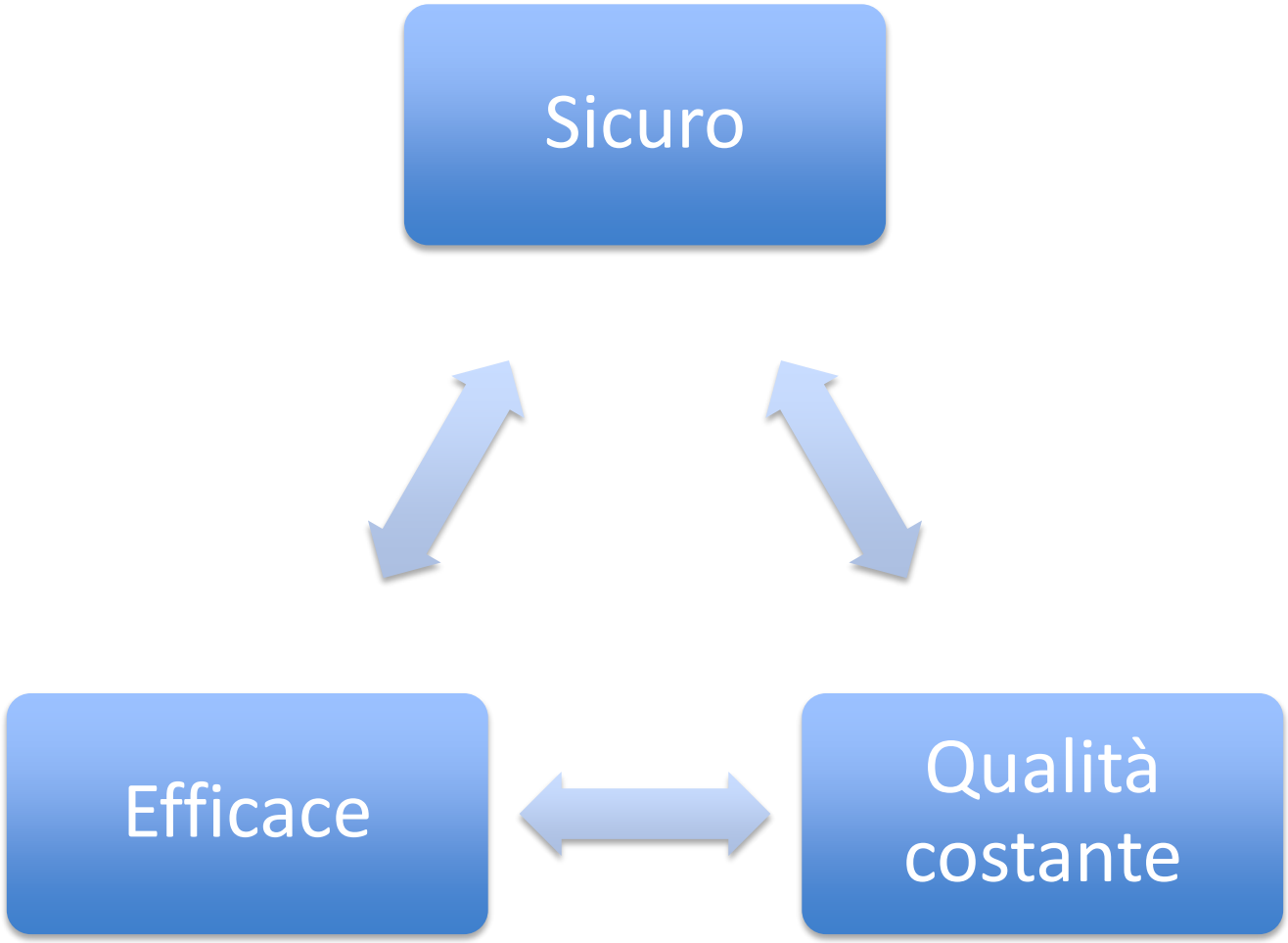
Classification and risk

- Class I: lowest risk
  - non sterile gauze, reading glasses, conductive gel
- Class IIa: lower intermediate risk
  - IV set, transfusion sets, ECG
- Class IIb: upper intermediate risk
  - Wound care, blood bag; DAE
- Class III: highest risk
  - Heart valves, medicated stents

Gli obblighi dei fabbricanti

- I dispositivi forniscono le prestazioni previste dal loro fabbricante e sono progettati e fabbricati in modo che, in normali condizioni d'uso, siano adatti alla loro destinazione d'uso. Essi sono sicuri ed efficaci e non compromettono lo stato clinico o la sicurezza dei pazienti, né la sicurezza e la salute degli utilizzatori ed eventualmente di altre persone, fermo restando che gli eventuali rischi associabili al loro utilizzo sono accettabili, considerati i benefici apportati al paziente, e compatibili con un elevato livello di protezione della salute e della sicurezza, tenendo conto dello stato dell'arte generalmente riconosciuto.

Traduzione…



Sicuro

- Aderente a standard minimi di sicurezza
  - Noti allo stato dell' arte
  - Testabili
  - Sicurezza elettrica, sterilità, biocompatiblità

- Bilancio favorevole tra rischi e benefici

Risk subjects

- Manufacturer shall evaluate impact of use of the device:
  - On patient
  - On intended user
  - On bystanders
  - On general environment
- Manufacturer shall evaluate effect of product impact in all life cycle, from manufacturing to disposal

Standards

- Device lifecycle is regulated as per:
  - ISO 13485 for Quality Systems
  - ISO 14971 for Risk Management
  - ISO 14155 and various guidelines for Clinical Investigations
- Each product category is then regulated by technical norms
  - For electro medical devices IEC 60601-1
  - For sterile devices ISO 11137 et al.
  - For devices in contact with the body ISO 10993
  - Multiple harmonised and not harmonised norms for technical regulation of product- specific features

Where do standards come from?

- International standardization Bodies
  - ISO
  - IEC
  - ASTM
- Some standards have regulatory effect
  - Harmonised standards in EU
  - Recommended standards in USA

I principali standard di sicurezza: sicurezza elettrica

- Correnti di dispersione sull apparecchio:
  - corrente che scorre dalla parte collegata alla rete verso terra attraverso il conduttore di terra di protezione, attraverso le parti conduttrici accessibili dell involucro e attraverso le parti applicate(cortocircuito);
- Corrente di dispersione nel paziente: corrente che scorre tra la connessione paziente attraverso il paziente verso terra; oppure dovuta da una sorgente esterna applicata sul paziente

I principali standard di sicurezza: biocompatibilità

noun bio·com·pat·i·bil·i·ty \-kəm-ˌpa-tə-ˈbi-lə-tē\

Compatibility with living tissue or a living system by not being toxic, injurious, or physiologically reactive and not causing immunological rejection

https://www.merriam-webster.com/dictionary/biocompatibility

Biocompatibility testing ranges from the initial screening of new materials to product release testing, periodic audit testing, and non-clinical or pre-market safety evaluations to meet current FDA and international standards

Safety evaluation studies (*in vitro* and *in vivo*) are conducted on a variety of biomaterials, medical devices, and related products to identify the presence of toxins or any other potentially harmful effects

Duration of body contact

clause 5.3

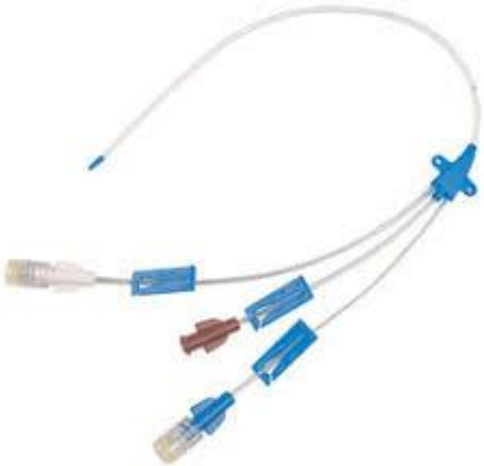
C: Permanent – 30d plus (even intermittent)

Implants

Repeated use devices

B: Prolonged – 24h to 30 d

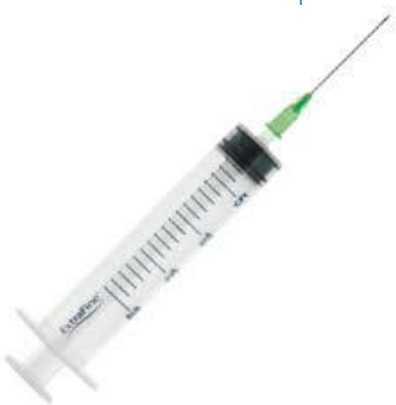
Catheters



A: Limited - 24h or less

Needles

Internal defibrillation electrodes



Nature of body contact

Surface

- Skin
- Mucosa

- Breached

External path

- indirect blood path

- tissue as path

- blood circuits

Implant devices

- Tissue

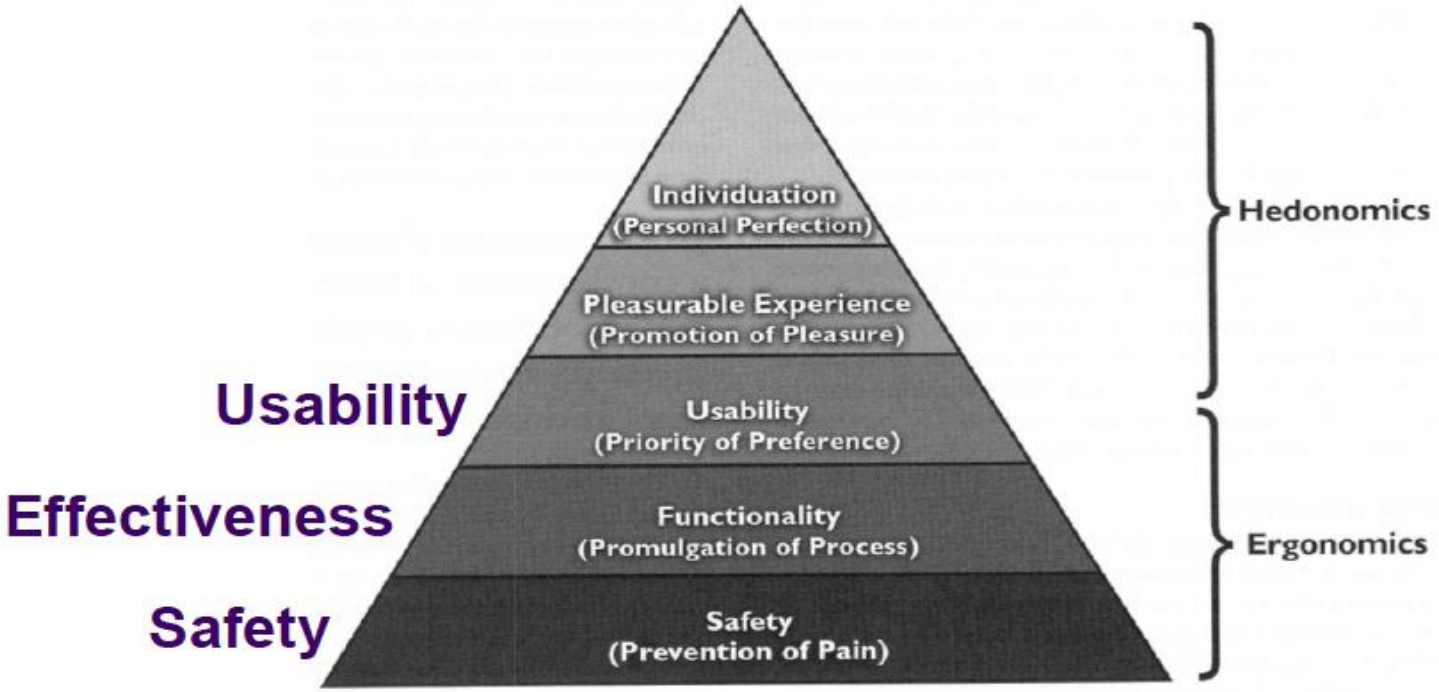
- Bone

- Blood

I principali standard di sicurezza: sterilità

USABILITA'
PREVENZIONE DELL'ERRORE UMANO

- IEC 62366
  - EFFECTIVENESS, EFFICIENCY, USER SATISFACTION



Source: Hancock, Pepe & Murphy (2005), *Ergonomics in Design*, 13 (1), 8-14

Technical data

- Performance evaluation
  - Physical outputs
  - Physical parameters (Temperature, flow, pressure,..)
  - Time of use, extended use
  - Sensors
  - Alarms and protection
- Bench testing
  - Simulation of use on dummies
  - Challenging environments

Pre-clinical evaluation

- Biocompatibility
- Degradation
- Tissue interaction
- Haemocompatibility of flows
- Surgery simulation
- Evaluation of interaction with drugs/ other treatments

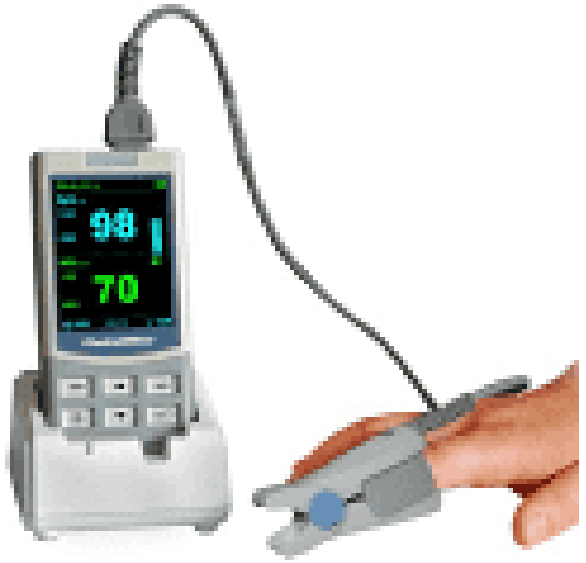
Testing on animals

- Permitted by Helsinki declaration
- Assessing biocompatibility of new raw materials
- Assessing failure modes
- Assessing surgery and insertion techniques
- Both healthy and disease simulated models

Example: a electro-medical device

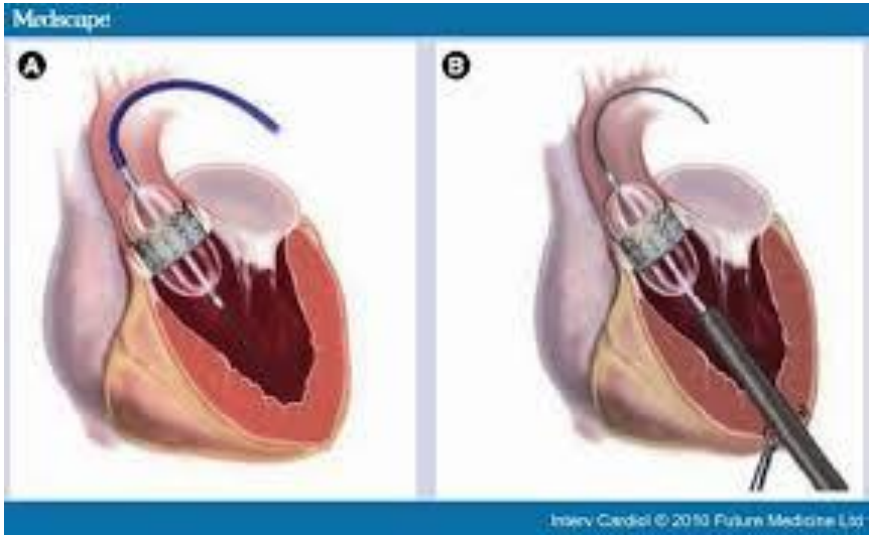
- Bench testing of compliance to all applicable safety and compatibility norms
  - Technical proof of functioning under “challenging” conditions: cold, hot, humid environment, low battery, interferences,….
- Validation of all sensibility intervals of sensors
- SW validation
- Stability, repeatability, adequacy, ….

- Output mapping VS different inputs
- Different user groups



Example: an implantable device

- Bench testing of repeated movements, challenging environment, ageing, wear and tear, stresses,…
- In vitro biocompatibility testing
- In vivo testing of surgical techniques



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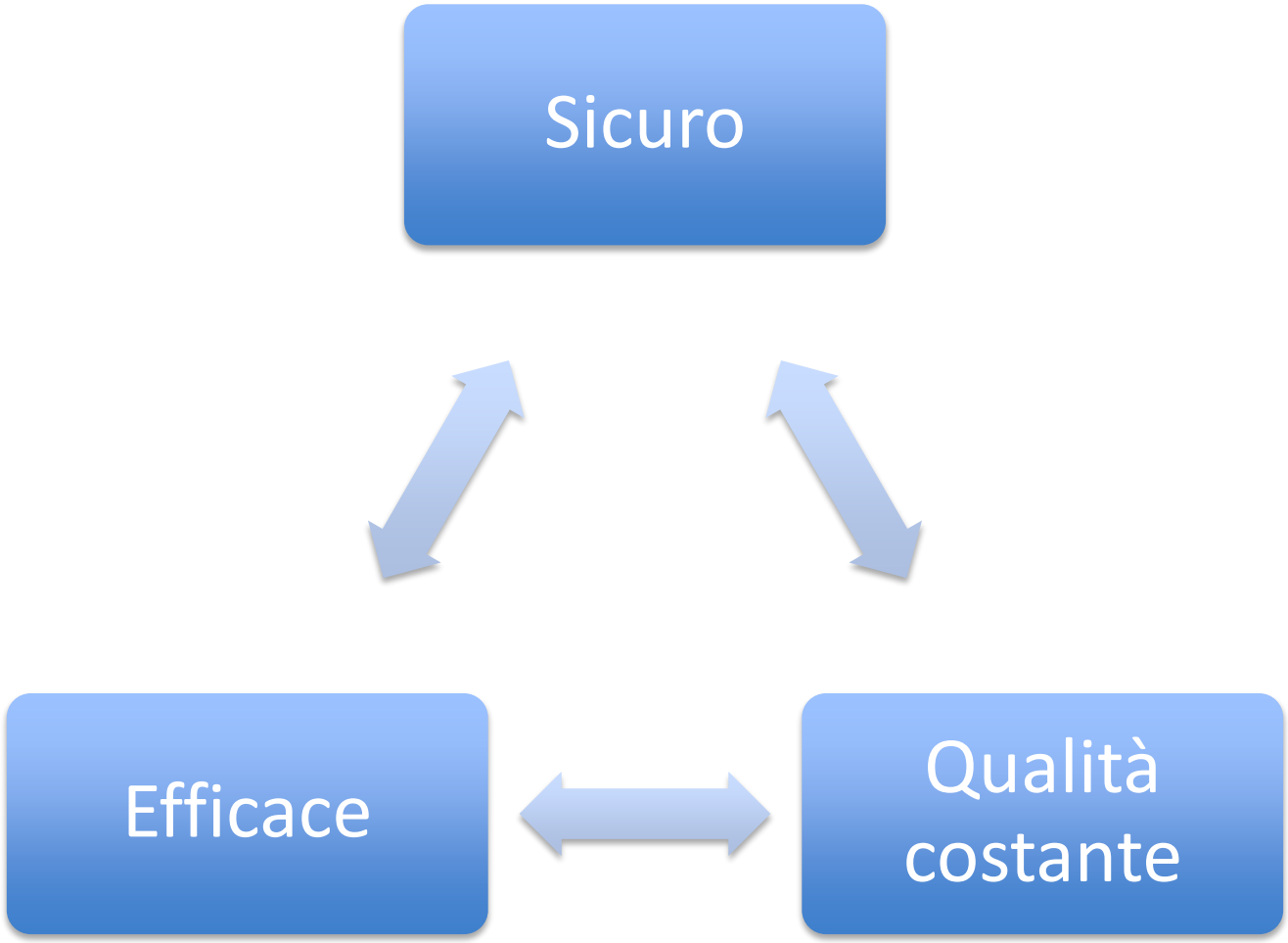
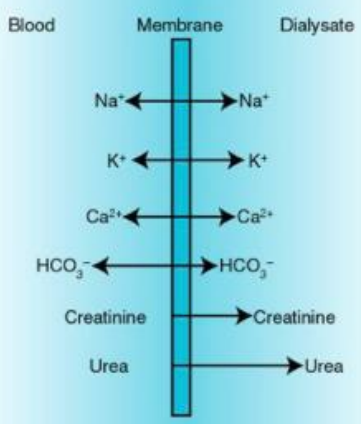


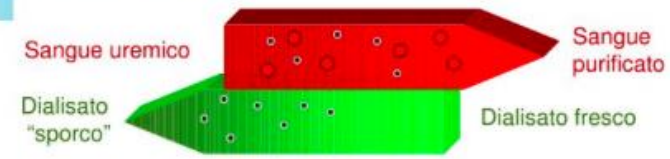
Clinical performance
MDR

- means the ability of a device, resulting from any direct or indirect medical effects which stem from its **technical or functional characteristics**, including diagnostic characteristics, **to achieve its intended purpose** as claimed by the manufacturer, thereby **leading to a clinical benefit** for patients, when used as intended by the manufacturer;

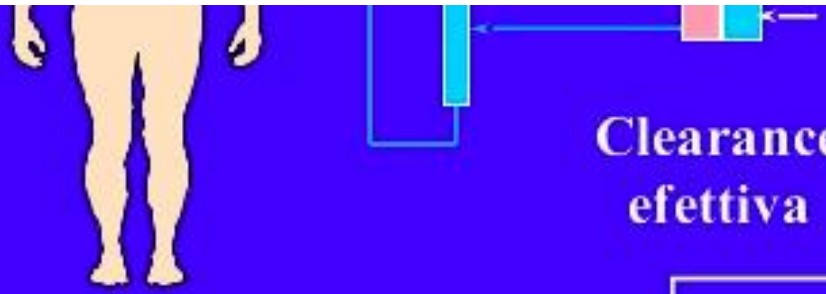
Dialisi



Processo mediante il quale la composizione di una soluzione "A" viene alterata dopo esposizione ad una seconda soluzione "B" attraverso una membrana semipermeabile



di trattamento

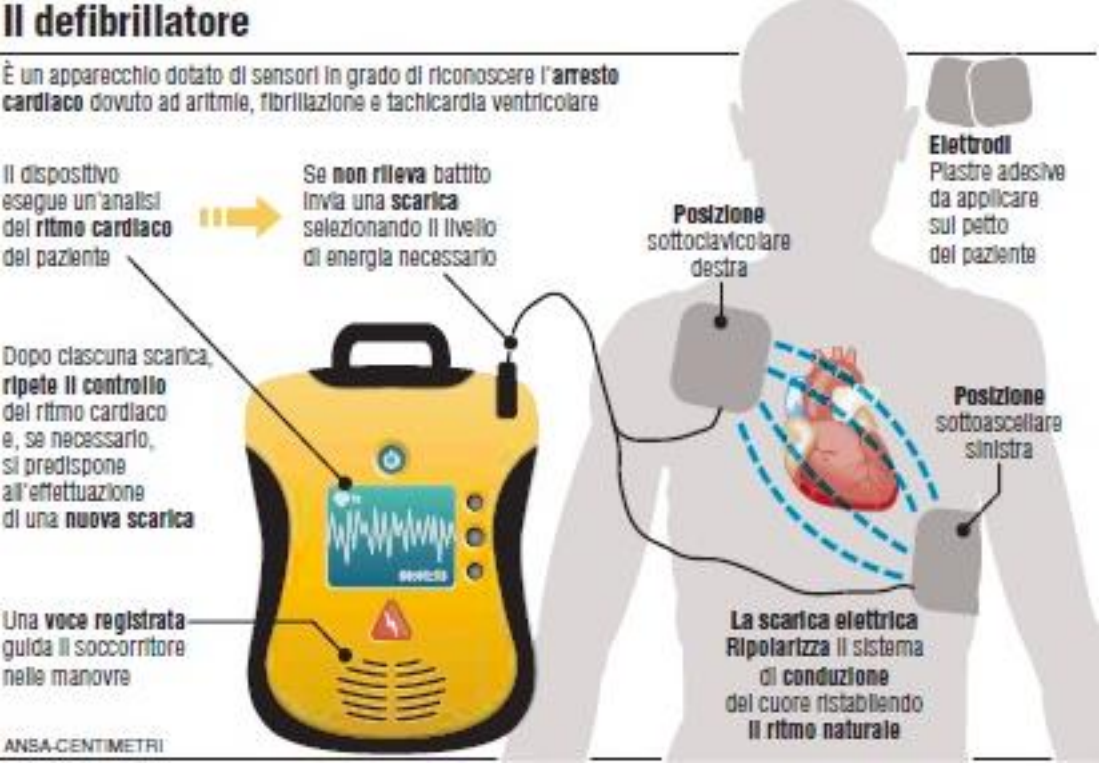


Clearance efettiva

Tempo effettivo : t

Volume distribuzione dell'urea

$$Kt/V = \frac{\text{Clearance} \times \text{tempo}}{\text{Volume}}$$

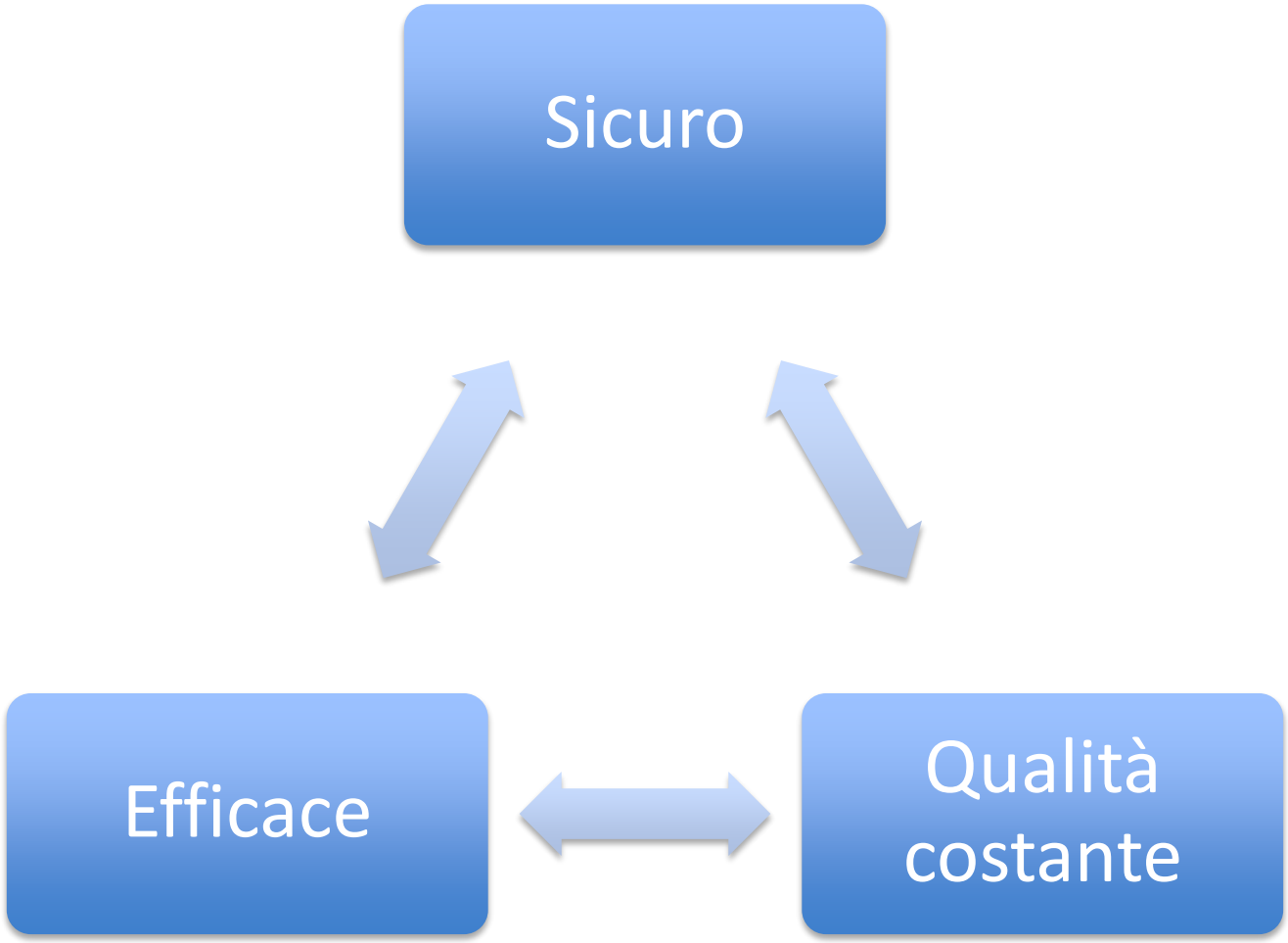


USEMED

Se il paziente è defibrillabile allora il DAE si prepara ad emettere il primo Shock a 200 Joule di intensità.

In totale il DAE emette tre scariche, la prima e la seconda di 200 Joule e la terza scarica di 360 Joule per i monofasici (a metà intensità per i bifasici).

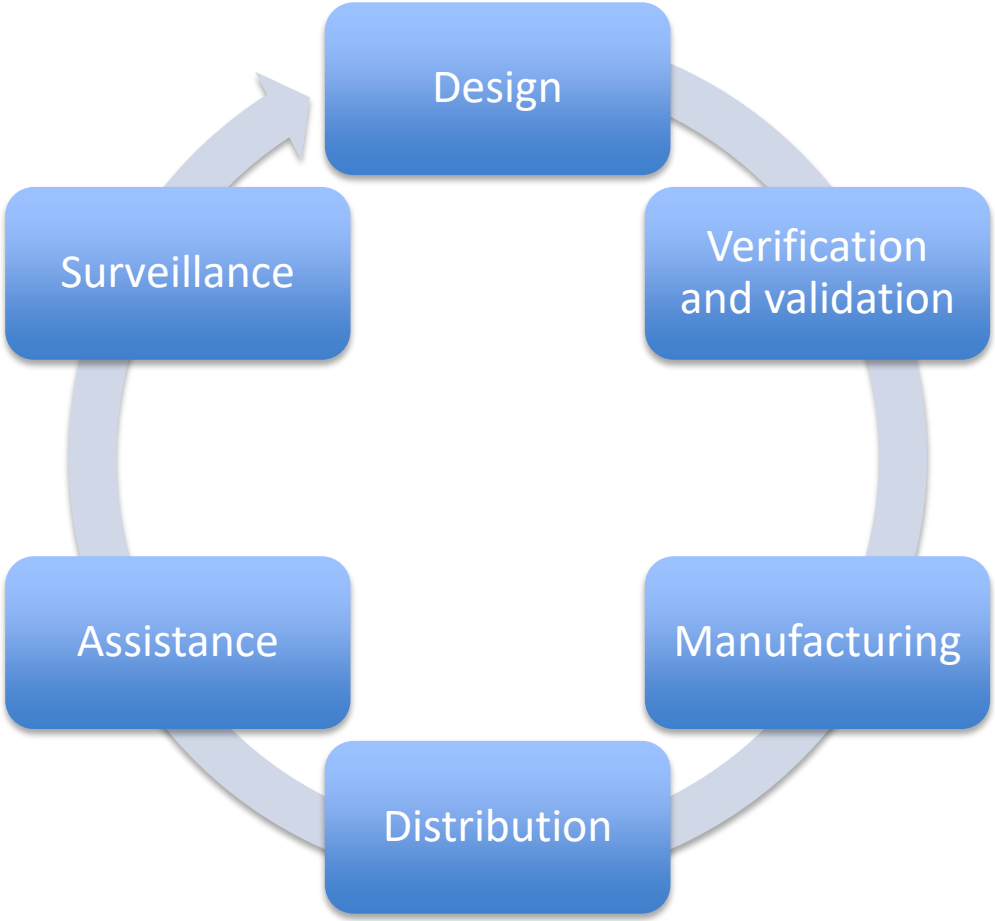
Traduzione…



Manufacturers obligations

- Design control
- Product and process validation
- Clinical evaluation
- Manufacturing as per Good Manufacturing Practice guidelines
- Retention of records
- Continuous surveillance
- Device database
- Strict control on clinical trials

Device life cycle



Manufacturing quality: the EU GMP “ISO 13485”

- The device shall be manufactured consistently to the Device Dossier
  - Equivalent to the prototype
  - Constant level of quality
  - Full traceability
- Standard operation procedures for Company management
  - Industrial processes
  - Equipment
  - Personnel

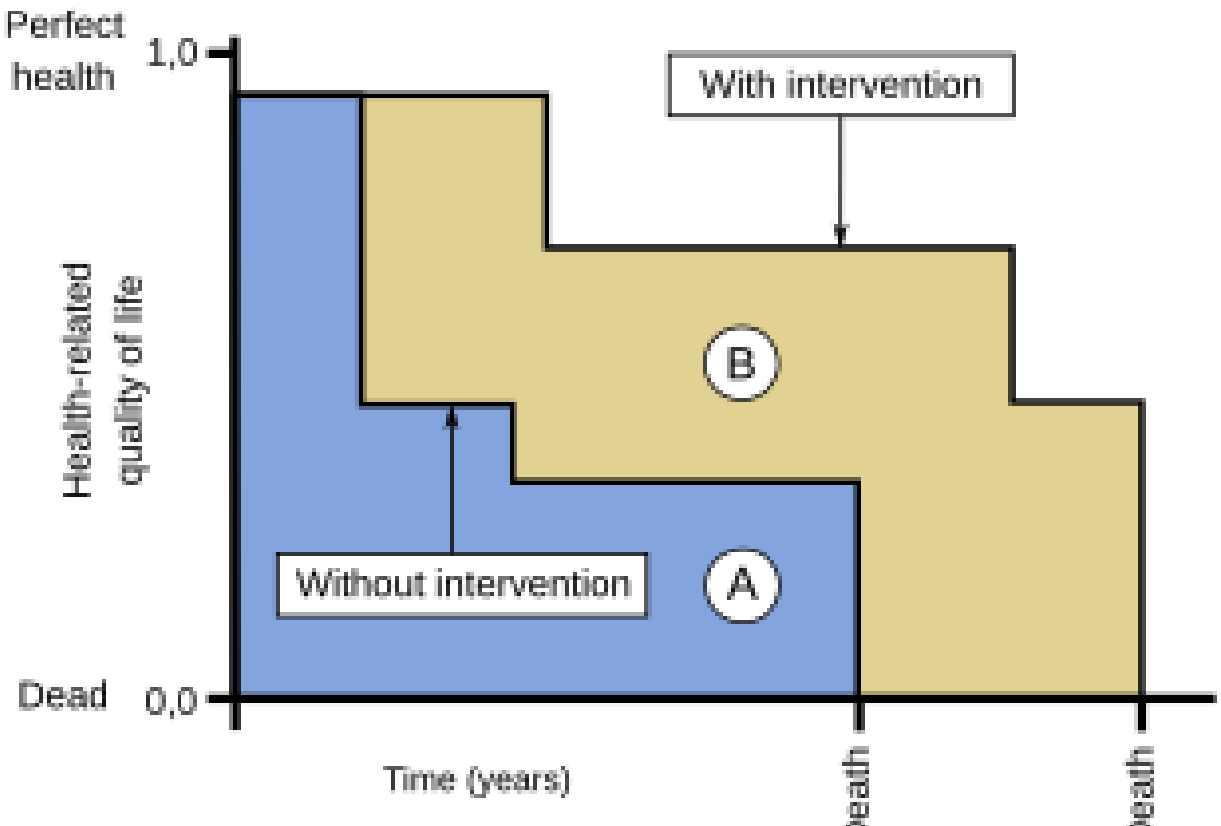
Manufacturing flow

Quality standards for production

- For Standard Operation Procedures: ISO 13485
  - Material control
  - Manufacturing
  - Quality control
- For manufacturing areas
  - Cleanrooms ISO 14644
  - Sterile manufacturing ISO 13408

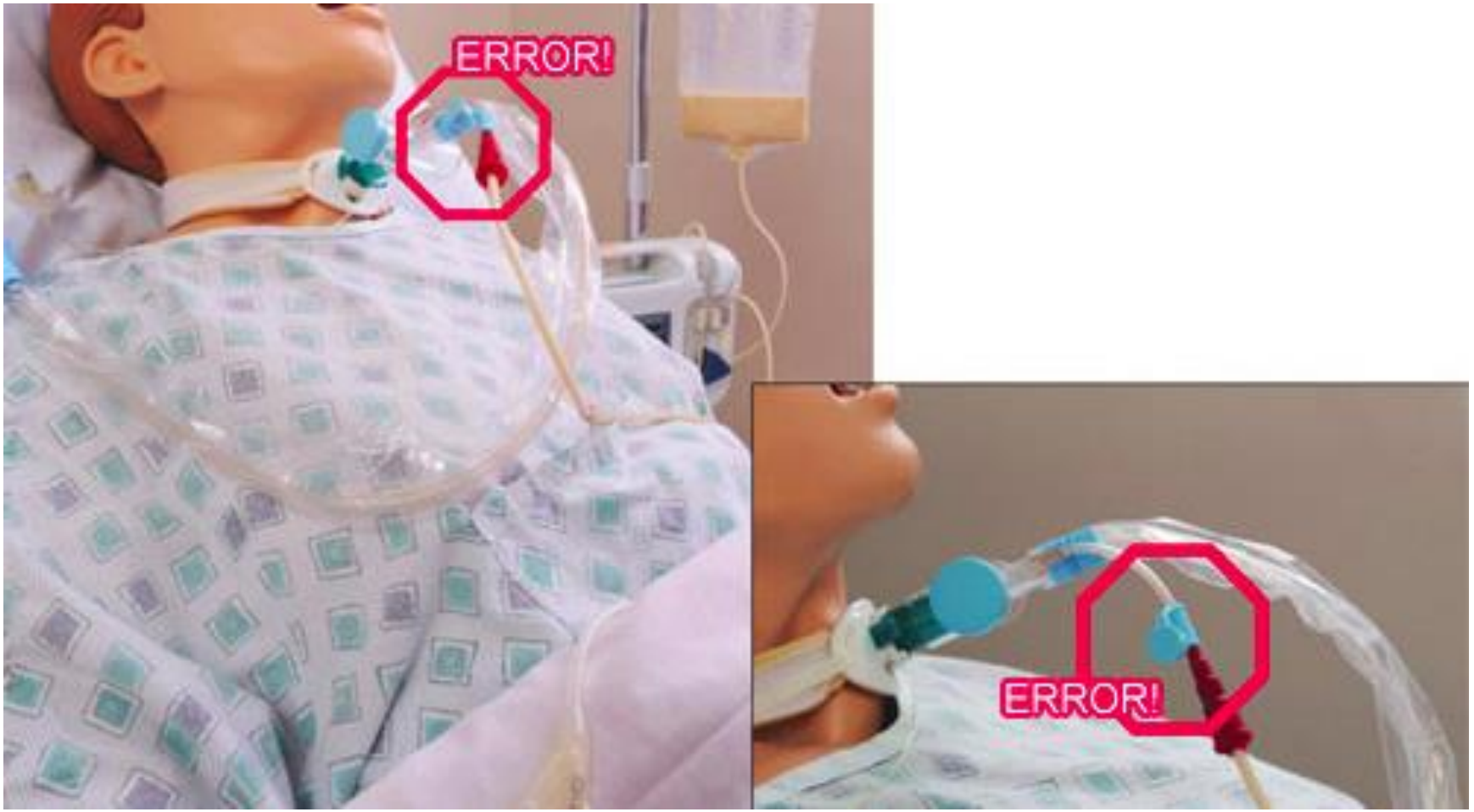
Usability and HTA: an evidence-based approach

ING. ALICE RAVIZZA
USE-ME-D srl



MEDICAL DEVICES KILL

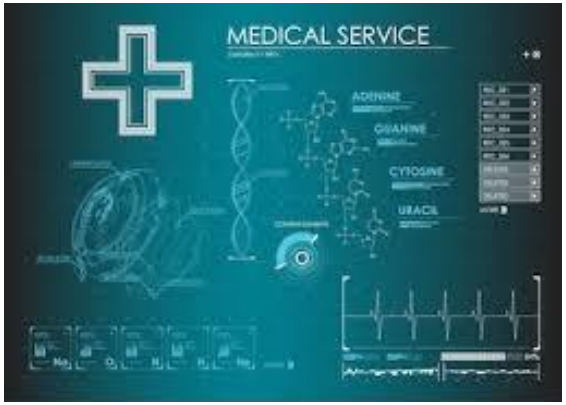
USEMED



Safety relates to usability

User interface design pitfalls

Adverse event



Scaring user with data

Critical alert dismissed

Usability in MDR

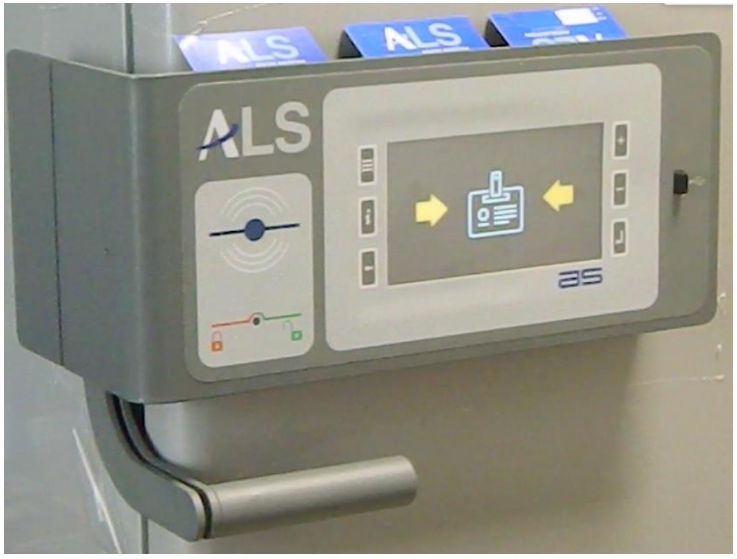
Essential requirement 5 Annex I

- In eliminating or reducing risks related to use error, the manufacturer shall:
- (a) reduce as far as possible the risks related to the **ergonomic features** of the device and the environment in which the device is intended to be used (design for patient safety), and
- (b) give consideration to the technical knowledge, experience, education, training and use environment, where applicable, and the medical and physical conditions of intended users (**design for lay, professional, disabled or other users**).

Efficiency relates to usability

User interface design pitfalls

Loss of data & time



Usability & HTA

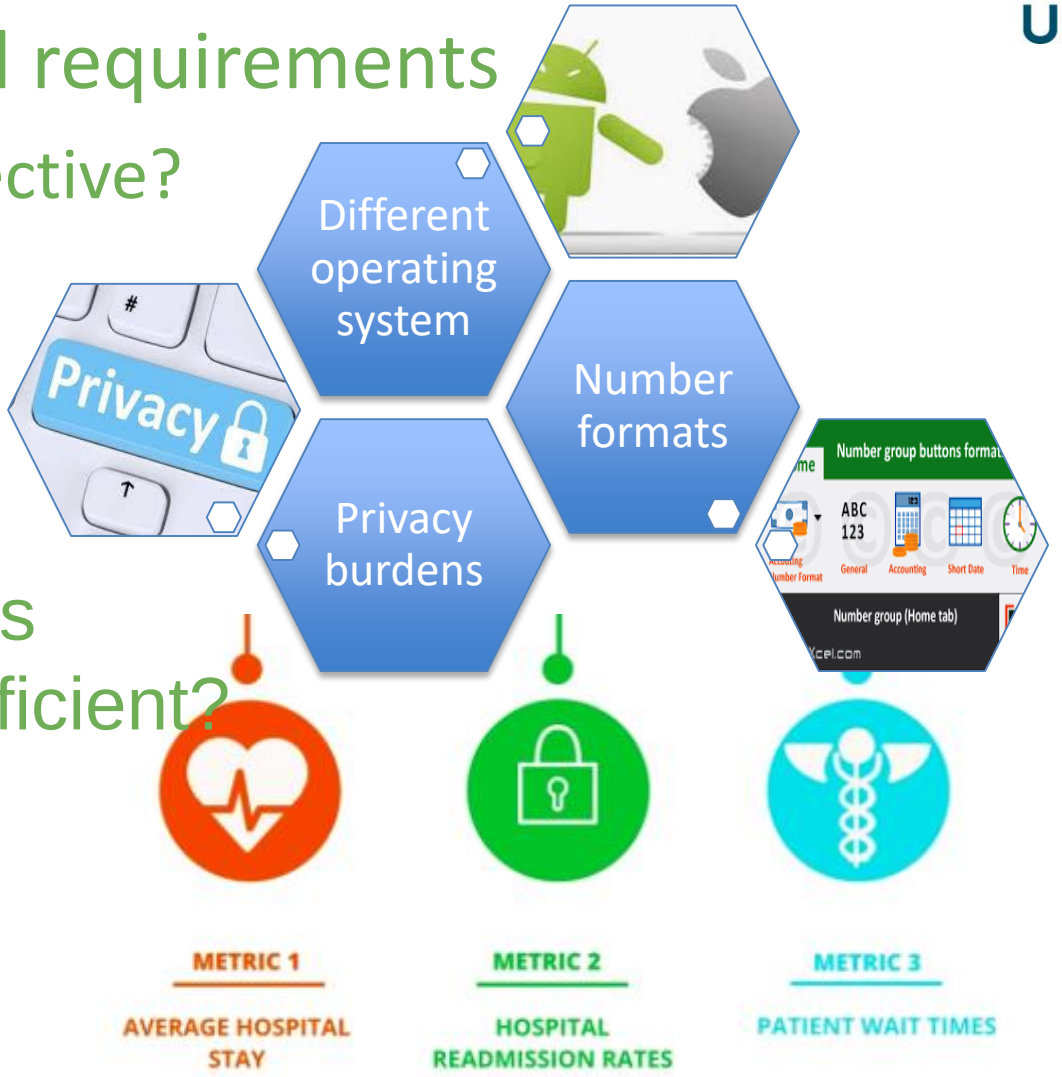
- th*e efficacy of a device depends not only on the device itself, but how it is used.*
  - Valid also for medical apps, , as the clinical outcome can depend on the digital literacy of the user
- *there may be a need for training, or more fundamentally, the local organizational context may be important for harnessing the improved cost-effectiveness of a device*
  - For example, local net conditions may impact the use of the app

Economic Evaluation for Devices and Drugs— Same or Different? Michael Drummond, PhD,1 Adrian Griffin, MSc,2 Rosanna Tarricone, MSc, PhD3

Metrics for usability

Testable technical requirements

Is the device effective?



Performance levels

Is the device efficient?

Formative and summative

Table E.1 – Recommended application of USABILITY methods

Method	Subclause	USER research	Analysis	Design conceptualization	Design implementation	FORMATIVE EVALUATION	Design finalization	SUMMATIVE EVALUATION	POST-PRODUCTION analysis
Advisory panel reviews	E.2	X	X	X	X	X	X	X	X
Brainstorm USE SCENARIOS	E.3		X	X		X			
Cognitive walkthrough	E.4	X		X		X			X
Contextual inquiry	E.5	X	X	X					X
Day-in-the-life analysis	E.6	X	X	X					
Expert reviews	E.7			X	X	X	X	X	
FMEA and FTA	E.8	X	X	X	X	X	X	X	X
Focus groups	E.9	X	X	X	X	X	X		
FUNCTION ANALYSIS	E.10	X	X	X	X	X			X
Heuristic analysis	E.11	X		X		X	X		X
Observation	E.12	X	X	X		X		X	X
One-on-one interviews	E.13	X	X	X	X	X	X	X	X
Participatory design	E.14	X		X		X			
PCA analysis	E.15	X	X	X		X		X	X
SIMULATION	E.16	X	X	X	X	X		X	
Standards reviews	E.17			X	X	X	X	X	
Surveys	E.18	X		X		X		X	X
TASK ANALYSIS	E.19	X	X	X	X	X	X	X	X
Time-and-motion studies	E.20	X	X	X	X	X			
USABILITY TESTS	16.2.4	X				X		X	
Workload assessment	E.21	X	X	X	X	X			

USEMED

Methods: IEC 62366

Expert review

- General review of the device
  - Simulation
  - Comparison to state of the art
- Heuristic analysis
  - 10 Nielsen
  - 14 Zhang
  - +1 … privacy

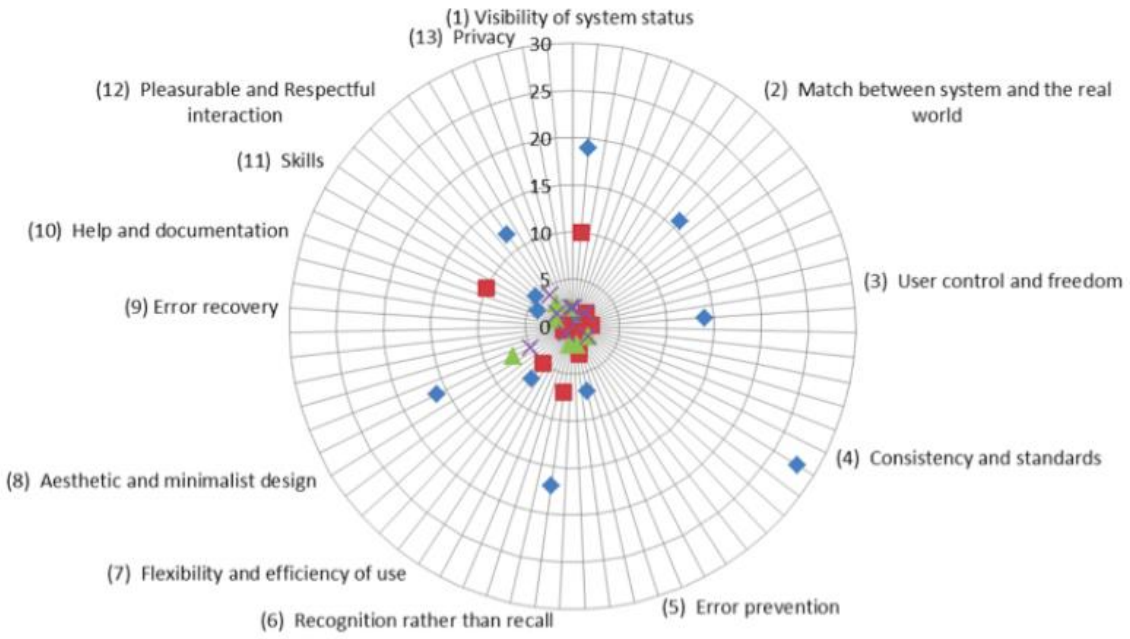
Expert review

What you need

- The experts
- The device
- The metrics

What you get

- A formal review
- A score

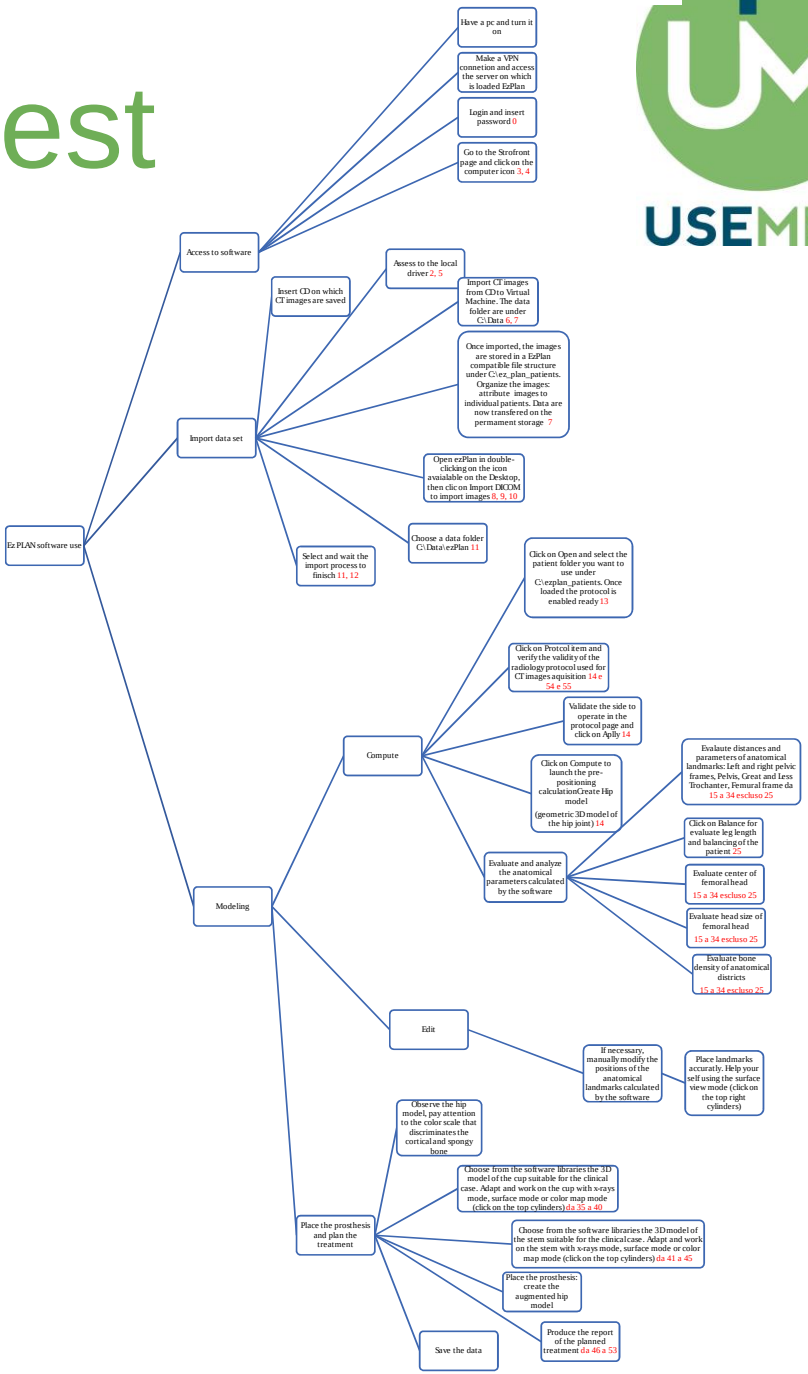


User test

- Real users
- Real or simulated condition
- Performing all

Developer watching videotape of usability test.

Hierarchical TASK ANALYSIS



User test

What you need

- The users
- The device
- A clear list of tasks
- An adequate setting for the test

What you get

- A list of completed tasks
- A list of errors and near misses

	Francesca Greco (Infermiera)	Roberto Albiani (Medico)	Gavinelli Chiara	Colpo Chiara	Gabriella Giustetto (TSLB)	Marika Salafia (TSLB)	Lucia Bisignano (TSLB)	Francesca Cristina Carnicella (TSLB)	Rosanna Mollica (Infermiera)	Teresa Flores (Infermiera)	Luciana Labanca (Biologa)	Cristina Scaglia (Biologa)	Giovanna Giannese (TdL)
STARTING OF THE MEDICAL DEVICE													
Read quick guides before using the device.													
Press the red button ENTER for 3 seconds									need help from moderator		need help from moderator	need help from moderator	
If necessary, select the SETPOINT temperature icon on the user menu to set the temperature									need help from moderator		need help from moderator	need help from moderator	
Set limits and alarm delay selecting the limits and alarm delay	help from moderators								need help from moderator		need help from moderator	need help from moderator	
If necessary, access to the EVENT LIST						need help from moderator						need help from moderator	
OPENING / CLOSING OF DEVICE DOORS													

Time and motion studies

What you need

- A very well performed user test

What you get

- Information on time to use and time to recover from error

Table 2: Time Spent on Visit (Precepting Time Removed)

Characteristic, Min (SD)	Face-to-Face Time	Total Non-face in Clinic	Out-of-Clinic EHR Time	Total EHR Time	Total Time
Overall, n = 980	18.5 (10.5)	7.5 (7.5)	6.9 (7.6)	18.6 (10.1)	35.8 (16.6)
Physician Level of Training					
PGY1, n = 8	24.4 (7.0)	10.9 (10.8)	0.5 (1.4)	14.7 (9.3)	38.6 (14.0)
PGY2, n = 263	17.3 (10.4)	9.7 (8.3)	7.1 (6.9)	20.5 (10.0)	37.3 (16.6)
PGY3, n = 376	16.5 (9.0)	7.4 (6.7)	5.9 (6.0)	17.4 (9.0)	33.1 (14.4)
PGY4, n = 18	17.5 (11.7)	6.5 (6.8)	2.2 (4.8)	12.9 (7.2)	29.1 (15.9)
Faculty, n = 315	21.9 (11.3)	5.7 (7.1)	8.4 (9.4)	18.7 (11.4)	38.2 (18.7)
P value	<.001	<.001	<.001	<.001	<.001

https://journals.stfm.org/familymedicine/2018/february/young-2017-0121

From qualitative to quantitative

Qualitative – state of the art

- Expert reviews
- Expert questionnaires

According to your experience, how important is each element on the left compared with each element on the right?

Spatial Resolution	is	*much less*	~~*less*~~	*equally*	*more*	*much more*	important than	***Speed Run***
Speed Run	is	*much less*	*less*	*equally*	~~*more*~~	*much more*	important than	***Processing software***
Processing software	is	*much less*	*less*	~~*equally*~~	*more*	*much more*	important than	***Spatial Resolution***

Figure 2
Questionnaire layout.

User needs elicitation via analytic hierarchy process (AHP). A case study on a Computed Tomography (CT) scanner

Quantitative – a proposal

- Heuristic (14 principles) assessment
- Time and motion studies
- Error and near miss count

Future and proposals

MDR and 2020

- Clear requirement for manufacturers
- Evidence based as per ISO standard
  - Device specific
  - Declared by the manufacturers
  - Metrics and techniques chosen by each manufacture

HTA for medical devices

- Part of HTA of institution
- PROPOSAL OF Guidelines for each device class
  - Not manufacturer specific
  - Standardised metrics and techniques

USE-ME-D
patient centered design

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