



IRPA 12

BUENOS AIRES - ARGENTINA - 19 / 24 OCTOBER 2008



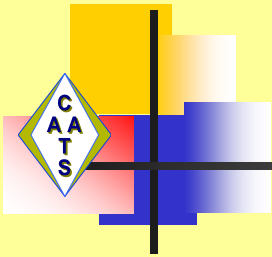
12TH INTERNATIONAL CONGRESS OF THE INTERNATIONAL RADIATION PROTECTION ASSOCIATION

Survey of patient dose and guidance (reference) level in interventional cardiology in France

C. Maccia

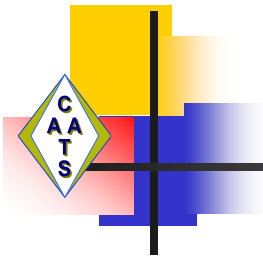
***C**entre d'**A**ssurance de qualité des **A**pplications **T**echnologiques dans le
domine de la **S**anté (**CAATS**). Bourg-La-Reine – France

General Radiation Protection Framework

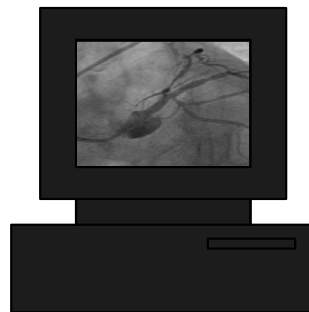
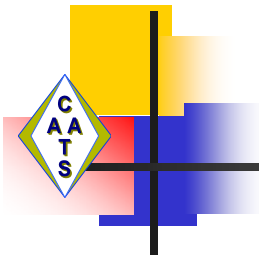


- Interventional cardiology is widely recognized as a radiological practice likely to be leading to high level of patient skin dose (**deterministic effects**)
- Several technical and clinical factors may be considered as to influencing the patient exposure (kV, fluoroscopy time, frame rate, lesion complexity etc..)
- Their knowledge is an essential part of any quality assurance programme and represents a valuable approach to the optimisation of patient radiation protection.

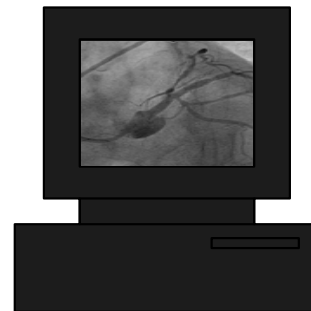
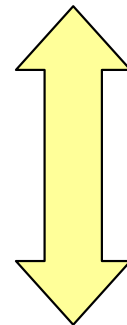
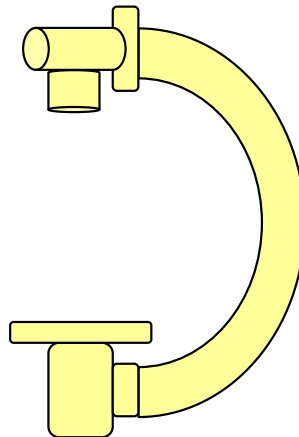
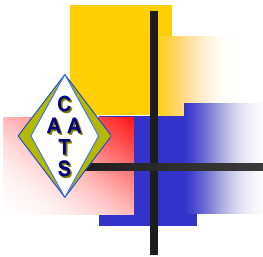
The Systemic Interactivity



The Systemic Interactivity

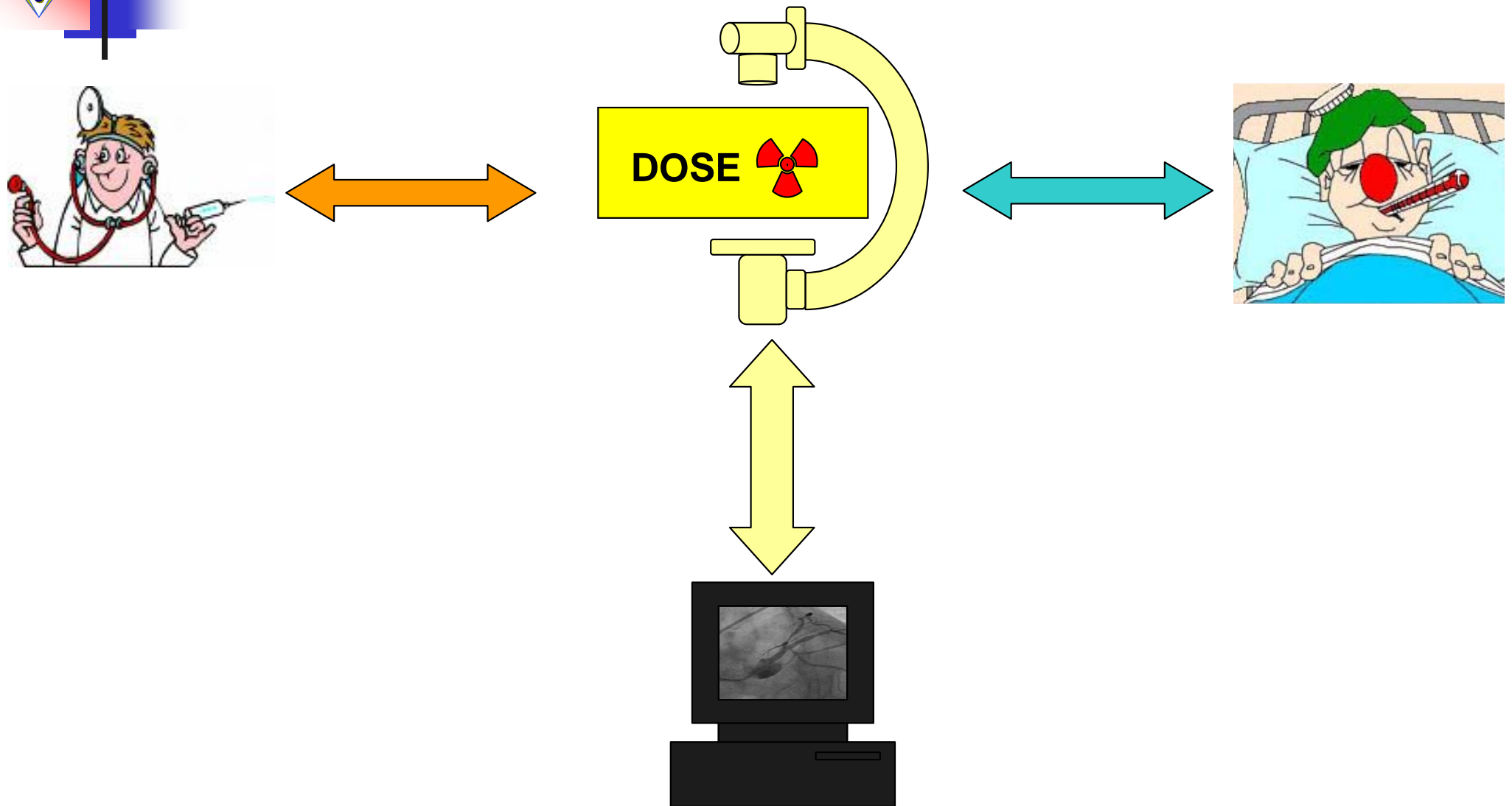


The Systemic Interactivity

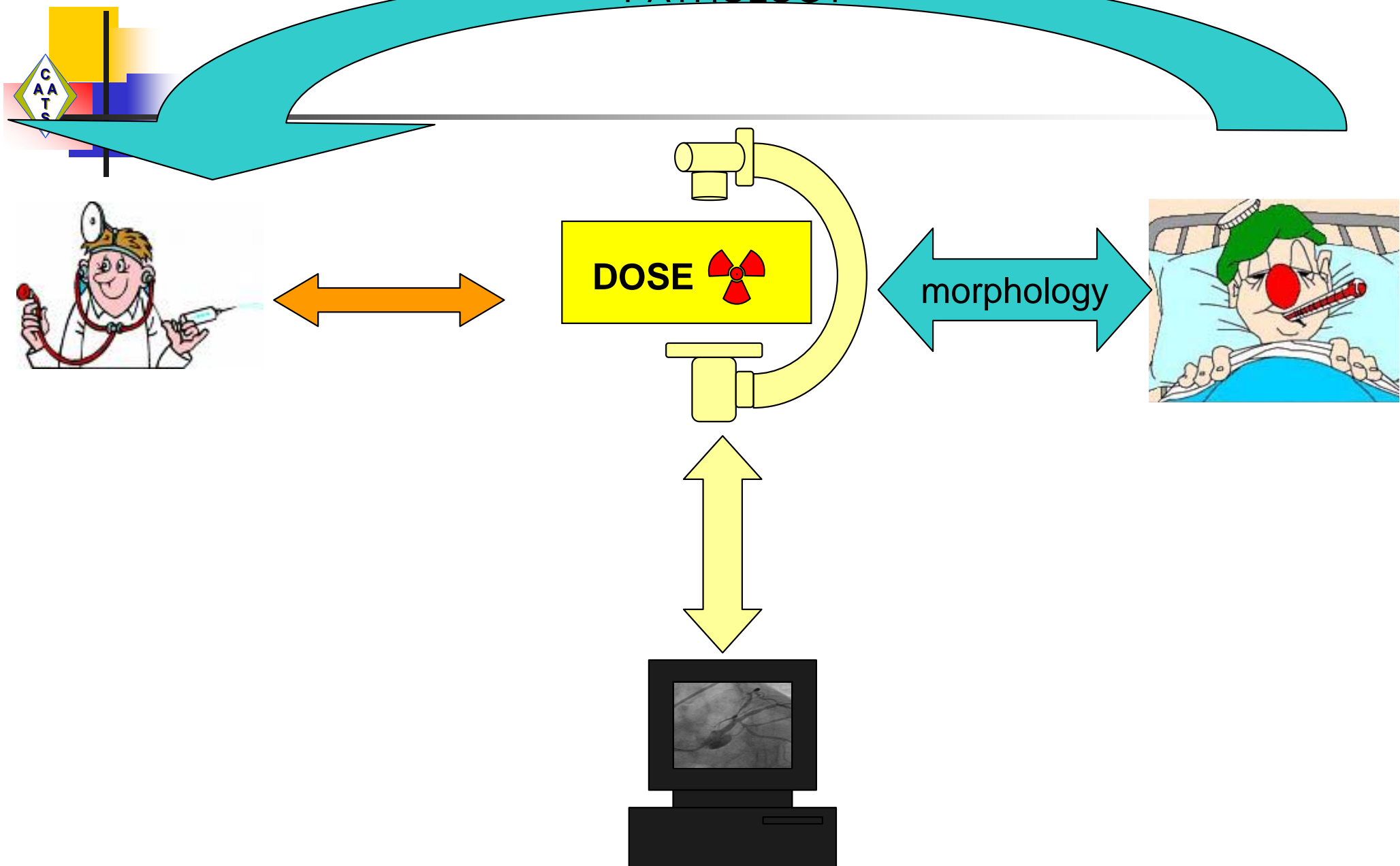


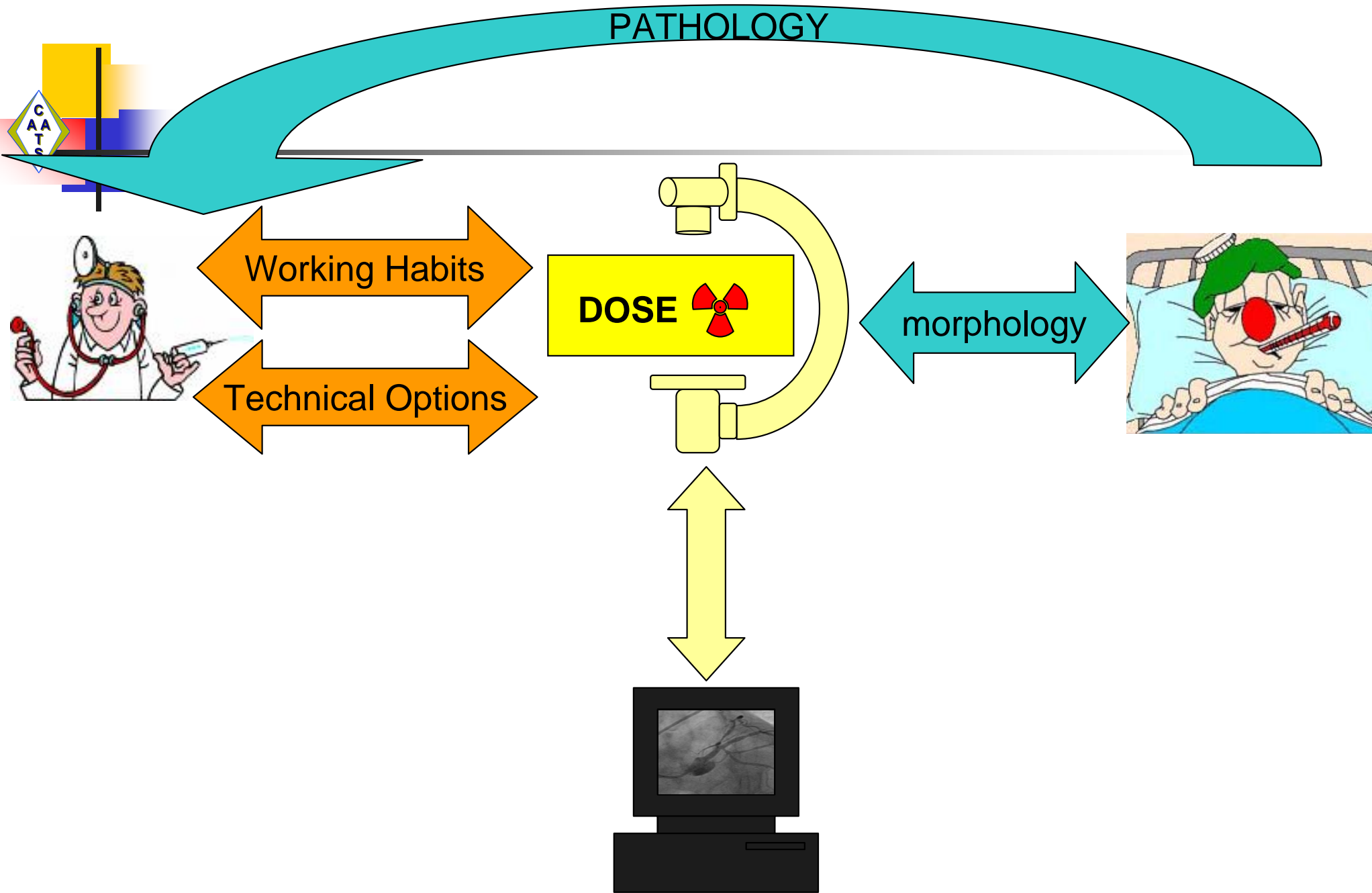
The Systemic Interactivity

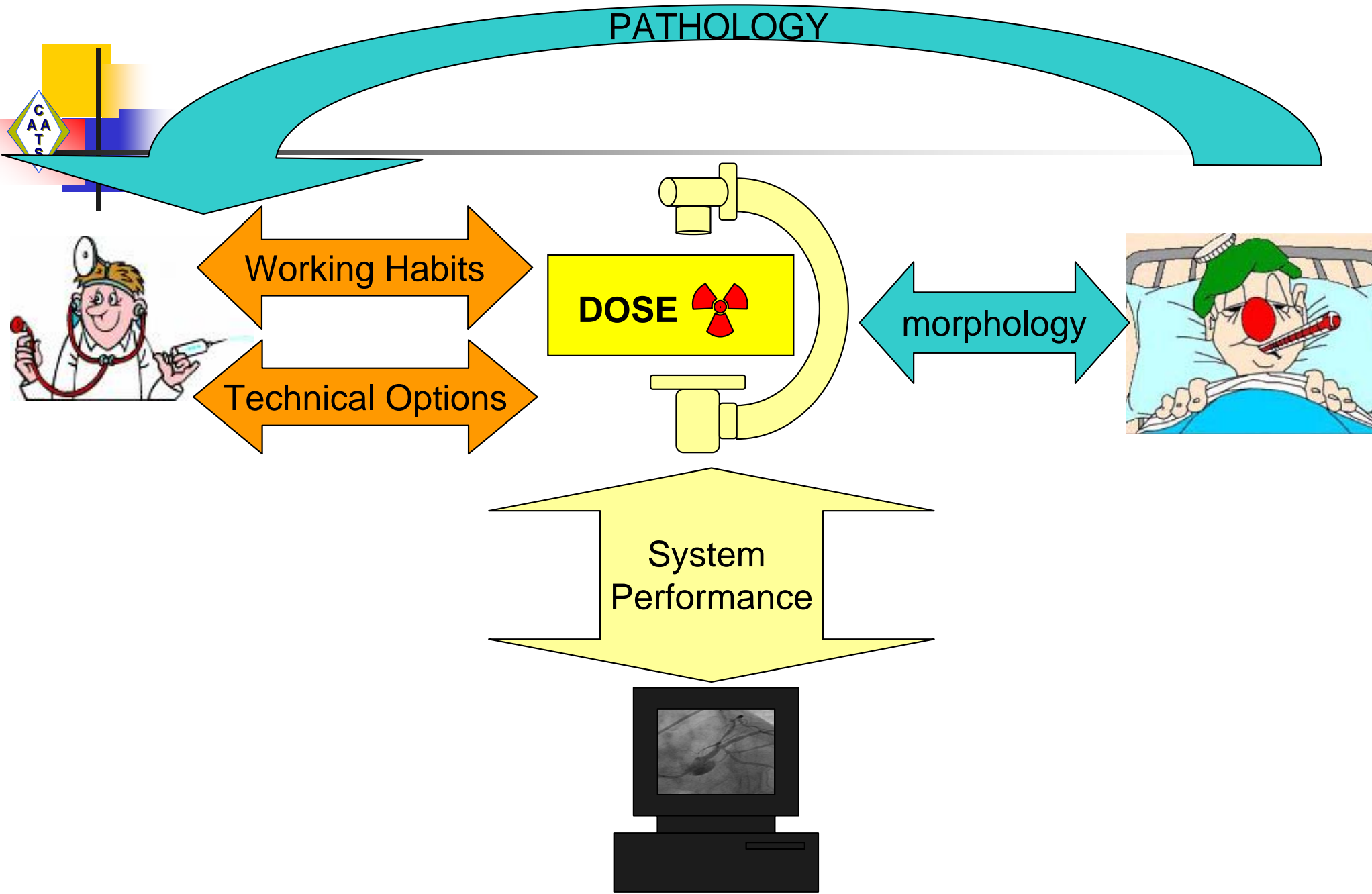
CAATS

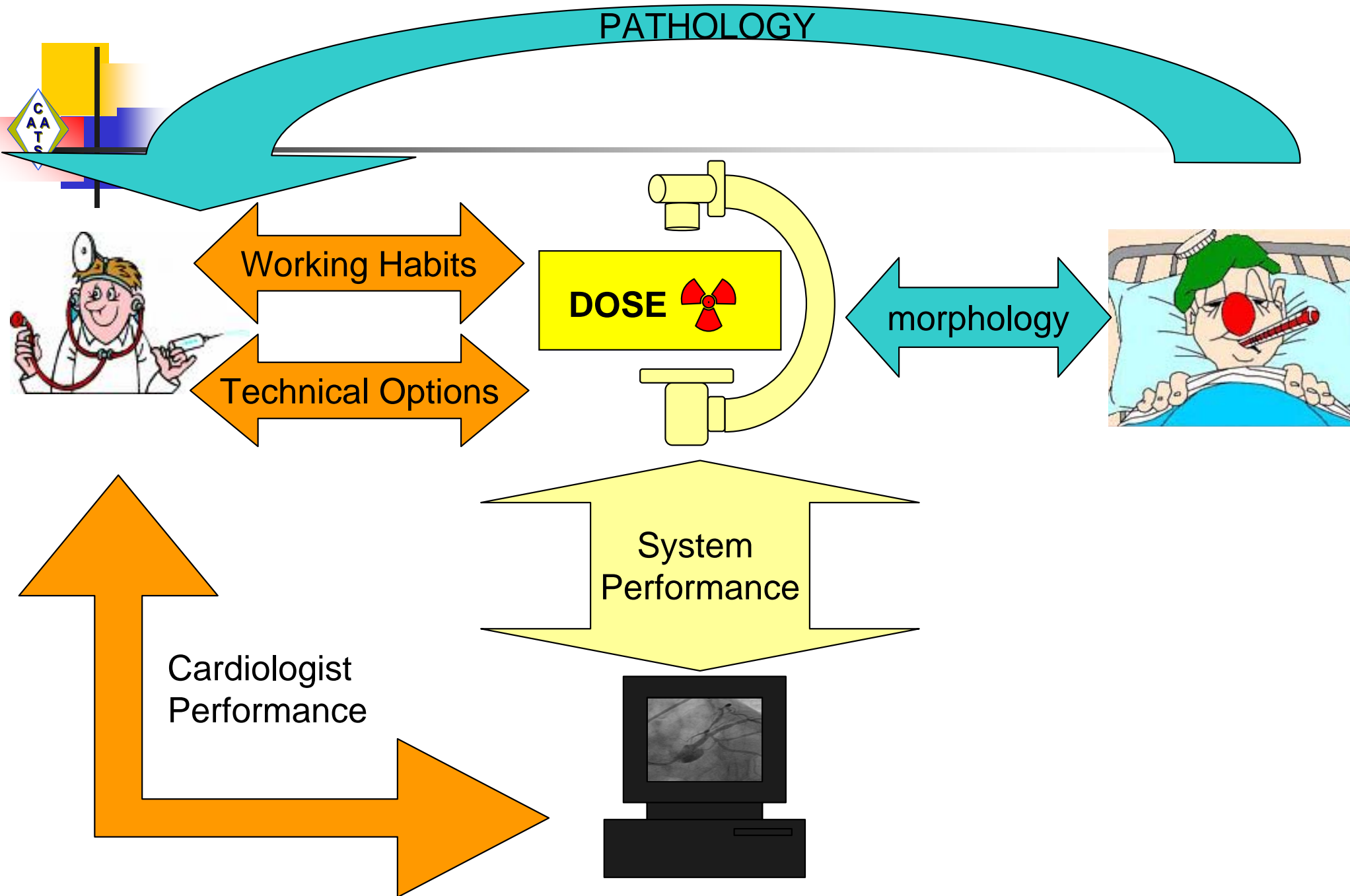


PATHOLOGY

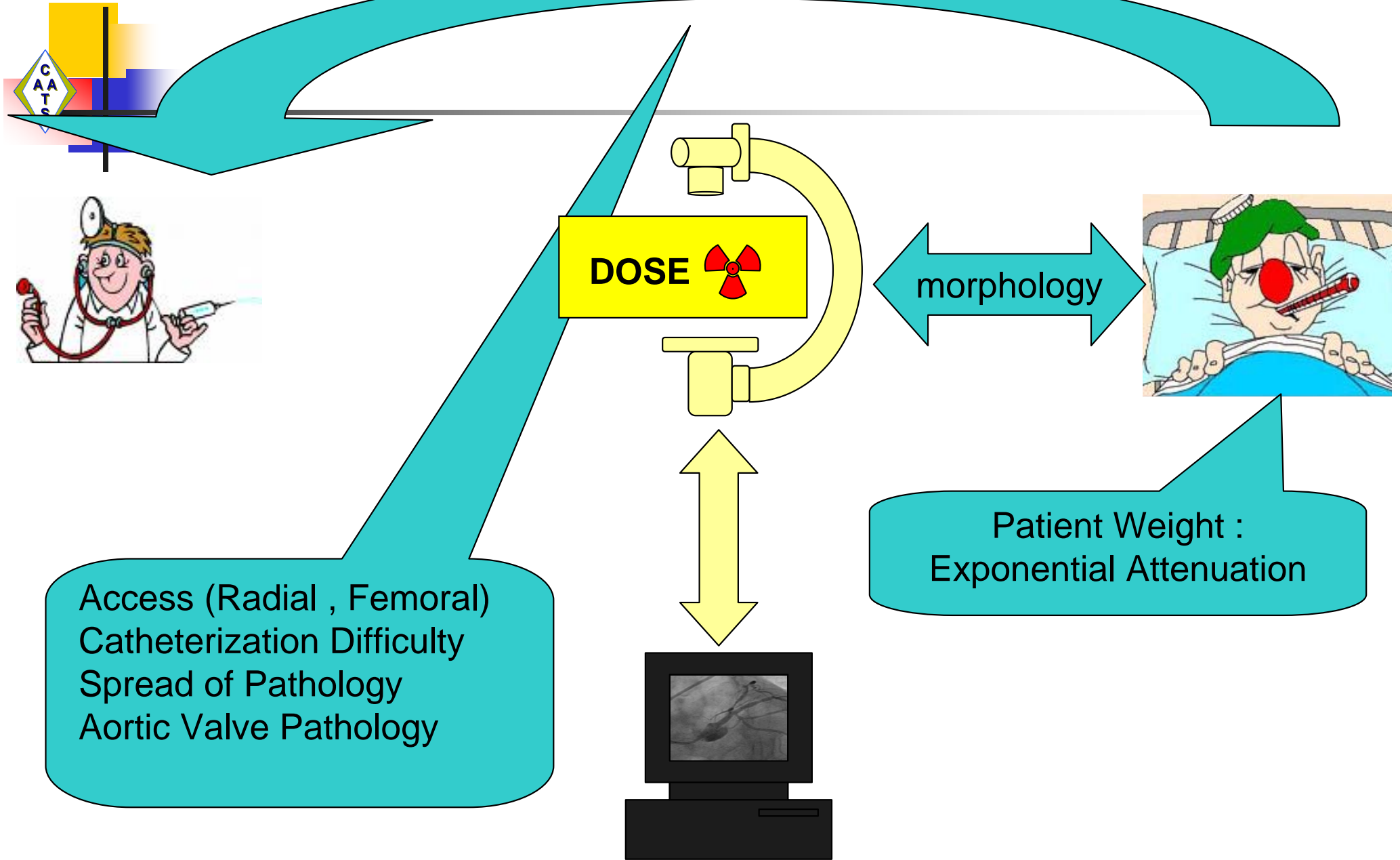


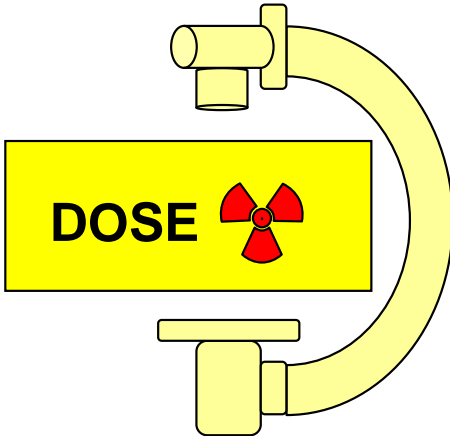
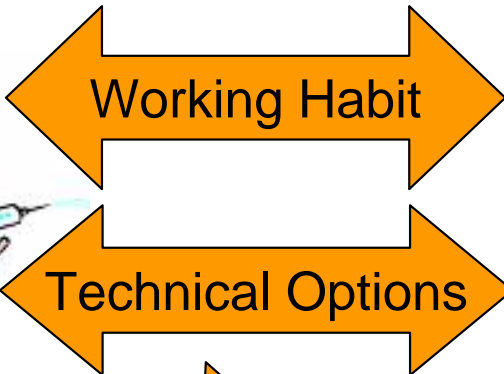
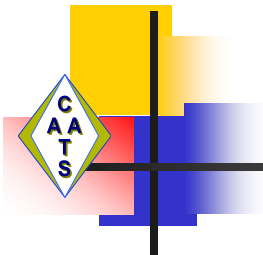




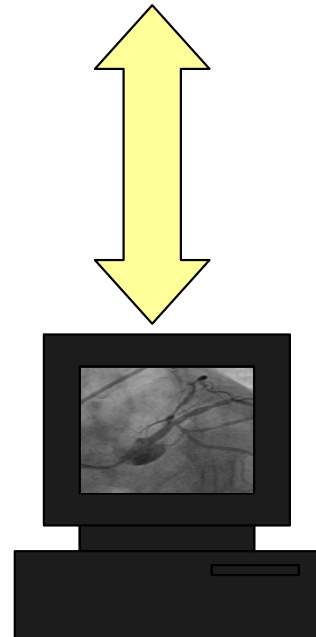


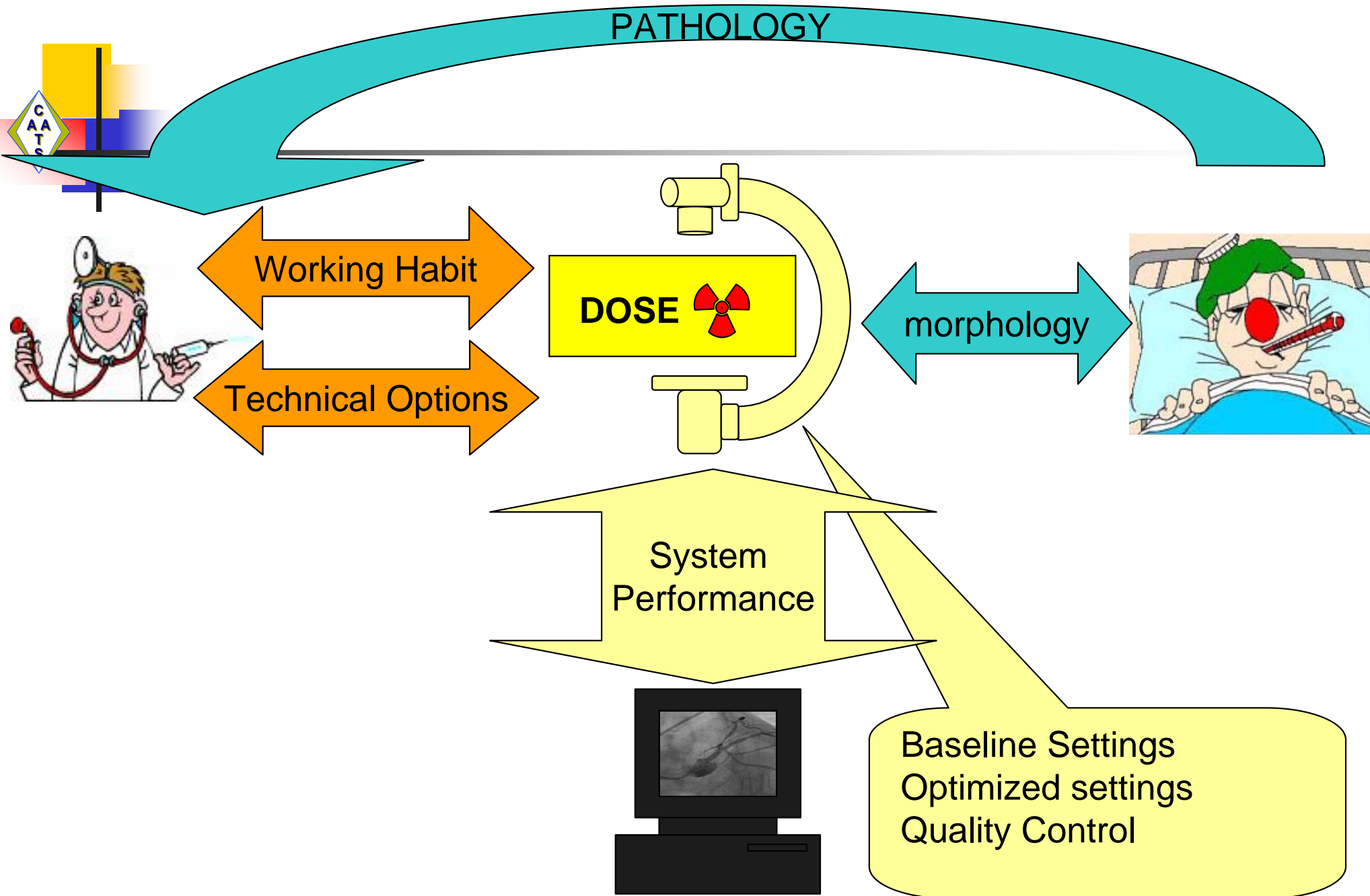
PATHOLOGY





- Acces (radial, femoral)
- Frame Rate
- Type of Fluoroscopy
- Collimation
- Tube to detector distance
- Radiographic Projection
- PTCA Strategy

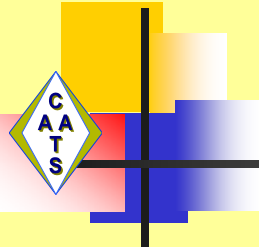




Crossing the channel while avoiding the X-ray burn

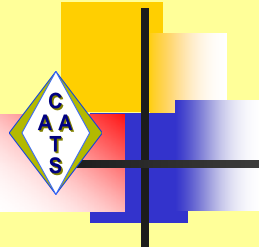
CAATS



The logo for CAATS (Cardiac Angiography and Catheterisation Assessment and Training System) is located on the left side of the slide. It features a diamond shape containing the letters 'C', 'A', 'A', 'T', 'S' stacked vertically. To the right of the diamond are several overlapping squares in yellow, white, blue, and red, with a vertical black line passing through them.

The main objectives of the GACI-CAATS (2006) survey (1)

- To demonstrate the feasibility of the adopted approach towards estimating patient exposure
- To get a first estimate of DRLs in France and make the provisional results usable as a tool to promote the optimisation of patient radiation protection at the level of each interventional cardiology centre
- To gather experience on data collection in view of nationwide future works on this subject

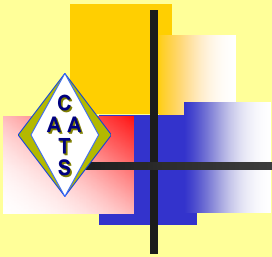
The logo for CAATS (Comprehensive Assessment of Accuracy and Timing in Simulation) is located in the top left corner. It features a diamond shape containing the letters 'C', 'A', 'A', 'T', 'S' in a grid. To the right of the diamond are several overlapping squares in yellow, white, blue, and red, with a vertical black line passing through them.

The main objectives of the GACI-CAATS (2006) survey (2)

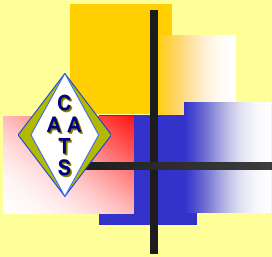
- Measuring as well as modelling skin and organ doses received by patients during either diagnostic or therapeutic procedures (sub sample of IC centres)
- To identify RP optimization strategies for both patient and staff
- To evaluate the need for training in Radiation Protection

The methodological framework

GACI-CAATS (2006) survey

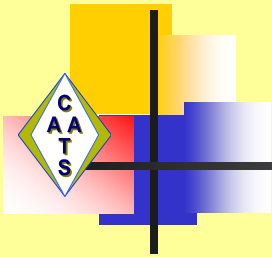


- The survey dealt with CL where at least one cardiologist had previously participated to a training course on both staff and patient radiation protection
- 35 out of 55 CL answered favorably, but due to default of adequate dosimeter device availability, only 19 were finally included in the survey.
- 29 installations (50% Flat Panel detector) representing 7 models from 3 different manufacturers were involved
- GafChromic XR type R film (patient skin dose) were used



Data Collection (1)

- For each procedure, were gathered :
 - patient characteristics (sex, age, height and weight, main risk factors: smoking, diabetes, etc..),
 - relevant dosimetry indicators (DAP-value, fluoroscopy time, number of runs, number of frames/run, kV, mA, field size etc.)
 - examination details (practitioner ID code, number of severe lesions, number of stents and balloons used).



Data Collection (2)

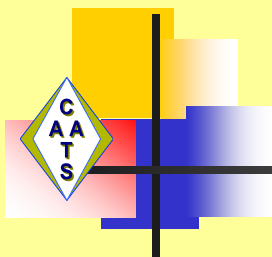
- Between mid-June and mid-July 2006, data on 813 diagnostic and interventional coronary procedures were collected from 19 Catheterization Laboratories.
- All the CDroms containing the images (anonymous copy in DICOM format) recorded for each patient were centrally collected at CAATS for further evaluation



Data Collection (3)

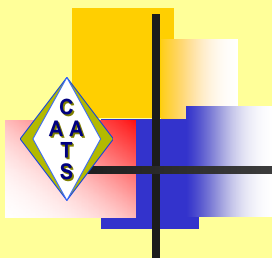
- Sub sample of 97 patients examined in four centers
- GafChromic films (Peak skin dose – DAP)
- Patient morphology, type of pathology, number of occluded arteries
- Number and type of stent used
- CD rom of images (Dicom header information)

Overall GACI-CAATS Survey Results (1)



- 813 patients
 - 26% woman – mean age : 70 years old
 - 74% men – mean age : 65 years old
- 60 Cardiologists
 - 14 (23%) performed at least 20 IC procedures
 - 41 (77%) performed less than 10 IC procedures.
- 55% of patients showed
 - at least one significant lesion, (more than 50% of artery stenosis)
 - multi-vessel diseases were diagnosed in 34.7 % of patients

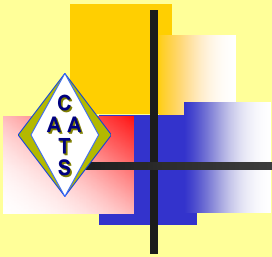
Overall GACI-CAATS Survey Results (2)



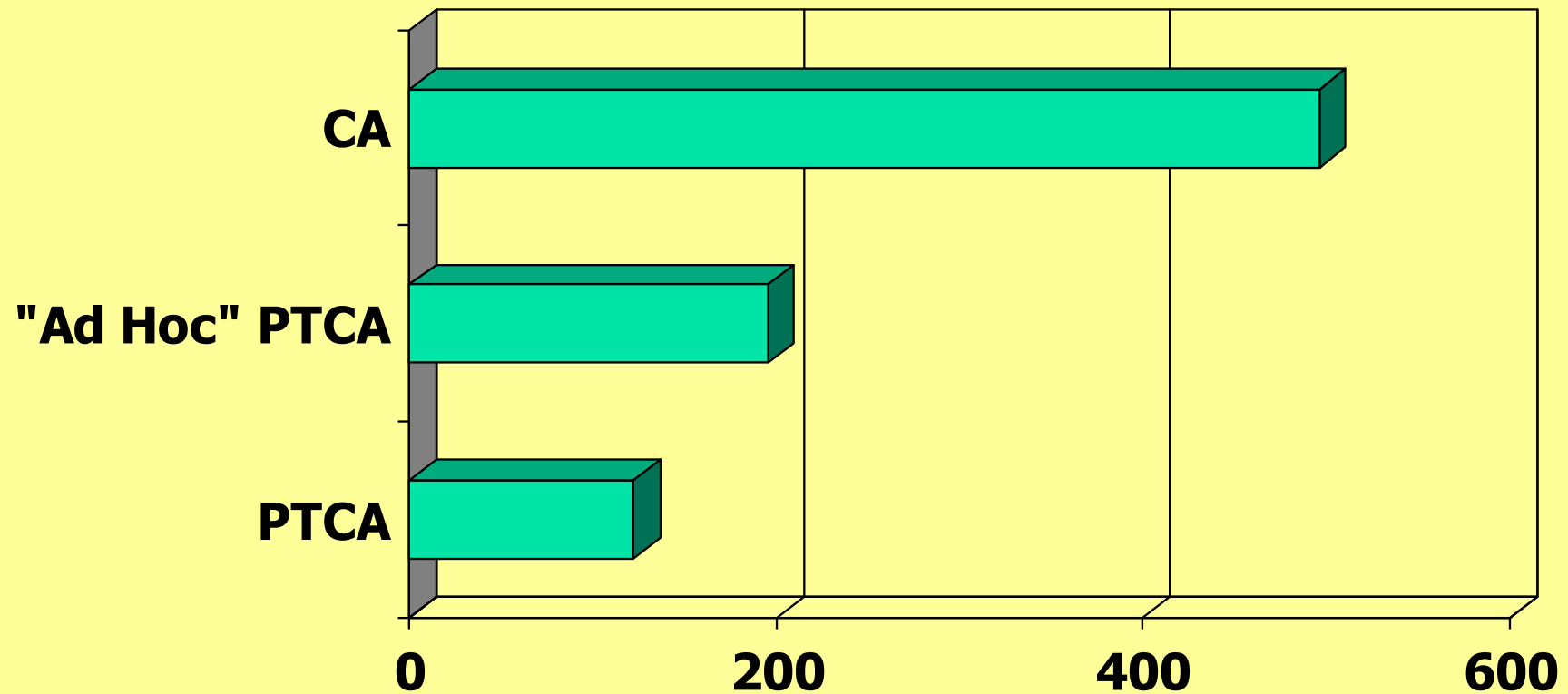
- Vascular access varied between centers
- radial access ranging from 0 to 94% of all procedures in one given centre, with an overall mean value of 51%.
- No systematic difference was observed between values for CA or PTCA (radial access in 52% and 50% of procedures respectively).
- A ventriculography was associated to a CA procedure in 34% of the cases

GACI-CAATS Survey Results

IC Procedures by type

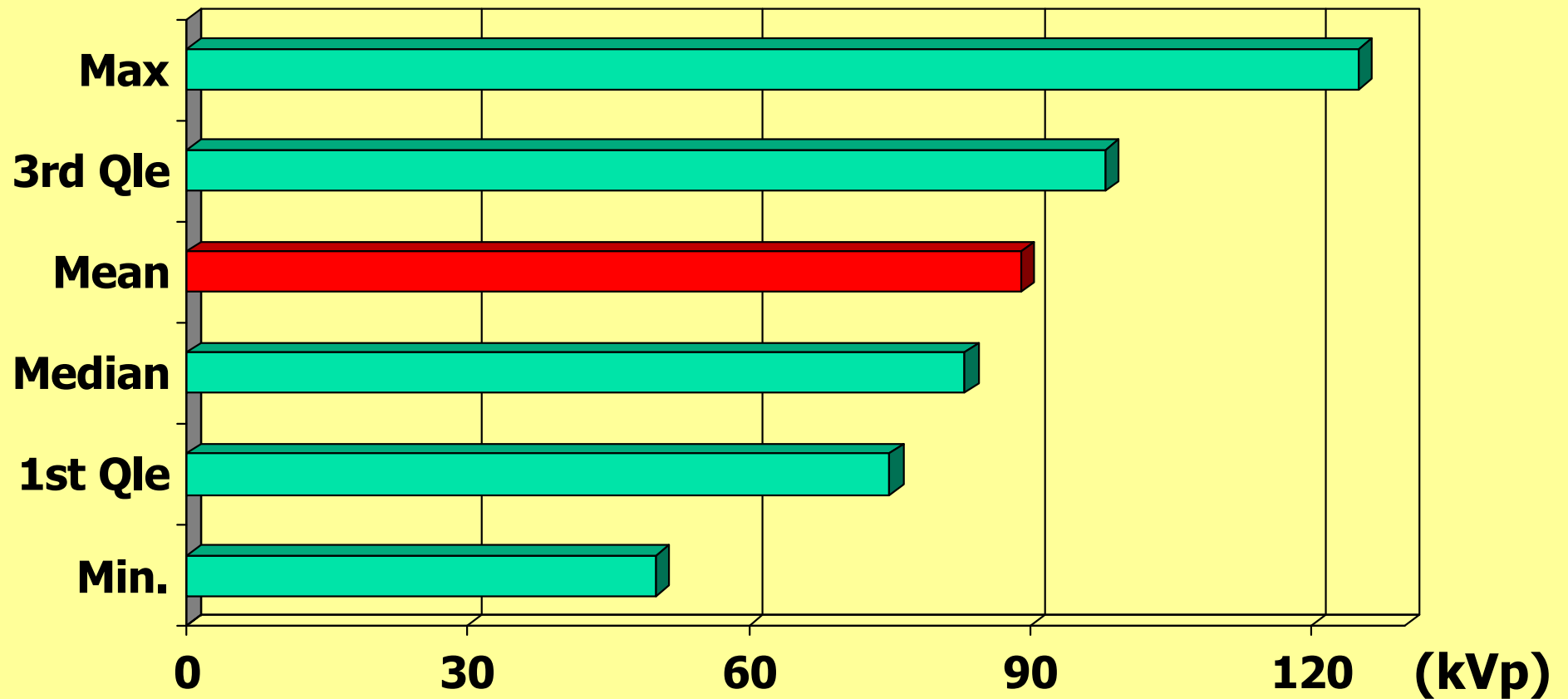
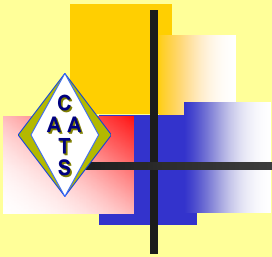


(N = 813)



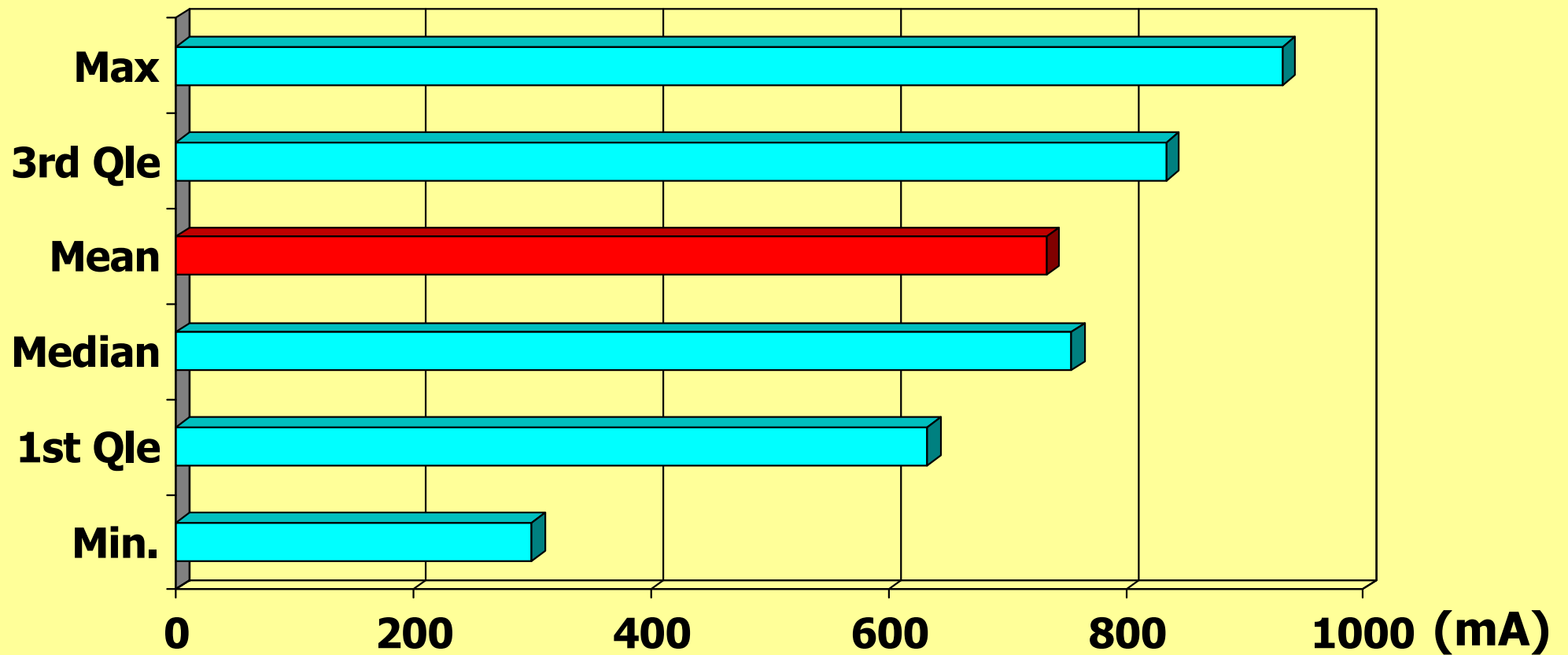
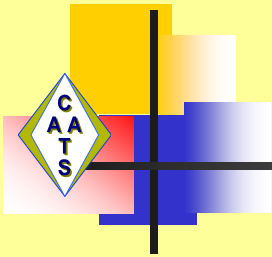
GACI-CAATS Survey

kVp statistics (N = 10,763)



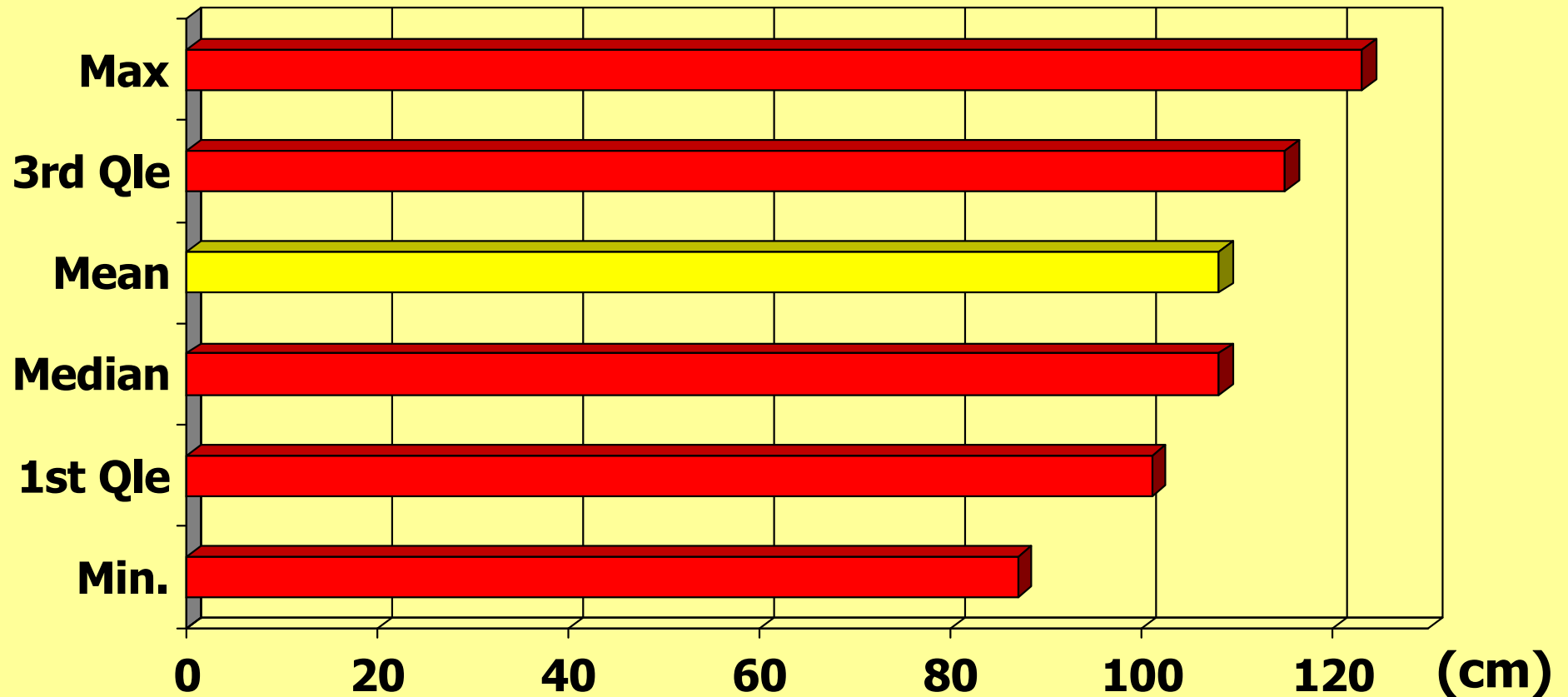
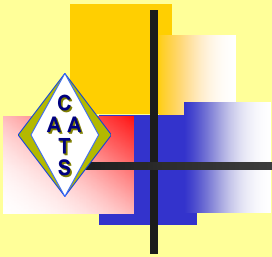
GACI-CAATS Survey

mA statistics (N = 10,763)



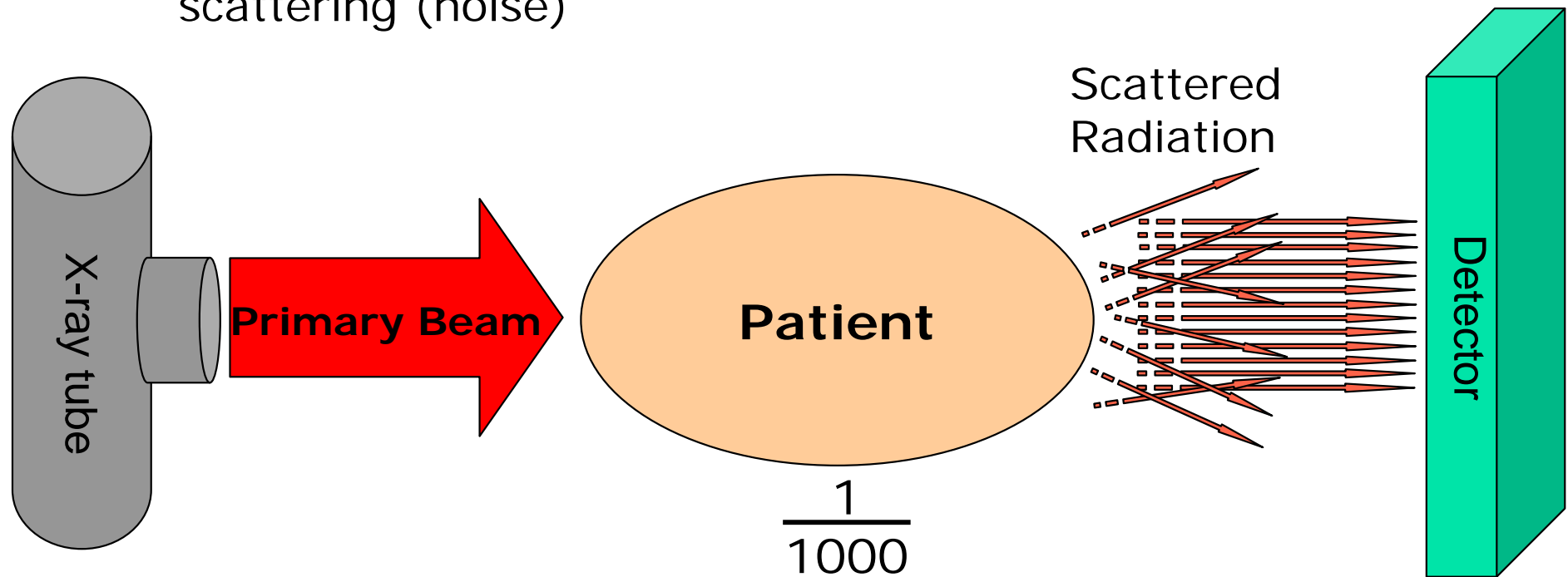
GACI-CAATS Survey

Source to Detector Distance (SDD) statistics (N = 10,763)



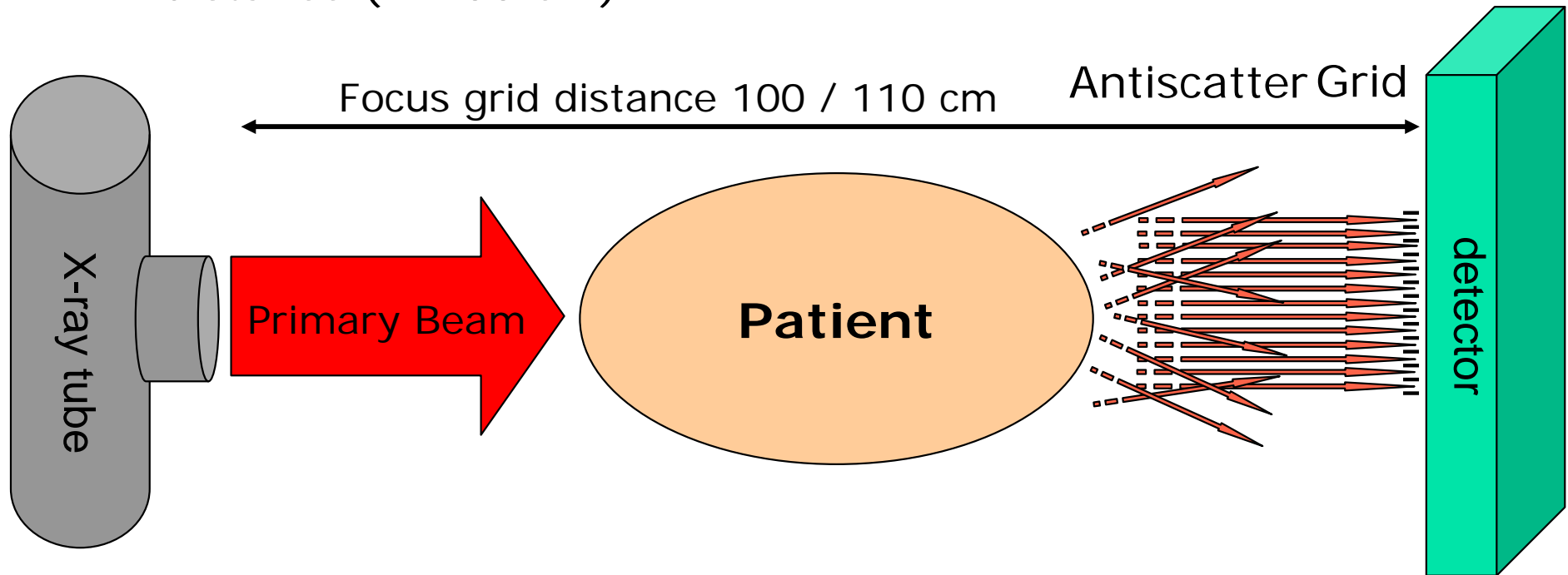
X-ray tube to patient distance and patient to detector distance : what is the best technical choice to make ?

Due to patient attenuation, the secondary beam intensity is much lower than the primary beam and includes scattering (noise)



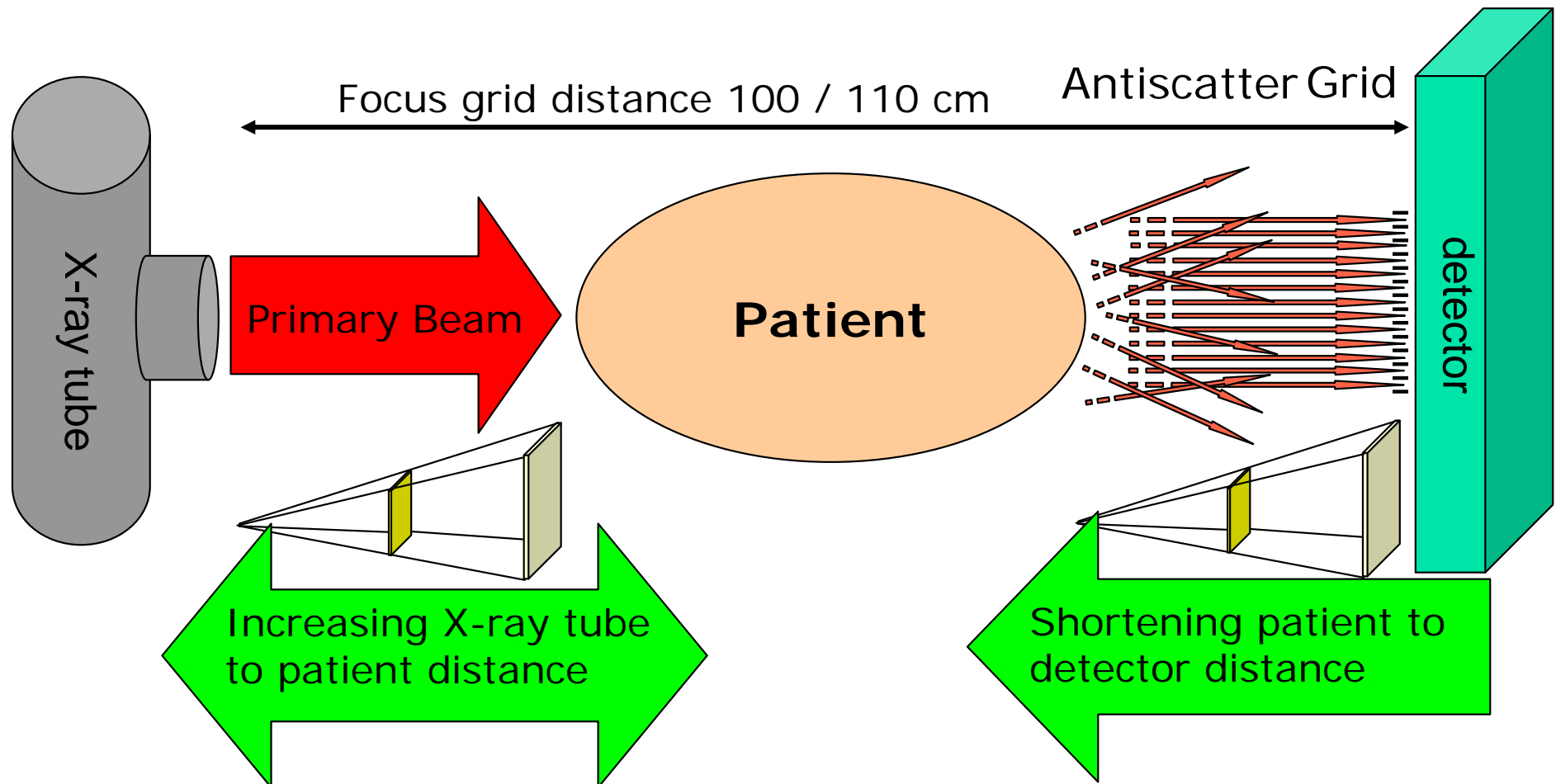
X-ray tube to patient distance and patient to detector distance : what is the best technical choice to make ?

The anti scatter grid reduces the noise, improves the image contrast and requires a given focus to detector distance (# 100 cm)



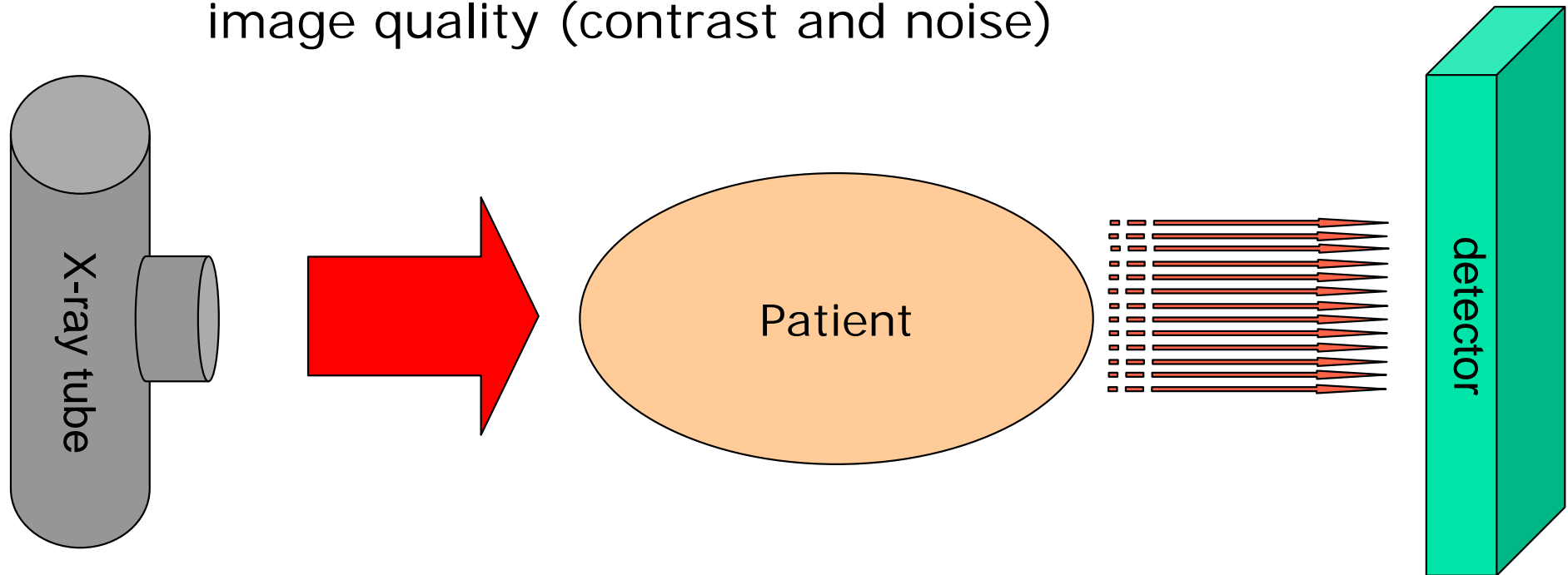
X-ray tube to patient distance and patient to detector distance : what is the best technical choice to make ?

The inverse square law applies at each side of the patient and must be taken into account



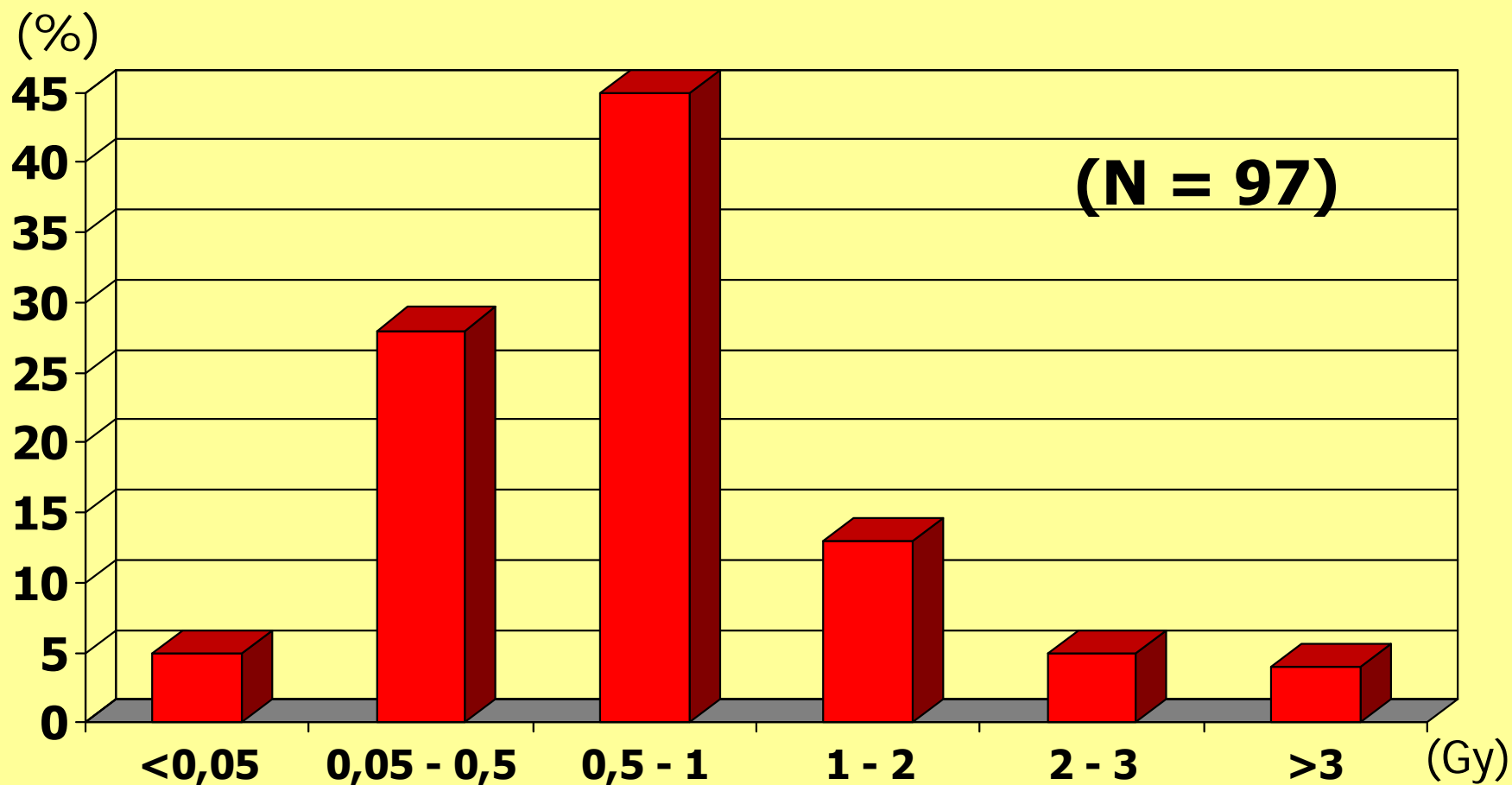
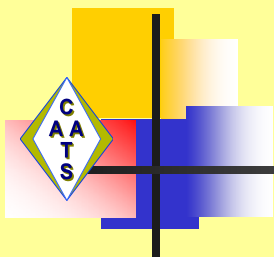
X-ray tube to patient distance and patient to detector distance : what is the best technical choice to make ?

The detector entrance dose rate level is set by the manufacturer to produce a given level of image quality (contrast and noise)

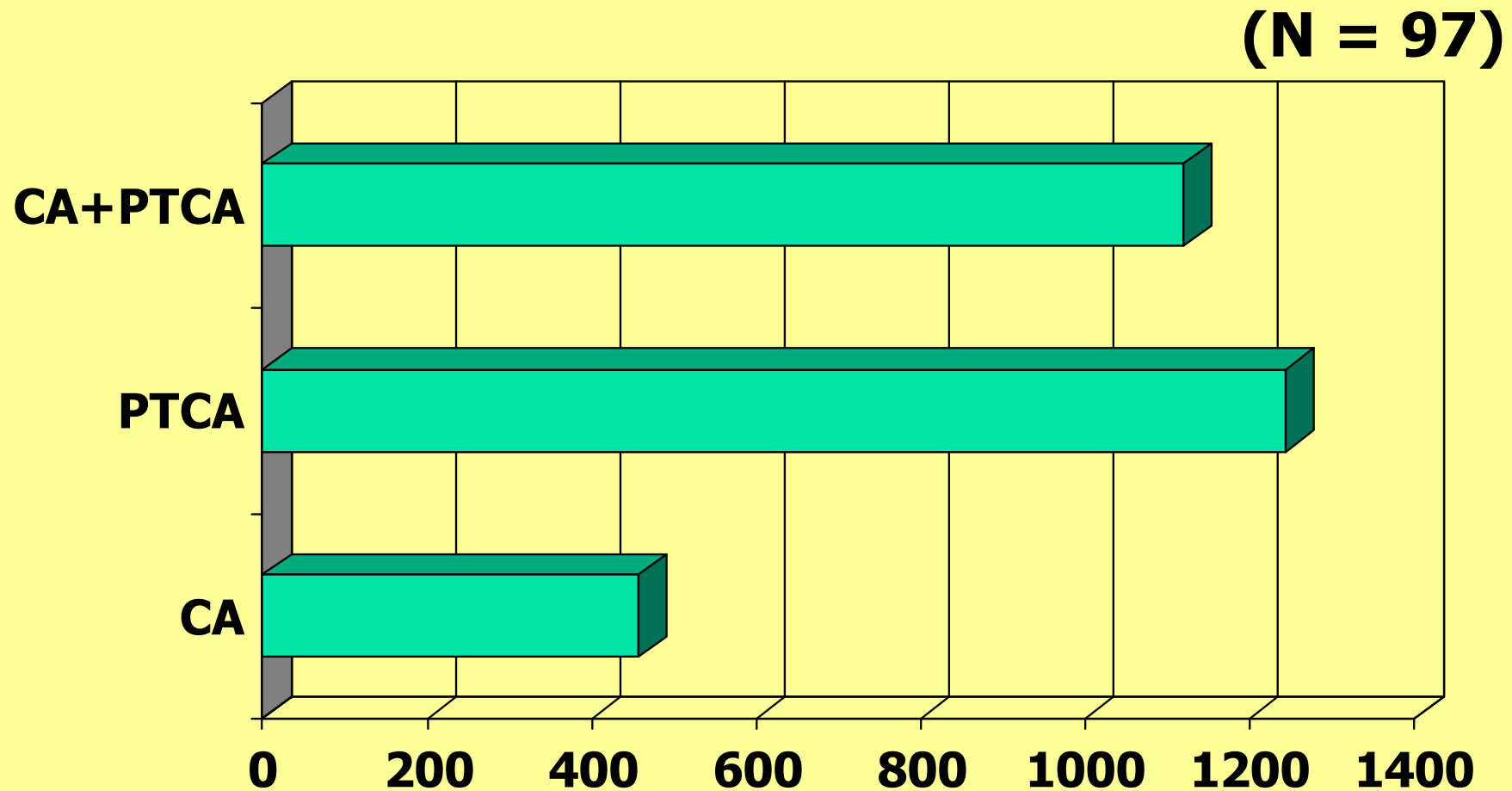
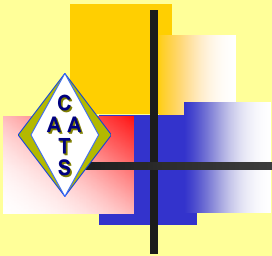


Automatic exposure control device (AEC) keeps constant the dose rate at the detector entrance level to provide the user with a consistent image quality regardless of the distances used.

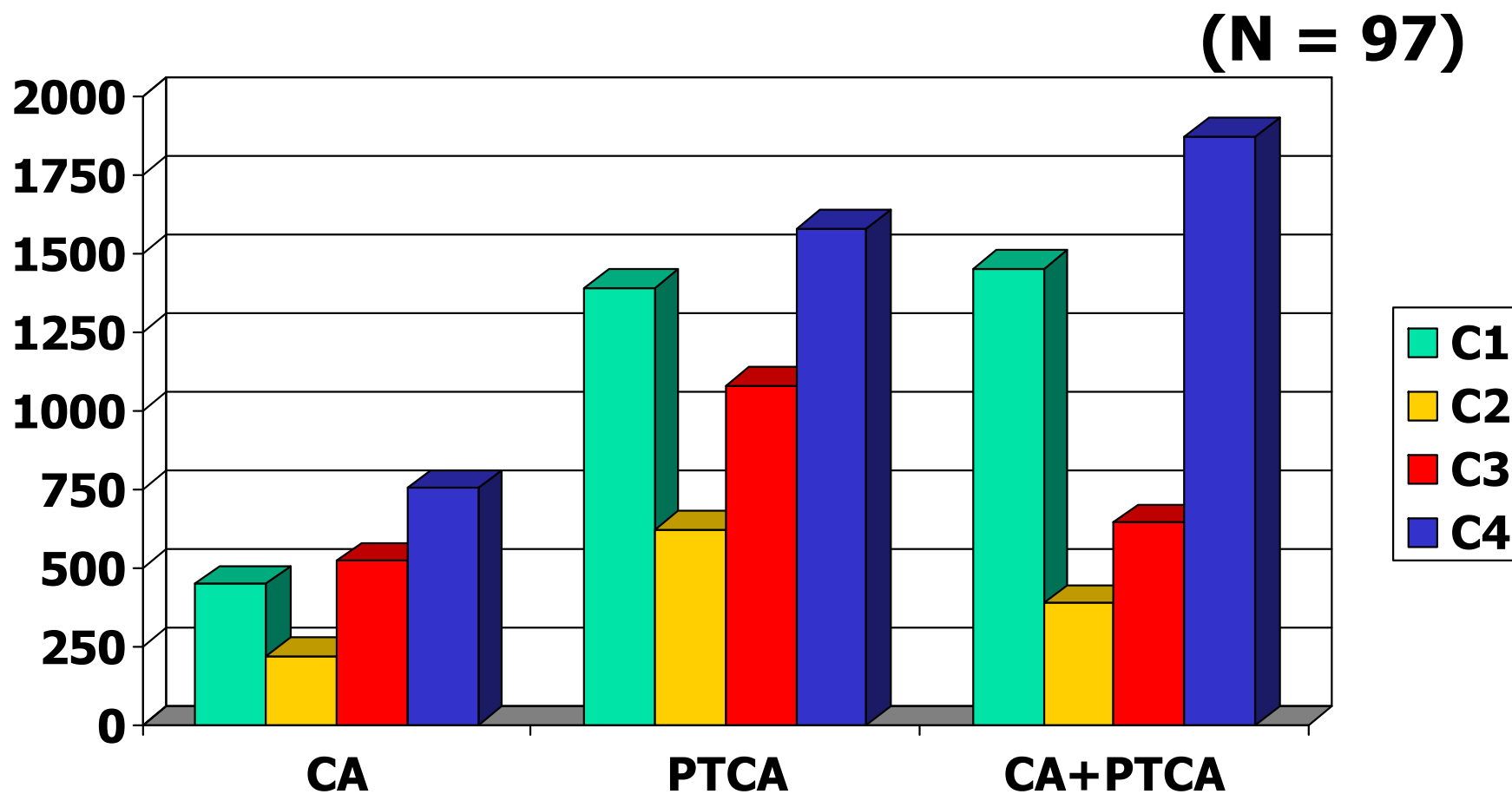
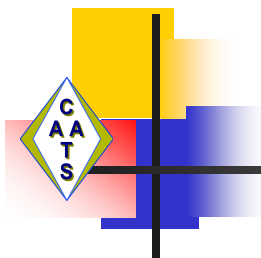
Histogram of measured patient peak skin dose (Gy)



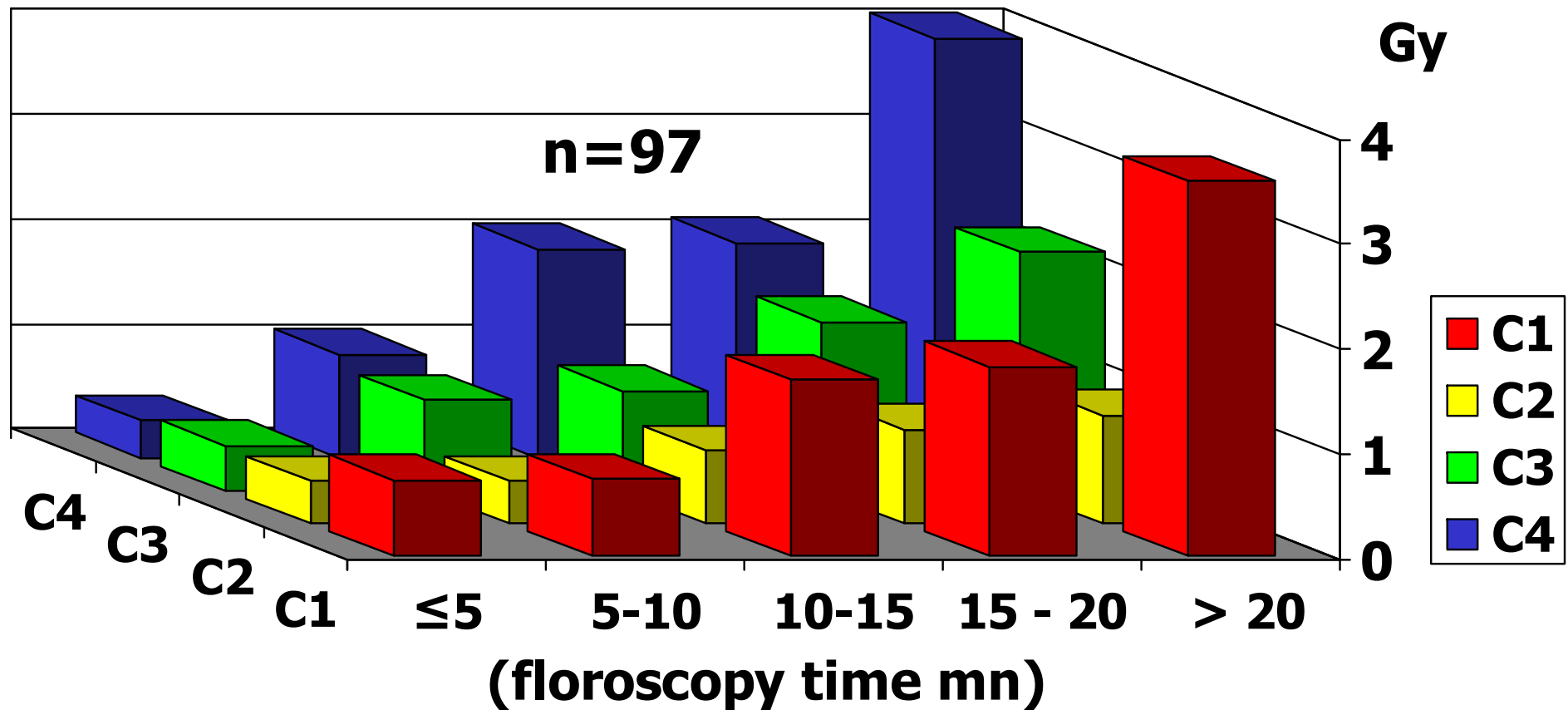
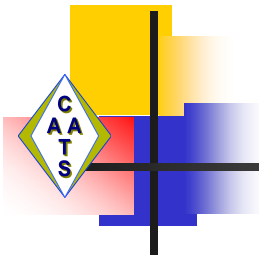
Average patient peak skin dose by type of procedure (mGy)



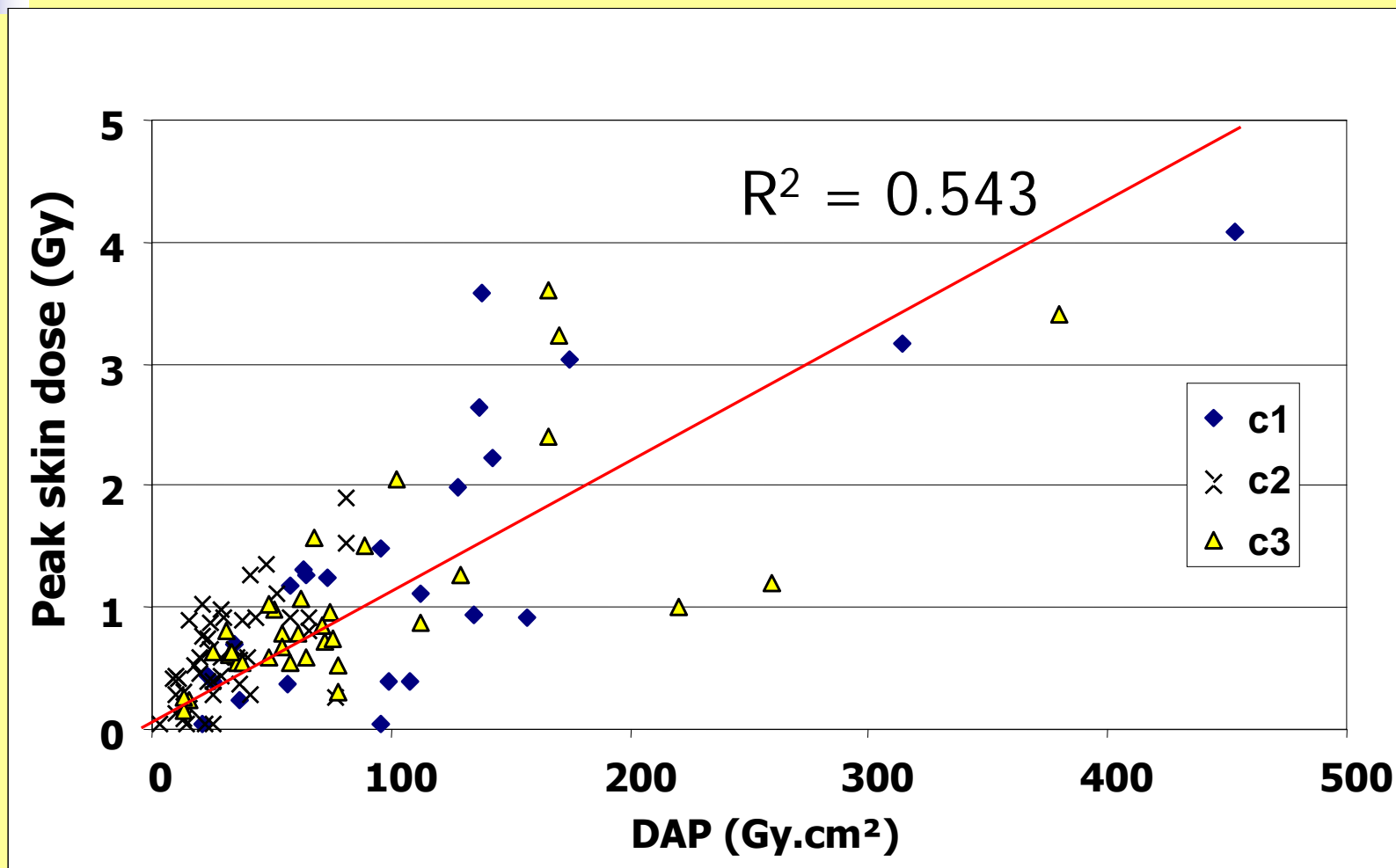
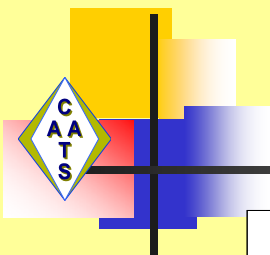
Average patient peak skin dose by cardiologist and by type of procedure (mGy)



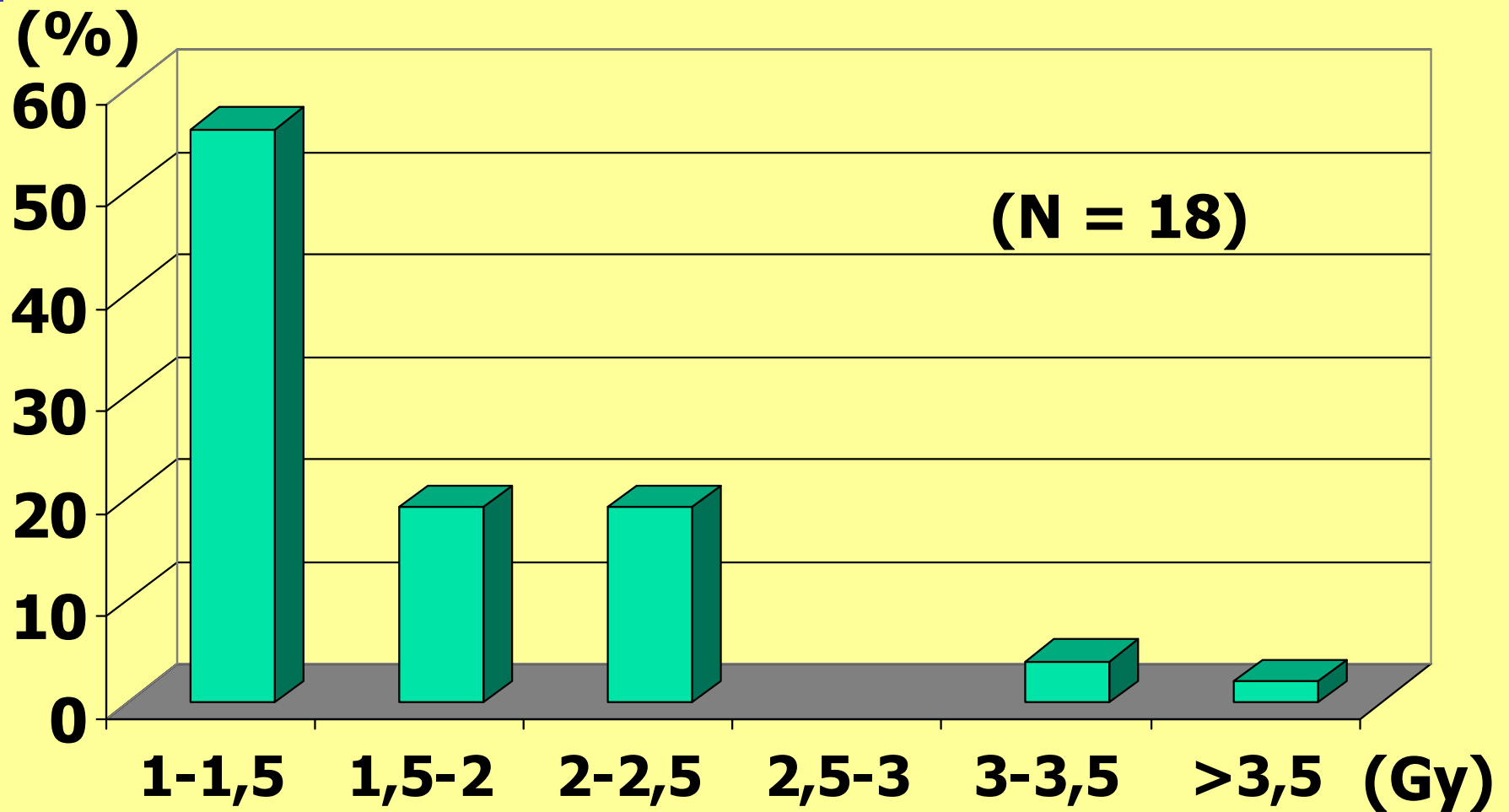
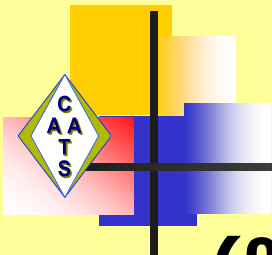
Average peak skin dose as a function of fluoroscopy time (PTCA)



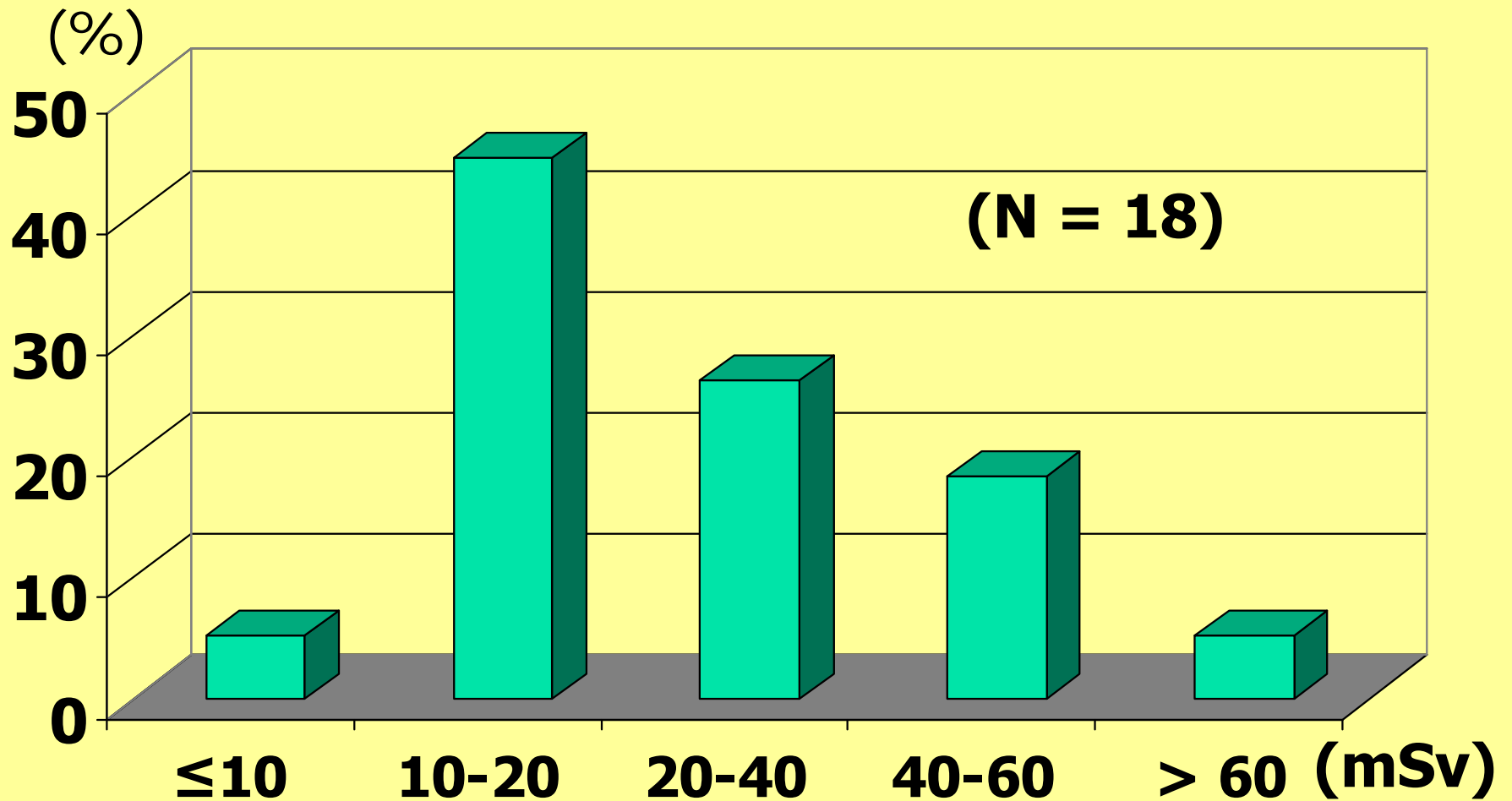
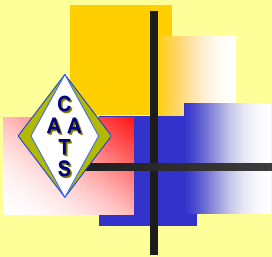
Patient peak skin dose as a function of the DAP value (N=104) PTCA



Histogram of peak skin doses greater than 1 Gy

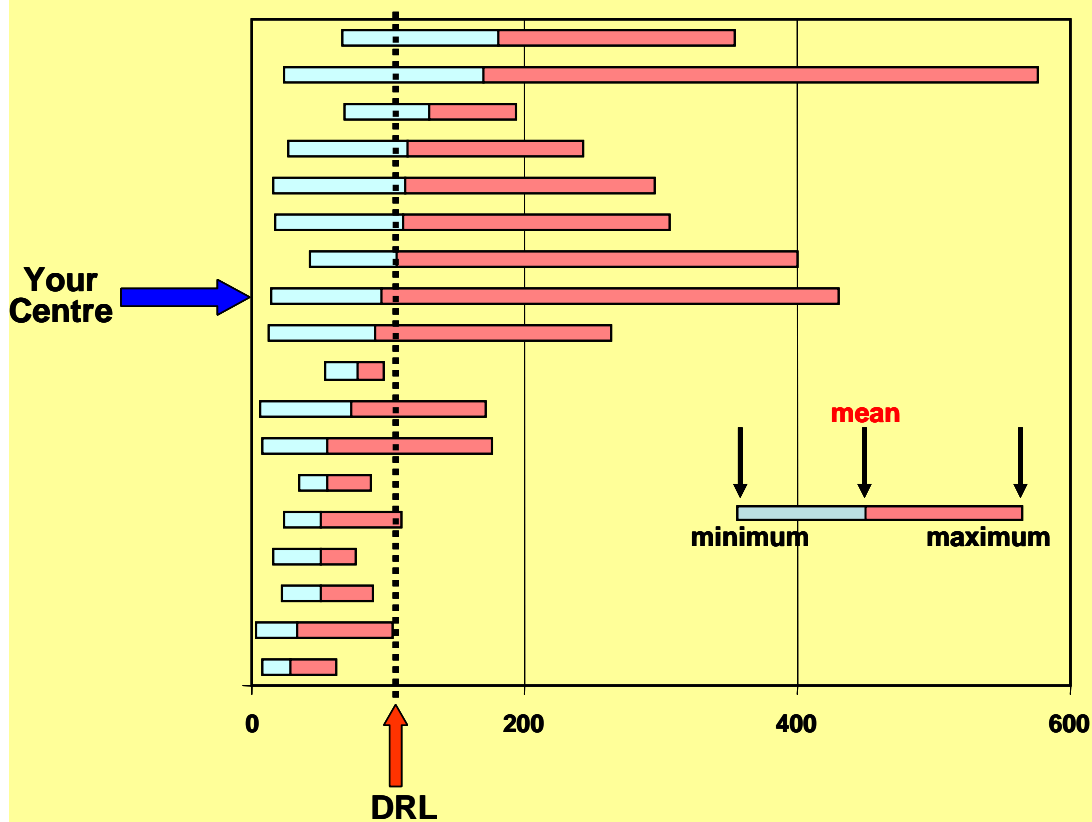


Histogram of effective doses associated to the highest peak skin doses (> 1 Gy)

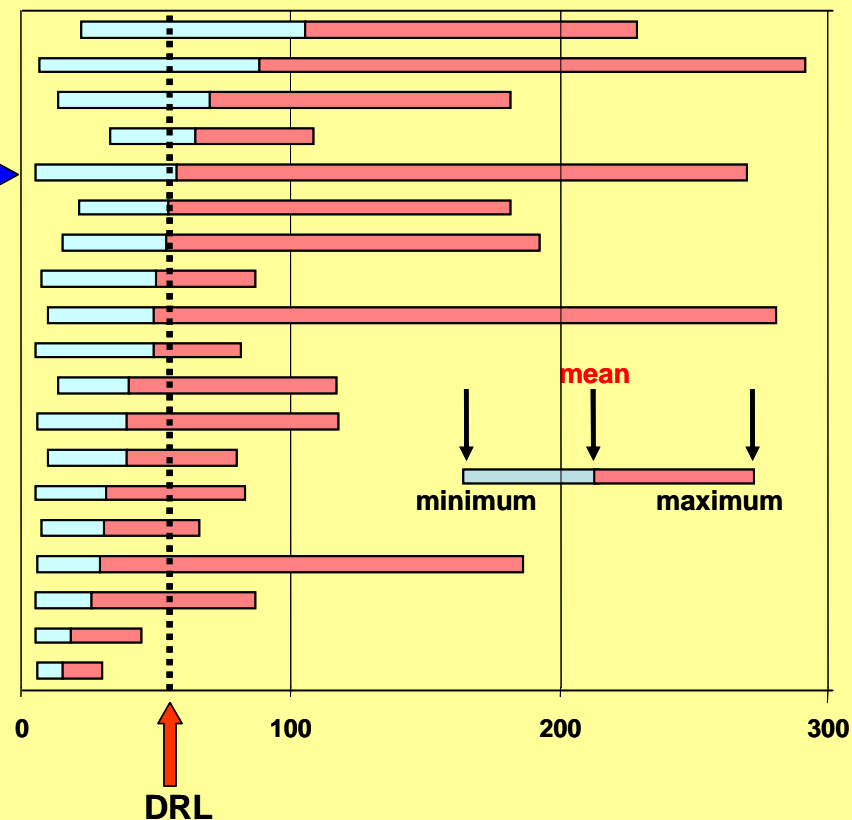


GACI-CAATS Survey

Distribution of DAP values (Gy cm²) :
angioplasties



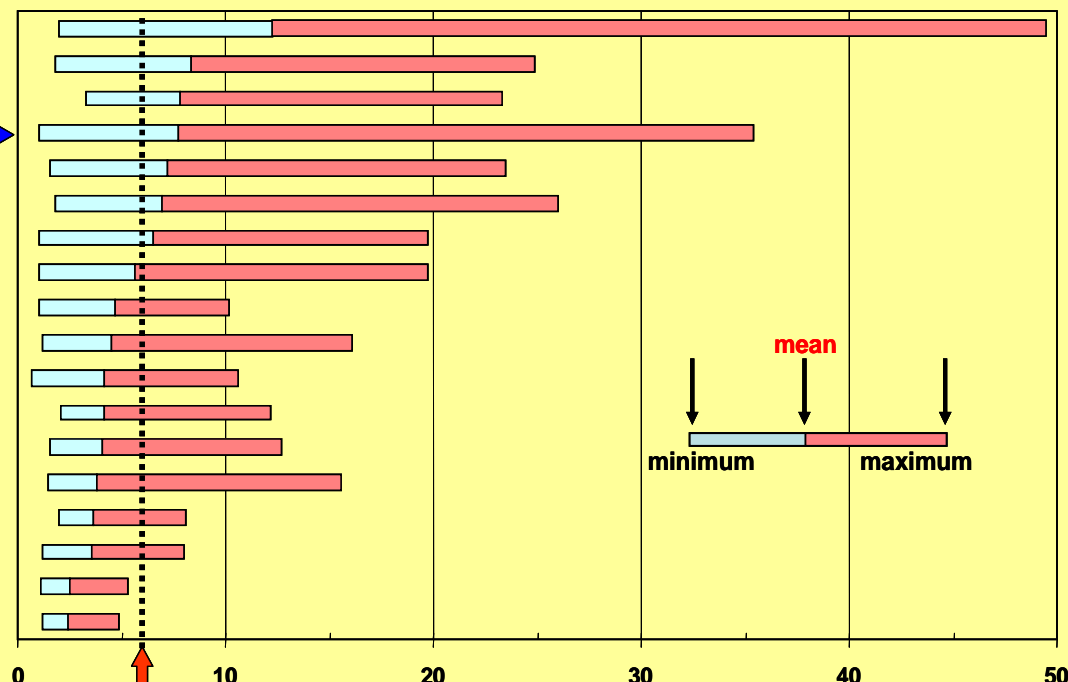
Your Centre



Distribution of DAP values (Gy cm²) :
Coronarography

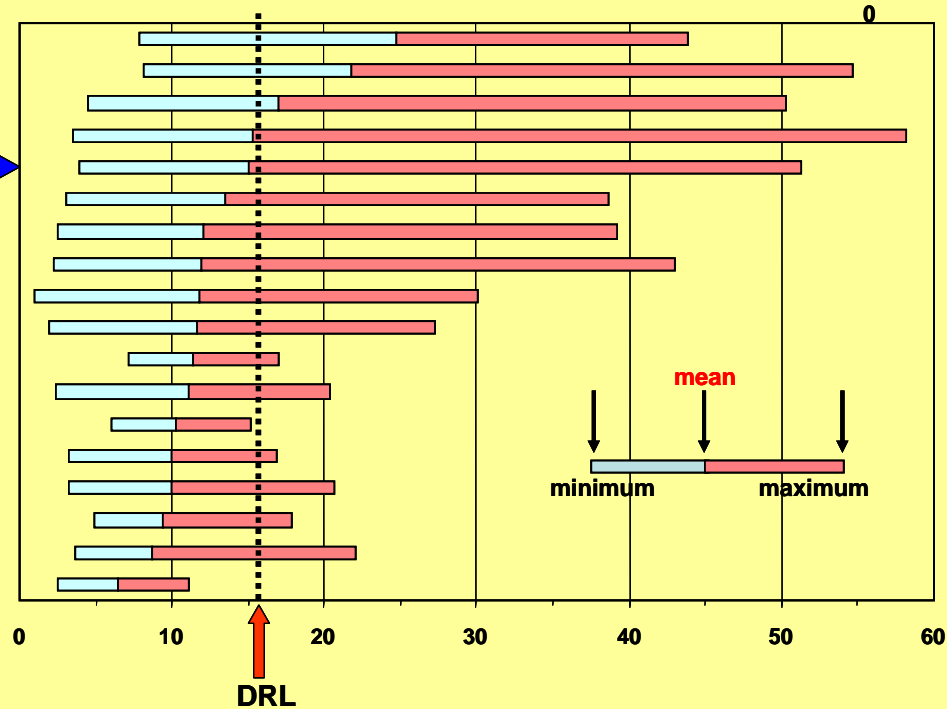
GACI-CAATS Survey

Distribution of Fluoroscopy time (mn) : angioplasties



Your Centre

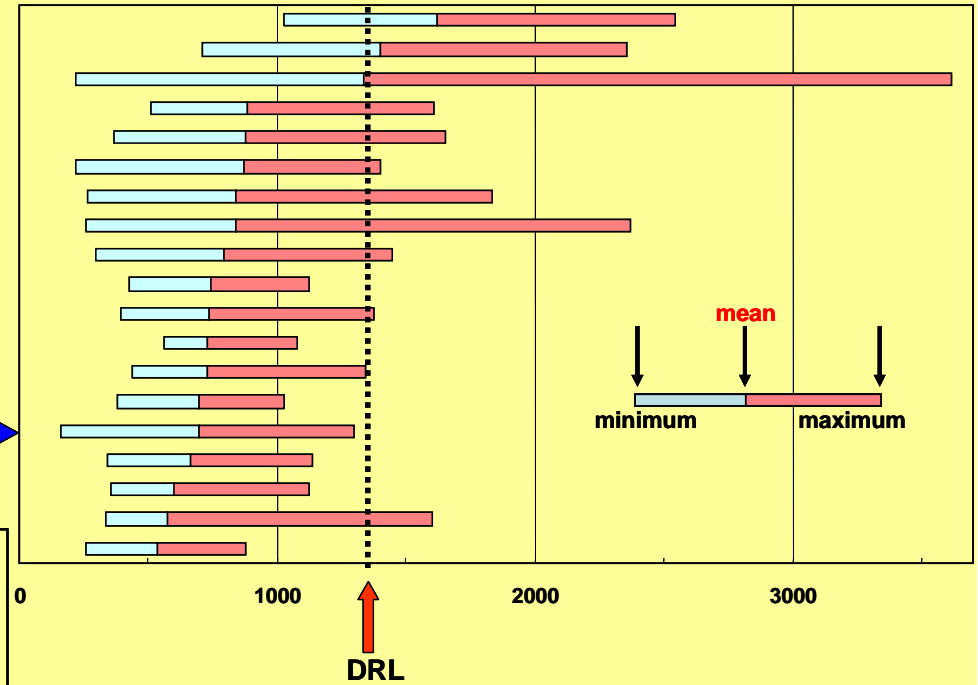
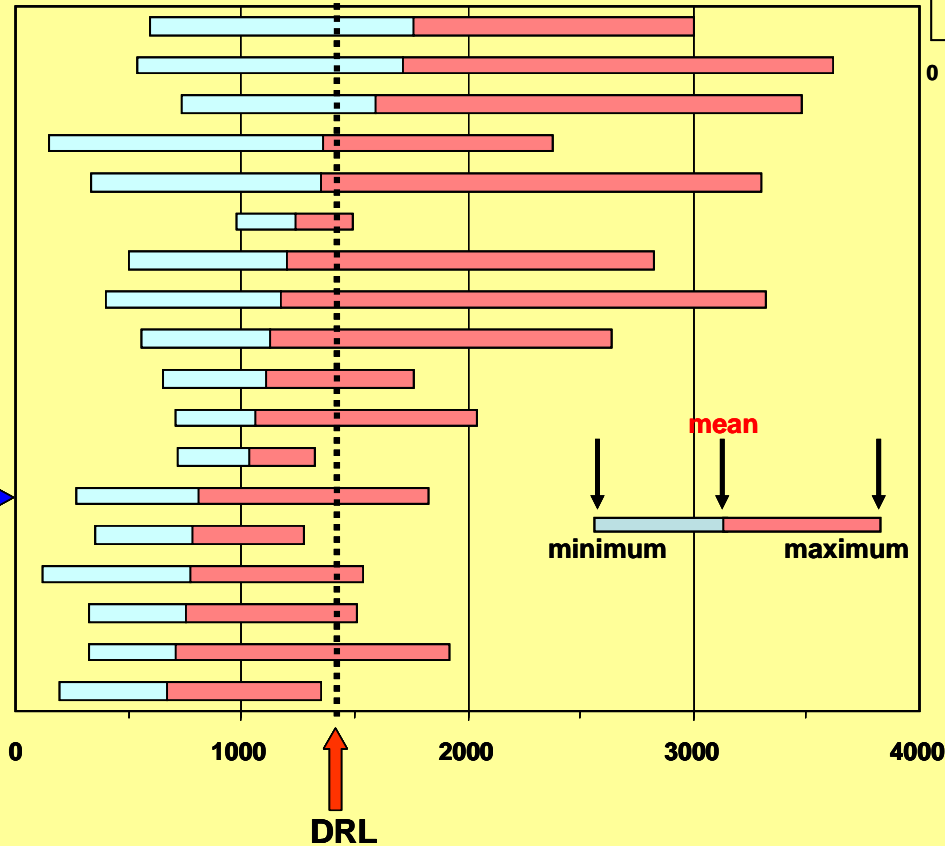
Distribution of Fluoroscopy time (mn) : Coronarography



GACI-CAATS Survey

Distribution of Number of frames :
angioplasties

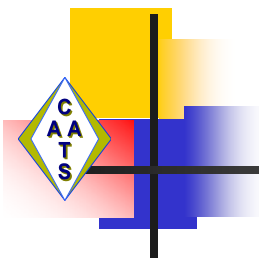
Your Centre →



Distribution of Number of
frames : Coronarography

Your Centre →

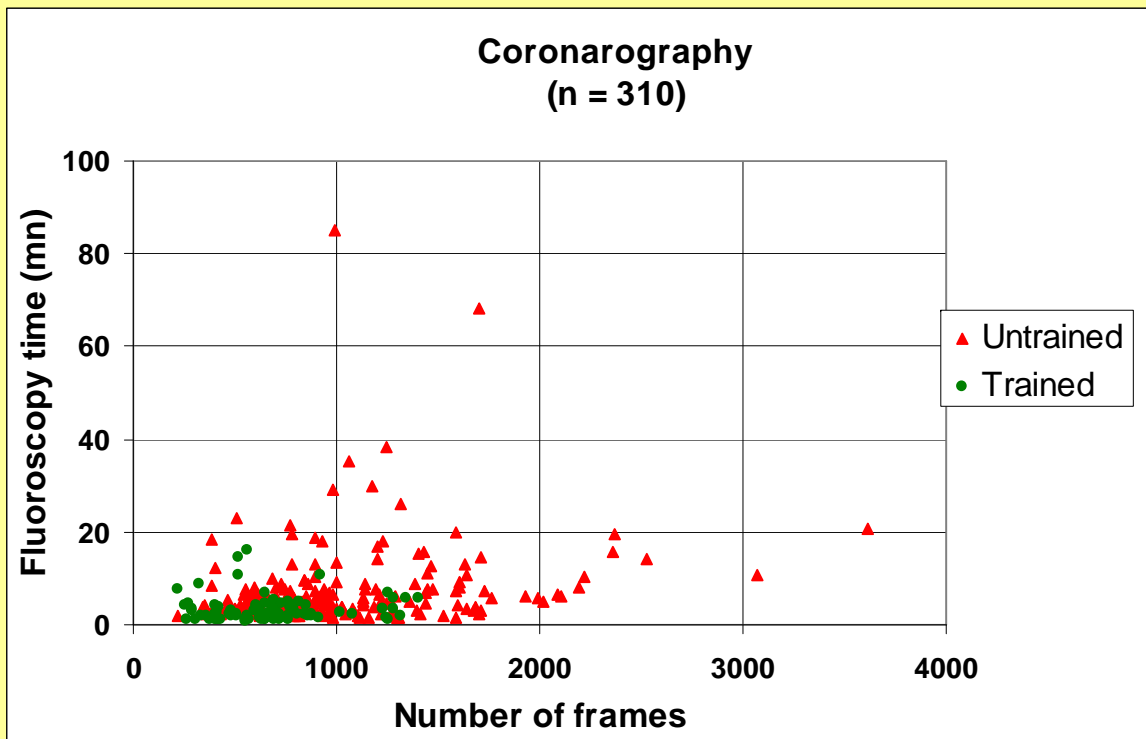
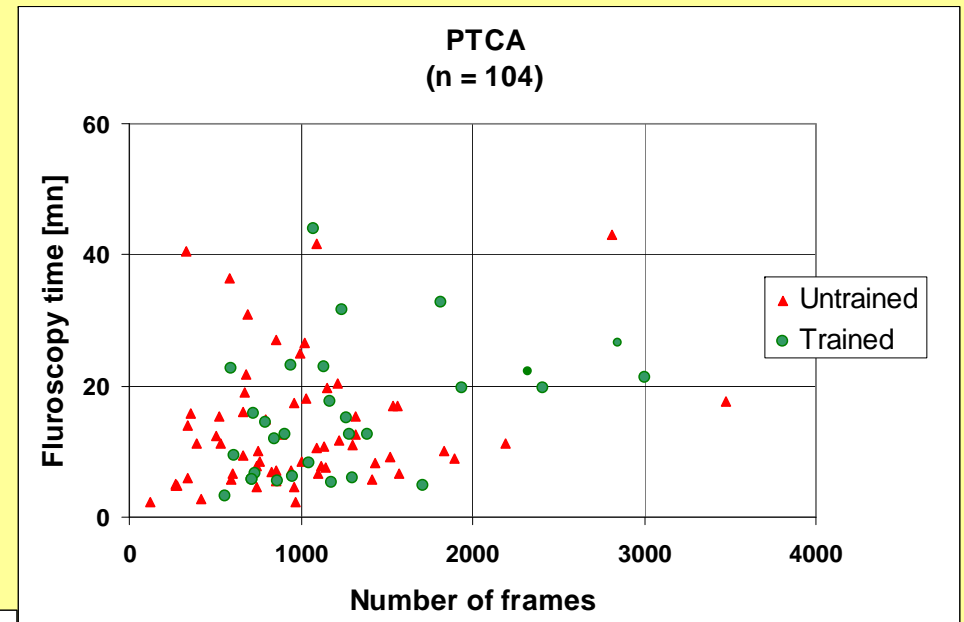
Overall results (n= 813)



| | Coronarography | | Angioplasty | |
|--------------------------------|-----------------------|------------------------|--------------------|------------------------|
| | This study | Reference value | This study | Reference value |
| DAP (Gy.cm²) | 56 | 57 | 110 | 94 |
| Fluoroscopy time (mn) | 7 | 6 | 15 | 16 |
| Image number | 856 | 1270 | 1325 | 1355 |

**Source: Neofotistou V, Preliminary reference levels in interventional cardiology, EUR RADIOL., 2003, 13, 2259-63*

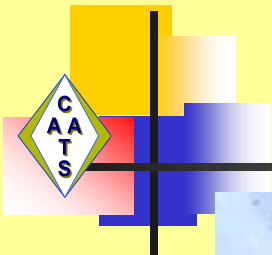
Comparison of dose related parameters between trained and untrained practitioners





Conclusions (1)

- There is a clear need for the optimization of patient dose in Interventional Cardiology (deterministic and stochastic effects)
- Assessment of Diagnostic Reference Level (DRL) should be promoted at National scale
- Training of Cardiologists in Radiation protection is essential and should be promoted



Thank you !!