Croatia and the EU:
Together
Against Cancer

IMPROVEMENT OF QUALITY OF THE NATIONAL CANCER SCREENING PROGRAMMES IMPLEMENTATION (CRO SCREENING)

MINISTRY OF HEALTH OF THE REPUBLIC OF LITHUANIA

NCI

LITHUANIAN UNIVERSITY OF HEALTH SCIENCES

CPVA

NIJZ Nacionalni institut za javno zdravje

Ministry of Health

HZJZ

This project is funded by the European Union

Training of trainers on medical expert topics on specialized type of cancer screening

Zagreb, 23-25 November 2016

Elaborated by experts:

- Dr. Astra Vitkauskiene,
- Dr. Rasa Vanseviciute,
- Dr. Laima Grinyte,
- Dr. Egle Jonaitiene,
- Dr. Tatjana Kofol Bric

Training the trainers workshop – Breast cancer screening – Day 1

Zagreb, 23 November 2016

9.00-9.25 Welcome and introduction

- Opening.
- The welcome greetings from **organizers** of the project.
- The welcome greetings from the **organizators** and **experts**.
  - Experts Dr. Egle Jonaitiene and Dr. Ruta Briediene introduce themselves.
- The experts ask the **participants (trainers)** to introduce themselves
  - how long do they work and what kind of activity and practice do they have working in the field of screening program. All trainers introduce him(her)self.

protection of breast against scatter radiation by lead shielding

European Radiology

November 2003, Volume 13, Issue 11, pp 2436–2440

Efficacy of breast shielding during CT of the head

Authors | Authors and affiliations

Z. Brnić ✉, B. Vekić, A. Hebrang, P. Anić

Breast

First Online: 25 June 2003

DOI: 10.1007/s00330-003-1945-1

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optimization of mammography positioning technique

Breast compression and radiation dose in two different mammographic oblique projections: 45 and 60°

Zoran Brnić, Andrija Hebrang
Department of Diagnostic and Interventional Radiology, University Hospital 'Merkur', Zajčeva 19, 10000 Zagreb, Croatia

DOI: http://dx.doi.org/10.1016/S0720-048X(01)00317-5

Abstract | Full Text | Images | References

Abstract

Introduction: Standard mammography includes two views, craniocaudal and medio-lateral oblique. Depending on patient's body constitution, central beam angle in mediolateral oblique projection may vary, with 45° being suitable for the majority of patients in routine daily practice. With continuous improvement in X-ray technology and radiographers' training, the risk of radiation induced cancerogenesis is considerably reduced and acceptable

nationwide audit on physical and technical image quality in mammography

Image quality of mammography in Croatian nationwide screening program: Comparison between various types of facilities

Zoran Brnić, Darko Blašković, Branimir Klasić, Jelena Popić Ramač, Mirjana Flegarić-Bradić, Damir Štimac, Ivan Zvonimir Lubina, Vedran Brnić, Dario Faj

DOI: http://dx.doi.org/10.1016/j.ejrad.2011.06.020

Abstract | Full Text | Images | References

Abstract

Purpose

The study was aimed to provide objective evidence about the mammographic image quality in Croatia, to compare it between different types of MG facilities and to identify the most common deficiencies and possible

analyse of the problem of old and outdated radiology equipment

ESR EUROSAFE IMAGING

EUROPEAN SOCIETY OF RADIOLOGY

ESR EuroSafe Imaging - Experts & Partners

Old and outdated radiology equipment in Croatia – radiation safety and economic consequences

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Introduction

Ionising radiation from medical imaging accounts for a considerable proportion of the radiation exposure experienced by the general population. The benefit of imaging and interventional procedures is well known, but also carries some risks. Appropriate quality and security of radiological services can be achieved only with the use of state-of-the-art imaging equipment, the operation and maintenance of which is technically demanding. The ESR position statement[1] adopted general rules endorsed by The Canadian Association of Radiologists regarding the life cycle of various types of equipment[2]. Radiological equipment up to 5 years is state-of-the-art, properly maintained equipment between 6 and 10 years old is still suitable for use, and equipment older than 10 years is no longer state-of-the art and replacement is essential[1]. It is recommended that more than 60% of the installed equipment in radiology departments should be

9:25-10:30 Morning session: Why organized and population based screening programs are important?

- Lectures related workshop: Quality assurance in Breast Cancer Screening Program.
- Moderators Dr. Egle Jonaitiene and Dr. Ruta Briediene conduct the discussions, focussing on several questions:
  - What is quality assurance in my practice?
  - How I can ensure quality in my practice?
  - What are the main obstacles in my practice and how I can solve them?

What is quality assurance in my practice? Systematic QA-QC activities **rare** and **inconsistent**, QA was **not done evidence based**, **image quality vary** from acceptable when experienced RTs are involved to poor when beginners were engaged

How I can ensure quality in my practice? **Identify** good MUs, good and motivated professionals, **prolypherate their skills** within the facilities and between them, **engage and educate medical physicists**, **license – certificate** the units, **eliminate** MUs with poor potentials

What are the main obstacles in my practice and how I can solve them?

- Identification of the patients – because of variable response rate in different age groups women are scheduled to mammography in 5-6 minutes intervals; in a case of good response, the technologists are hurried and hence the mistakes in identification occur, ranging from a letters mismatch to serious misidentification of the women. Making staff allert to be carefull about identification, reorganize scheduling to 10 minutes intervals
- IT technology does not support all letters with Croatian diacritic signs on all levels (hospital PACS, national program data system, printers for CDs…) e.g. ČAČIĆ vs ČAĆIĆ, ĆAĆIĆ vs CACIC, DŽINIĆ vs ĐINIĆ vs DJINIC vs DINIĆ vs DINIC. Different variants od the same name occur on envelopes, CDs and PACS records (Matoić, Mataić, Matajić) which all lead to possible confusion and misindentification. Making staff allert to be carefull about identification, and correct writing the names
- Large hospital's PACS is full of same names (e.g. MARIJA HORVAT) even with the same years of birth which can lead to misindentification

- The CR cassetes are not labeled and artifacts cannot be identified instantaneusly if occured
- The delayed reading the screening mammograms: three weeks deadline for completion and shipping of exam not fulfilled and delay occur, women urge for the report disturbing the staff
  - Clinical radiologists invoved in shift working system, working in different hospital location that are not interconected, and generally overloaded with other duties: radiologists dedicated to screening mammography
  - Reading environment not adequate – no dedicated monitors on all workplaces, ambient light generally inadequate, films for comparison often lacks (remember that analogue, CR and FFDM coexists in Croatian screening system): license the workplaces with adequate reading environment
- The problem of lack of the technologists, esp. dedicated for mammography
  - RTs perform SMG as extra hours, possibly tired after daily work, coming back in afternoon after night shift, lack of concentration and dedication – dedicated screening institutions with specific working organization

10.50-12.30 Lecture and related workshop: "Quality control implementation and breast radiation protection in BC screening in Croatia"

- lecturer and moderator Prof. Zoran Brnic:
- Lecture 1: "An issue of Breast Radiation Protection in Screening in Croatia" (~10-15 min).
- Lecture 2: "The proposal of QC implementation in Croatia" (~10-15 min);

- The lecturer promotes a discussion stressing on several questions:
  - What QC model is suggested as the best for BC screening efficiency in Croatia?
  - What QC elements are essential to reach this purpose?
  - Who should be involved in QC implementation?
  - How could the proposed QC model be implemented?

What QC model is suggested as the best for BC screening efficiency in Croatia?

- the mammography screening is too decentralized
- QA-QC activities have been inconsistent and limited to several centres which have medical physicists
  - The majority of other MUs did not performed even basic daily and weekly activities
- The centralization of QC is needed
  - QC audits by the radiologist members of Working group for QA-QC should be continued at least once a year for each MU
  - Quarterly QC session of Working group to analyse the Reports, decide about corrective actions and deadlines to fulfill,
- Introduction of daily and weekly activities in major MUs suported by physicists and/or more experienced technologists during 2017
- Prolipheration of daily and weekly activities to other smaller MUs by educational visits to major MUs during 2018

What QC elements are essential to reach this purpose?

- Professionals: members of Working group
- Basic QA-QC equipment
- The engagement of medical physicists – the finantial resources have to be found to pay the physicists
- To establish central administration of QAQC – possibly the Office with 1 full-time administrator

Who should be involved in QC implementation?

- Ministry of health
  - Commission for organization of NBSP
  - Working group
- County coordinators
- Professionals
  - Medical physicists
  - Radiology Techs through its Chamber
  - QA-QC technologists in Mus
  - Radiologists reading mammograms

How could the proposed QC model be implemented?

- Step-by-step
  - Don't try to introduce the whole system at once, as the experience showed that the activities are prone to cease, if continuous stimulation does not exists
- Continuously
- Centralised with sharing good practices to regional facilities
  - if one element is good, support the local group to continue the local good practice, then enablee the other to see it and copy in their MUs

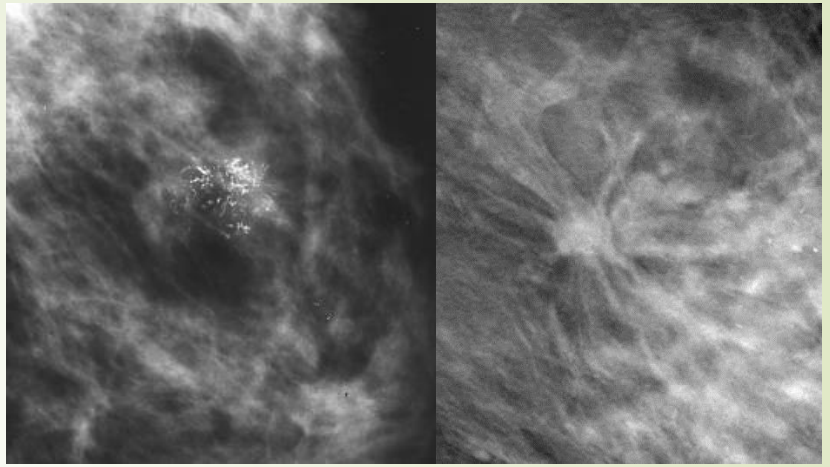
An issue of Breast Radiation Protection in Screening in Croatia

Zoran Brnić

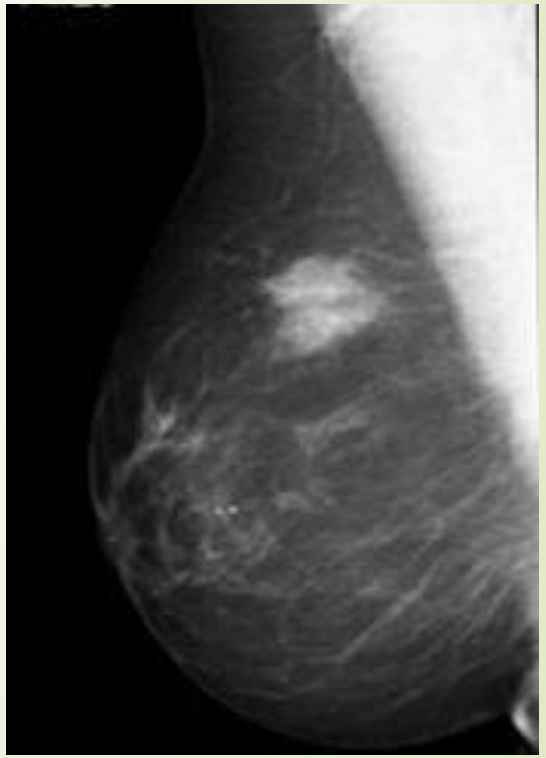
Breast radiation dose in mammography

The basics

Introduction



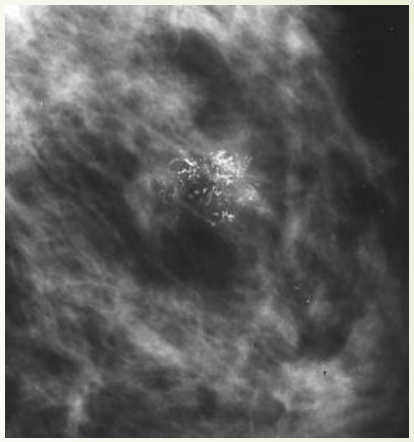
- X-ray mammography is a reliable method of detecting breast cancer
- The method of choice for breast cancer screening programs in many developed countries
- The best possible **image quality** should be achieved through optimization of all variable imaging parameters – the importance of QA/QC
- **breast radiation dose** should be ***ALARA*** - image quality and radiation exposure **should be balanced**

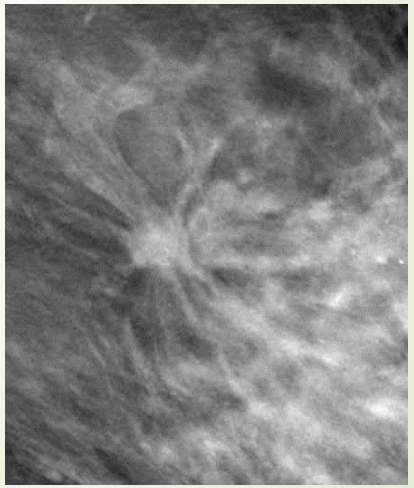


Mammography image quality requirements

- High spatial resolution
- High contrast
- High SNR

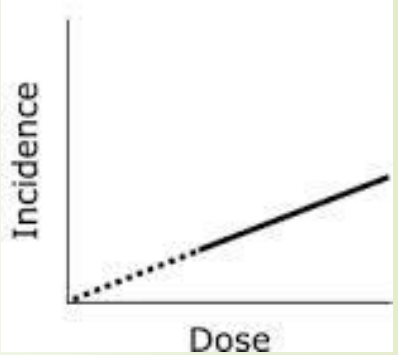
are necessary to detect
the signs of early breast cancer





Radiosensitivity of the breast
Radiation induced cancerogenesis

- Glandular breast tissue – high radiosensitivity
  - stochastic type - linear dose–response relationship
  - no dose threshold
  - increases considerably with younger age
    - BC incidence increases in young women
    - glandular tissue amount larger in young age



Lifetime risk of radiation-induced breast cancer for UK women (screening ages are shown in bold)

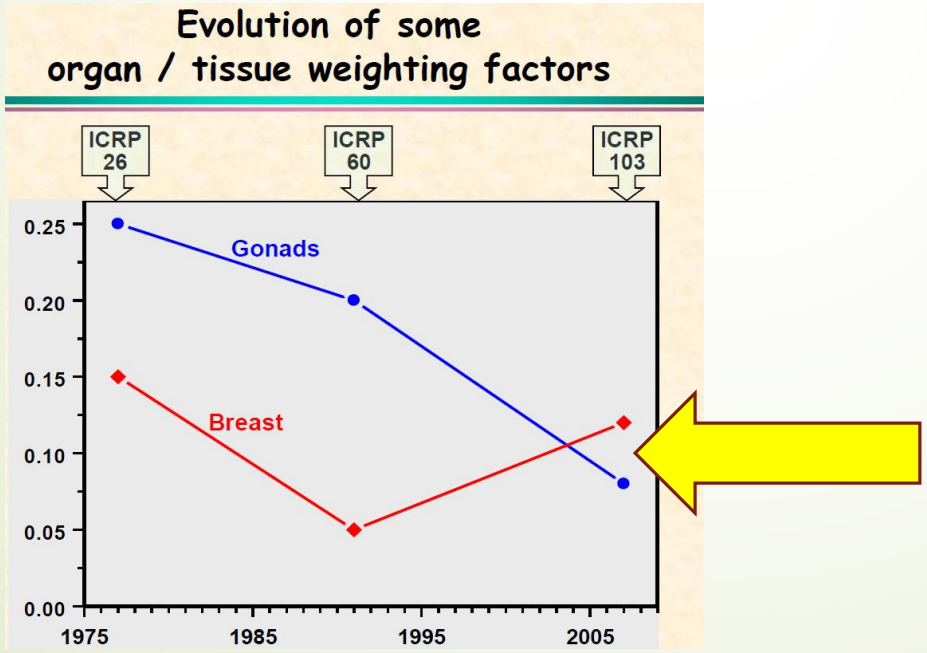
Age at exposure (years)	Lifetime risk (per million per mGy)
5	43
10	43
15	43
20	18
25	18
30	18
35	17
40	16
45	15
50	**14**
55	**12**
60	**10**
65	**8.0**
70	**6.1**
75	4.2
80	2.5
85	1.2

- Fat not radiosensitive!

Breast tissue weighting factor

- Tissue weighting factor w_T for breast is now relatively high
  - 0,05 (ICRP 1991)
  - 0,12 (ICRP 2007)

$$Effective\ Dose = E = \sum_T w_T H_T$$

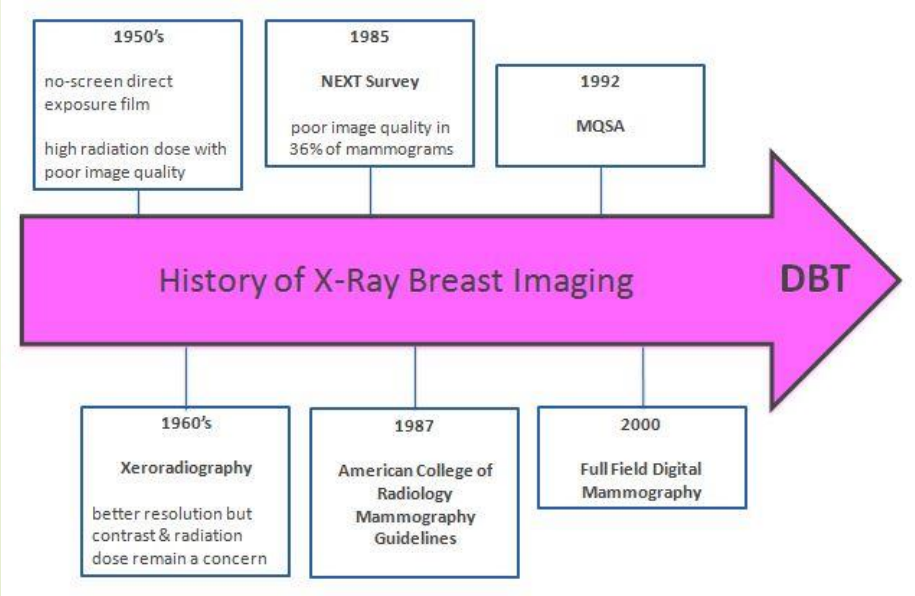


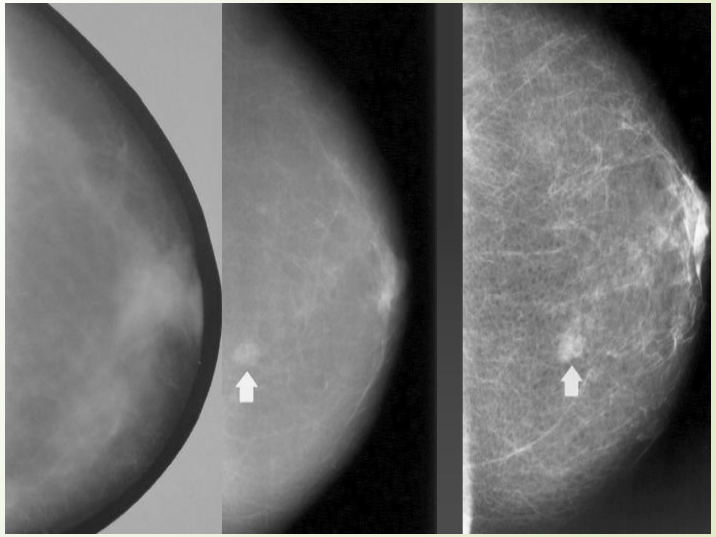
Organ/tissue	w_T ICRP (2007)	ICRP (1991)
Breast	0.12	0.05
Bone marrow	0.12	0.12
Colon[a]	0.12	0.12
Lung	0.12	0.12
Remainder	0.12[b]	0.05[c]
Stomach	0.12	0.12
Gonads[d]	0.08	0.20
Bladder	0.04	0.05
Liver	0.04	0.05
Oesophagus	0.04	0.05
Thyroid	0.04	0.05
Bone surfaces	0.01	0.01
Brain	0.01	—
Salivary glands	0.01	—
Skin	0.01	0.01

Risk of carcinogenesis
vs.
Benefit of saving lives through early cancer detection

The history of mammography doses

- 1930s - attempts to image the breast with X-rays with 70 kVp
- 1950s – direct-exposure films -low kVp, high mAs, no grids – very high doses
- 1960s – Xero-mammography – high contrast, good sharpness, doses lower
- 1970s – SFM – acceptable image quality, dose 20 mGy/image
- 1980s – rare earth screen FM, AEC- doses 5-10 mGy/image
- 2000s – DM - dose <1 mGy/image





The evolution of image quality
1960 1975 2010

Factors influencing radiation burden in a screening mammography programme

- **Organization dependent**
- The age of population invited
- The genetics of exposed women – all women – non-selected
- Screening interval – 2 yrs
- One- vs two-view mammography
- **Equipment dependent**
- The age and quality of MG machines
- The technology: SFM vs CR vs DM
  - The films and cassettes (sensitivity, green vs blue), dedicated processors, dedicated view-boxes
- The maintenance of equipment: x-ray tubes, AEC, film processors
- QA-QC implementation
- **Radiographic technique dependent**
- Grid use
- Large breast Bucky
- Breast positioning
  - Angle
  - Compression
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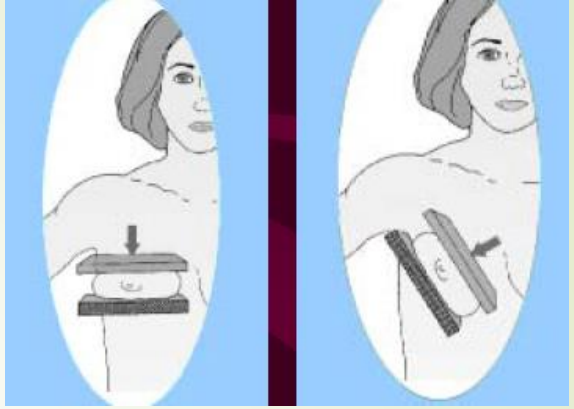
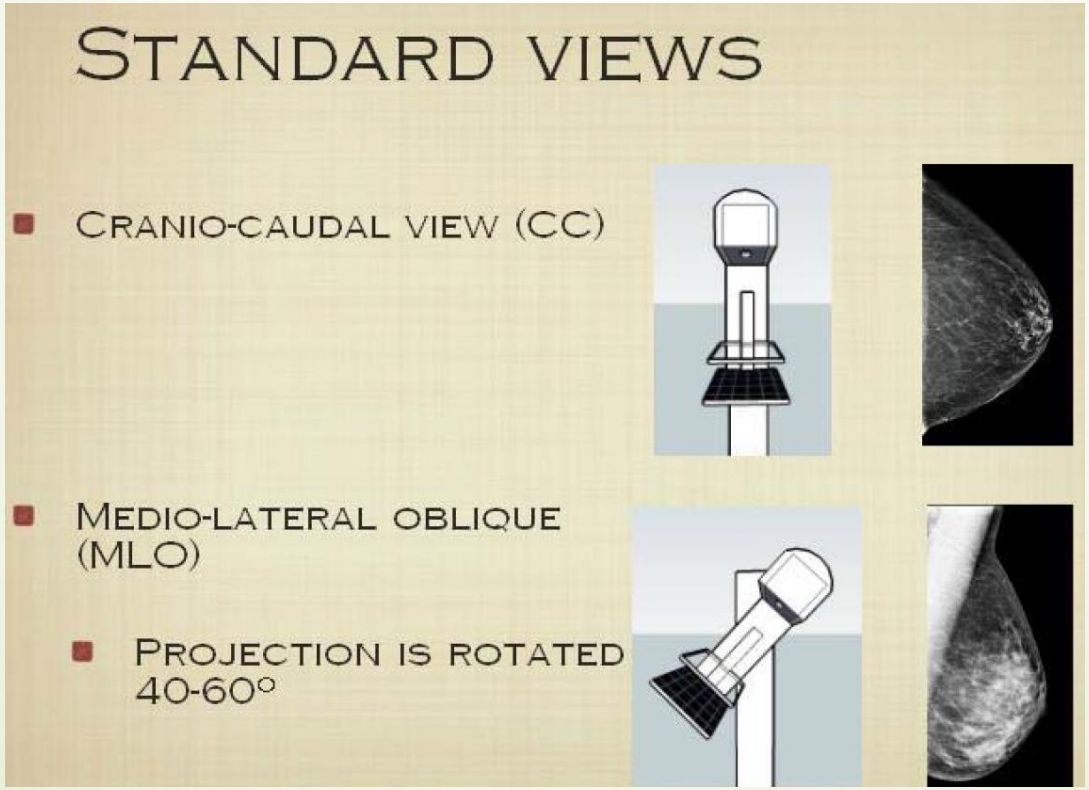
Breast positioning



- Craniocaudal view (CC)
- Mediolateral oblique view (MLO) 45-60°



AGD CC vs. MLO view

- MLO view significantly higher AGD
  - greater compressed breast thickness
  - But – in MLO view
    - Better depiction of ULQ
    - less superimposition

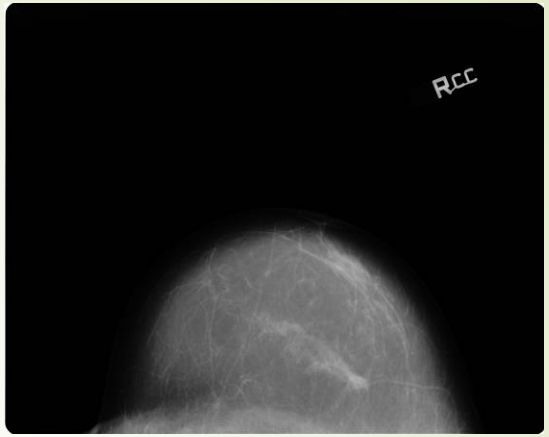


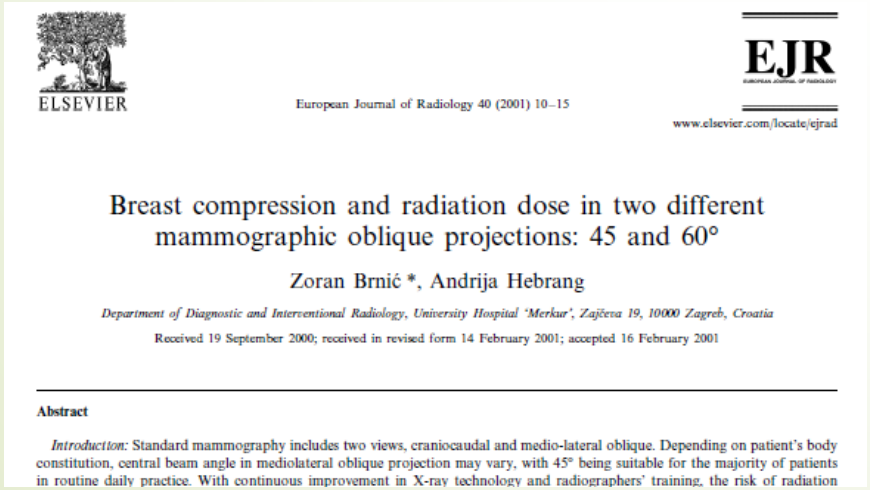
Table 4. Comparisons of breast thickness, mAs, and mean glandular dose (MGD) obtained in craniocaudal (CC) and 45° mediolateral oblique (MLO) imaging projections. Values are mean ± standard deviation (SD).

Projection	n[a]	Thickness (mm)	mAs	MGD (mGy)
CC	37	56.2 ± 4.4	55.3 ± 15.0	1.0 ± 0.2
45° MLO	62	64.2 ± 7.5	87.7 ± 27.2	1.4 ± 0.4
P[b]		<0.05	<0.05	<0.05

[a]Study group: large breasts and Kodak 2000 film/Kodak 2190 screen combination.
[b]Significance *P* value of Student's t test.

AGD MLO 60° vs. 45°

- 7-22% lower AGD with 60 instead of 45
- Fibroglandular tissue in the 60°-view is projected onto a larger film area, with less effect of superimposition, while breast compression is more favourable
- MLO 60 advisable for smaller and pendulous breasts due to
  - lower MGD
  - better compression
  - same or better image quality compared to 45°



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European Journal of Radiology 40 (2001) 10–15

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Breast compression and radiation dose in two different mammographic oblique projections: 45 and 60°

Zoran Brnić *, Andrija Hebrang

Department of Diagnostic and Interventional Radiology, University Hospital 'Merkur', Zajčeva 19, 10000 Zagreb, Croatia

Received 19 September 2000; received in revised form 14 February 2001; accepted 16 February 2001

Abstract

Introduction: Standard mammography includes two views, craniocaudal and medio-lateral oblique. Depending on patient's body constitution, central beam angle in mediolateral oblique projection may vary, with 45° being suitable for the majority of patients in routine daily practice. With continuous improvement in X-ray technology and radiographers' training, the risk of radiation

Diagn Interv Radiol 2007; 13:134–139

BREAST IMAGING

ORIGINAL ARTICLE

Clinical evaluation of breast dose and the factors affecting breast dose in screen-film mammography

Ayşegül Özdemir

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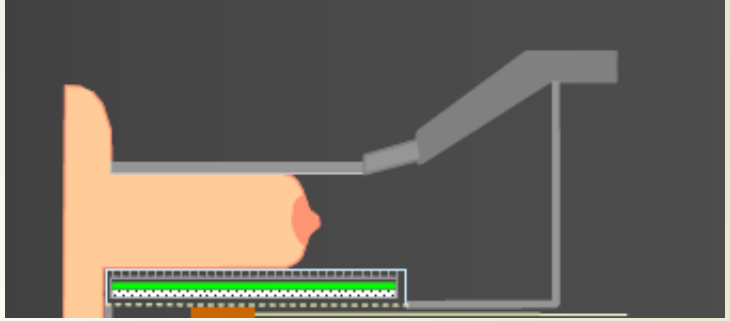
[a]Study group: large breasts and Kodak 2000 film/Kodak 2190 screen combination.
[b]Significance *P* value of Student's t test.

Table 5. Comparisons of breast thickness, mAs, and mean glandular dose (MGD) obtained in 45° and 60° mediolateral oblique (MLO) projections. Values are mean ± standard deviation (SD).

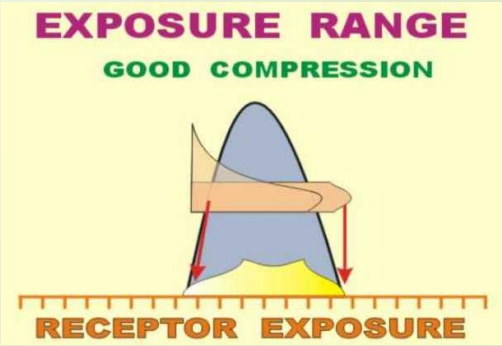
MLO angle	n[a]	Thickness (mm)	mAs	MGD (mGy)
45°	42	64.2 ± 10.7	79.1 ± 25.6	1.3 ± 0.3
60°	42	62.2 ± 9.9	71.8 ± 21.3	1.2 ± 0.3
p[b]		<0.05	<0.05	< 0.05

Breast compression



INCREASES THE IMAGE QUALITY

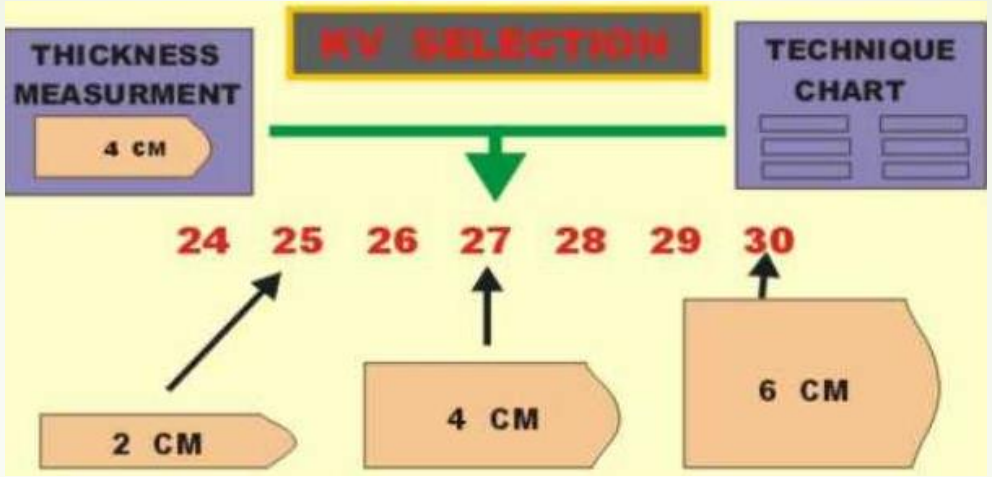
- *Increases sharpness* through
  - *Immobilization of the breast (less motion blur)*
  - *decrease of geometric blur (focal spot blur) and exposure time*
  - *decrease of superimposition by spread the glandular breast tissue onto larger area of film*
- *Increases contrast* through
  - *Reduction of scatter by decrease of breast thickness to 3-8 cm*
  - *Evens out breast thickness, evens out penetration od anterior and dosal parts of the breast*
  - *incompressible tumor emerge by its density*

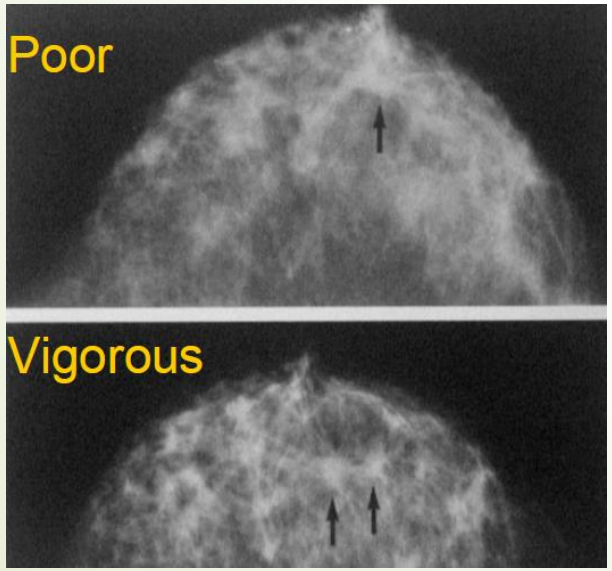


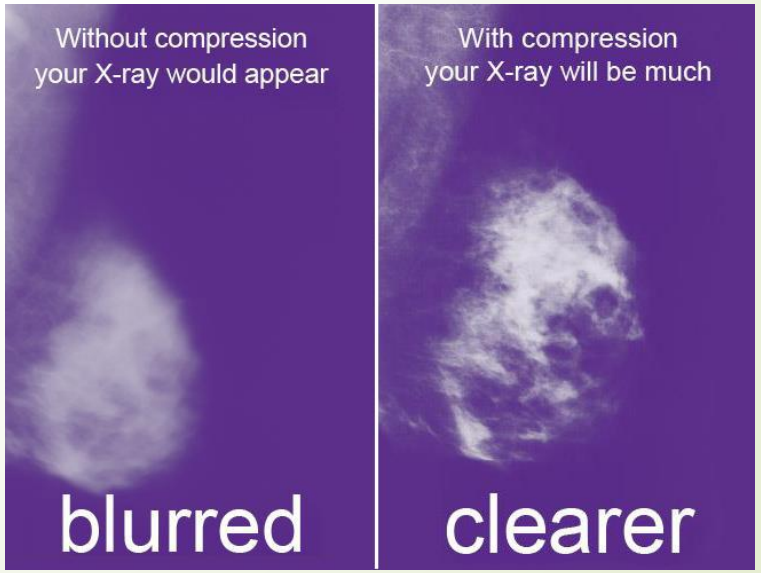
DECREASES THE RADIATION DOSE

- *Decrease of breast radiation dose*
  - *Better penetration with lower kVp – decrease of exposure (mAs) –* ***lower radiation dose***

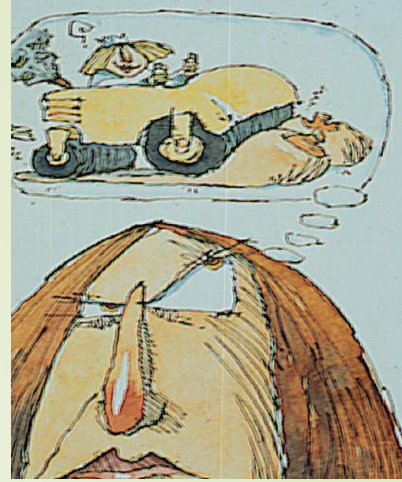
Breast compression and image quality







Breast compression and dose



- Along with proper breast positioning, properly applied breast compression is one of the the most important factor influencing breast dose and image quality
  - Compressed breast thickness 45 mm vs 40 mm
    - 20% decrease of AGD
  - Compressed breast thickness 80 mm vs 40 mm
    - 4× decrease of AGD

Compressed Breast	Entrance Exposure	Mean Glandular Dose
2 cm	260 mR	0.69 mGy
4 cm	1080 mR	1.79 mGy
6 cm	1450 mR	2.37 mGy

Breast compression

- Advise women before MG of the importance of proper compression
- Inform woman when compression starts
- Communicate with women whether can tolerate more force

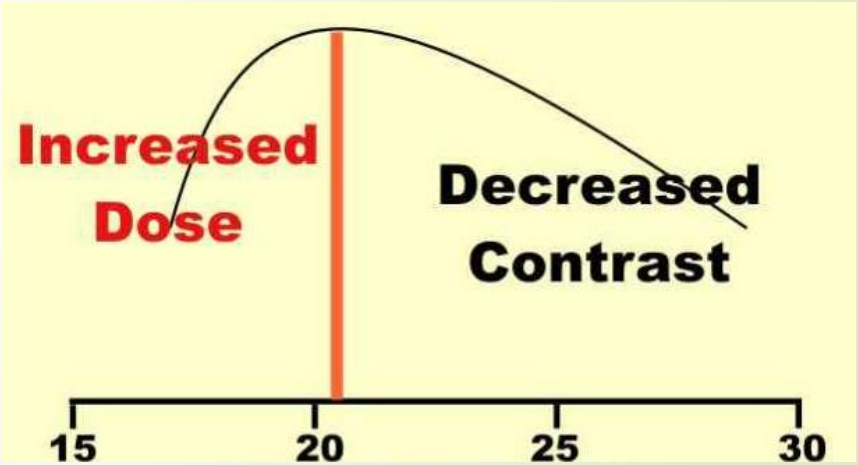
minimal 11 kp
desirable 13-20 kp

- QC of compression device
  - Check of integrity of compressor
  - Must remain parallel during compression
  - Compression force display
  - Automatic release after exposure

Optimal kVp in mammography

is a balance between the need for penetration the glandular tissue **(dose)** and image quality **(contrast)**

- Manual technique needs experience of technologist:
  - breast size
  - breast composition
  - breast compressed thickness
- AEC needs
  - Proper postioning of AEC detector
  - Regular calibration – QC task



REPEAT ANALYSIS

- Repeat Rate = $\frac{\#\ of\ repeated\ films}{total\ \#\ of\ films} \times 100$

- Diagnostic Radiology = less than 5%
- Students = less than 10 %
- In mammography the retake rate should be less than 2%

- Repeat analysis is a quarterly QA task

What obout retake policy?

- Retake the film only when critical deffieciency occurs
- Do not retake films with non-critical positioning defficiencies (slight asymmetry, skin folds, pectoral muscle non-inclusion…)
- Communication radiologist - technologist – RT must be informed of the defficiencies in mammography technique, RTs with poor technique should be trained

Average (mean) glandular dose

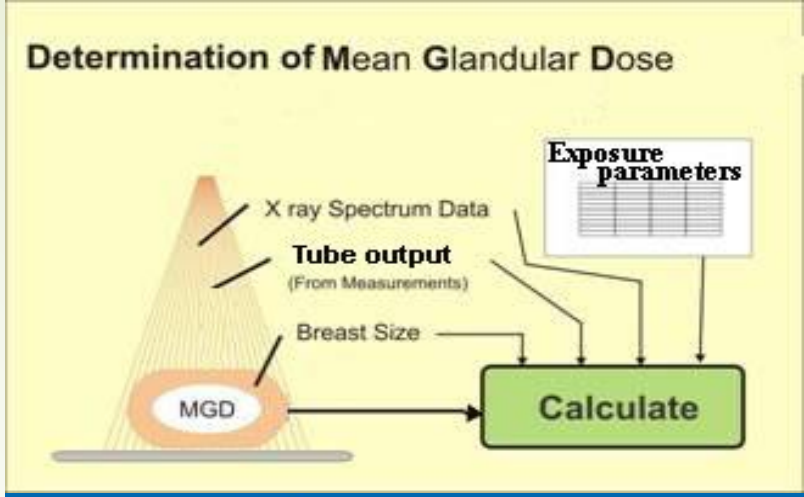
Mean glandular dose (MGD) is the best representant of breast dose...

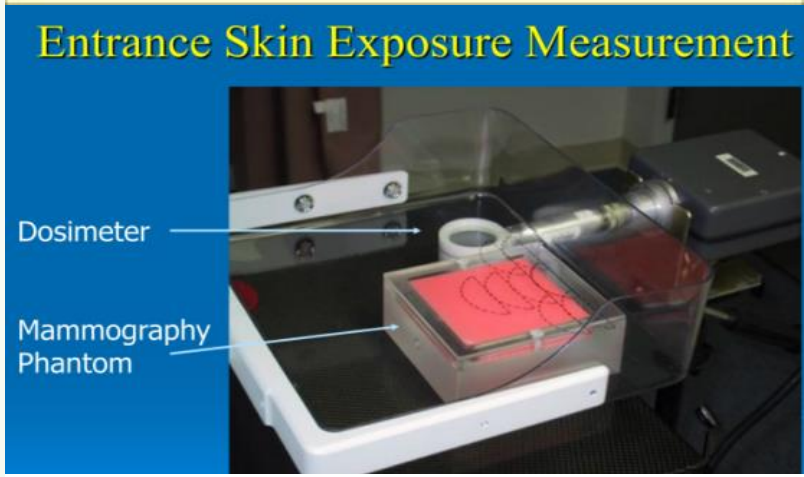
...because glandular breast tissue has high radiosensitivity, while fat is not radiosensitive!

- good correlation between MGD and stochastic risk of cancerogenesis

MGD

- **Mean (average) glandular dose (MGD, AGD) is the best measure of the risk of cancerogenesis**
  - cannot be directly measured, but only **indirectly estimated**
  - exposure in air (ESAK) with standard (50/50) phantom and exposure conditions is measured with TLD or ionization chamber
- AGD [mGy] = **ESAK** [mGy] × **g** [mGy/mGy]
  - conversion factor **g** (Dance, Monte Carlo calculation)
- AGD for SFM with grid **1-2 mGy/image**
- **in screening 0,7 mSv/image**





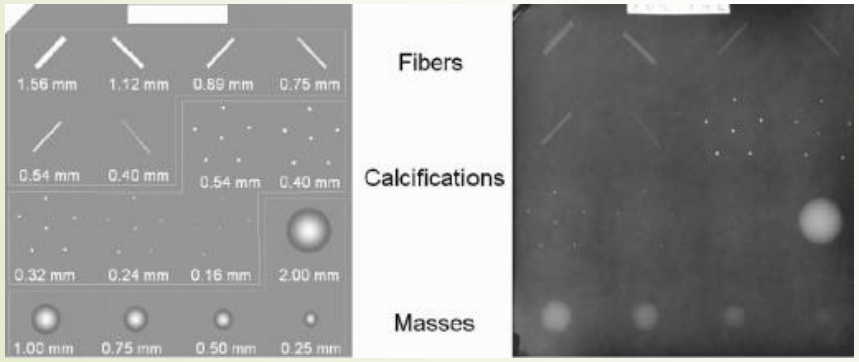
4.5 cm breast: 50% glandular and 50% adipose breast tissue composition

kVp

HVL (mm)	25	26	27	28	29	30	31	32
0.25	122							
0.26	126	128						
0.27	130	132	134					
0.28	134	136	138	139				
0.29	139	141	142	143	144			
0.30	143	145	146	147	148	149		
0.31	147	149	150	151	152	153	154	
0.32	151	153	154	155	156	158	159	160
0.33	155	157	158	159	160	162	163	164
0.34	160	161	162	163	164	166	167	168
0.35	164	166	167	168	169	170	171	172
0.36	168	170	171	172	173	174	175	176
0.37		174	175	176	177	178	178	179
0.38			179	180	181	182	182	183
0.39				184	185	186	186	187
0.40					189	190	191	192

AGD estimation by phantom

- AGD should be determined annually by a certified medical physicist
  - The AGD is obtained using the measured entrance skin exposure when imaging an ACR phantom that simulates a 4.2 cm breast with 50% glandularity
  - MQSA regulation (ACR) recommend AGD for a 4.2-cm thick breast should be less than 3 mGy/image for SFM with a grid



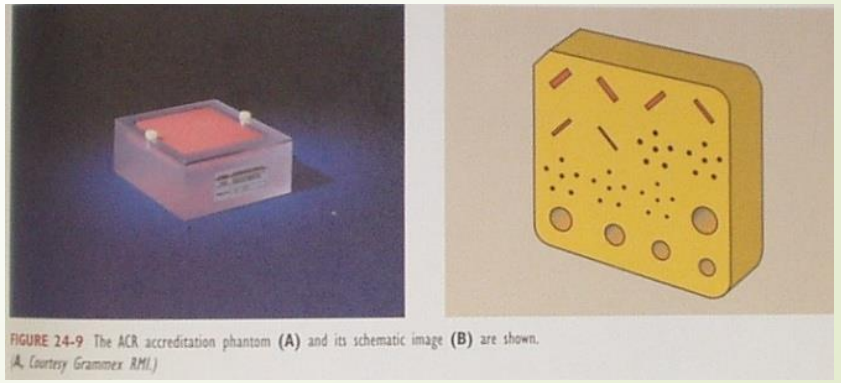


FIGURE 24-9 The ACR accreditation phantom (A) and its schematic image (B) are shown. (A, Courtesy Gammex RMI.)

Breast dose calculator on the web

DUKE UNIVERSITY AND DUKE MEDICINE
Radiation Safety Division
www.safety.duke.edu

Radiation Dose to the Breast From Mammography

Parameters for Computing Radiation Dose

This program uses parameterized data tables developed by Wu and colleagues (see "References" below) to compute radiation dose to the breast consequential to mammography. You can vary the thickness of the breast, the composition of the breast tissue and other variables to determine their effect on breast dose.

Complete the form below and click the **"Compute Dose"** button to calculate the radiation dose factor (millirads per roentgen of skin entrance exposure) for glandular breast tissue. Make sure you enter values for the parameters you wish to vary, consistent with the appropriate units. If you leave a field blank, a *default value* [shown in brackets] will be used. See "Notes" below for valid ranges for the parameters.

Enter kVp (kilovolts): 27 [25]
Enter Filtration Half-Value Layer (mm aluminum): 0.3 [.265]
Enter Thickness of Compressed Breast Tissue (cm): 3 [4]
Enter Glandular Fraction (0.0 - 1.0): .5 [.50]
Enter Skin Entrance Exposure (roentgens): 20 [variable]

Enter kVp (kilovolts): 27 [25]
Enter Filtration Half-Value Layer (mm aluminum): 0.3 [.265]
Enter Thickness of Compressed Breast Tissue (cm): 3 [4]
Enter Glandular Fraction (0.0 - 1.0): .5 [.50]
Enter Skin Entrance Exposure (roentgens): 20 [variable]

Mammography risks vs benefits

- exposing 1 million 45-year-old women to AGD of 1 mGy may result in 2 excess breast cancer deaths
- two-view screening mammography (total AGD 3 mGy) results in excess risk of **6 cancers** / 1 million women
  - equivalent to
    - 200 km airplane travel
    - 30 km car driving
    - 3 cigarettes

2700-3000 carcinomas will be detected in 1 million screened women

Stochastic risk related to mamography (NRPB 2001)

Examination	Lifetime additional risk of cancer per exam*
	Negligible Risk
Chest, teeth, arms & legs, hands & feet x-rays	Less than 1 in 1,000,000
	Minimal Risk
Skull, head, neck x-rays	1 in 1,000,000 to 1 in 100,000
	Very Low Risk
Hip, spine, abdomen, pelvis x-rays, CT head, breast mammography	1 in 100,000 to 1 in 10,000
	Low Risk
Kidney & bladder [IVU], Stomach – barium meal, CT chest, CT abdomen	1 in 10,000 to 1 in 1,000

Breast radiation dose in mammography

The recent situation in Croatia

Factors influencing radiation burden in mammography screening in Croatia - weakpoints

- **Organization dependent**
- The age of population invited – 50-69 yrs
- The genetics of exposed women – all women – non-selected
- Screening interval – 2 yrs
- One- vs two-view mammography
- **Equipment dependent**
- The age and quality of MG machines >10 yrs
- The technology: SFM vs CR vs DM
  - The films and cassettes (sensitivity, green vs blue), dedicated processors and viewboxes rarely available
- The maintenance of equipment: x-ray tubes, AEC average, film processors unsatisfactory
- QA-QC implemented partialy in<1/3 MUs

- **Radiographic technique dependent**
- Grid use is common
- Large breast Bucky lack in some MUs
- Breast positioning
  - Angle mainly 45, technique is average to poor in some MUs
  - Compression too low (7-11 kp)
  - AEC position
- Exposure parameters
  - kVp
  - AEC vs manual
    - Some RTs are „AEC addicts" not able to do manual technique
- Rejection/retake policy – no repeat analysis in the majority of MUs
- Fast vs slow film processing

Factors influencing radiation burden in mammography screening in Croatia – corrective actions are needed

What should we do to reduce radiation dose?

- Immediately
  - Disengage MUs with low throughput, MG units >15 yrs and poor image quality
  - Continue QC audits systematically annualy
- Mid-term (3-6 mts)
  - RTs education (positioning, compression)
  - Consistent QA-QC system implementation
  - Measure MGDs in all Mus to prepare the Croatian DRLs
- Long-term (1-2 yrs)
  - Mammography equipment renewal and standardization, the role of tomosynthesis?
  - Rejection/retake policy control
  - Establish the role of 2nd radiologist as a primary image QC, feedback to RTs
  - Establish DRLs in Croatian NBCSP

The proposal of QC implementation in nationwide breast cancer screening in Croatia

Zoran Brnić

The evident defficiencies in breast cancer screening in Croatia

- Old and and outdated mammography equipment:
- Lack of medical physicists, mainly engaged in radiotherapy
- Critical lack or radiologists
- RTs of varying education level, skills and motivation
  - POSITIONING INADEQUATE
  - POOR KNOWLEDGE ON DIGITAL TECHNOLOGY
  - NO QA-QC EXPERIENCE
- Many low-volume MUs in Healthcare Centres (Domovi zdravlja) w. only 1-2 radiologists per unit
- Low number of cytologists with reliable experience to be a basis for basic work-up of positive pts
- Tissue diagnosis available only in larger regional centres
- Stereotactic biopsy available only in few institutions, some of them of local importance

Reorganization of breast cancer screening program in Croatia - *the principles*

- Rationalization
  - Small volume MUs should be disengaged, as it cannot be expected that they will introduce consistent QAQC because of lack of staff
  - Large volume MUs should be supported to participate in continuous education and sharing skills
- Availability of the service for all women
  - 50 km principle – transportation to nearby MUs <50 km
  - Mobile units for scarcely populated areas
- Leading role of university institutions
  - Quality evidently superior in comparison to non-university facilities
  - Women like to attend these units
  - Centers of education, sharing of skills to local radiologists and RTs, and research
- Digitalization and communication
- Mammography equipment renewal (the last but not the least important)
- Centralized implementation of QAQC w. centrifugal promotion

How to do it?

- Consider the evidence approved until now: the results of investigations of performance of screening in Croatia already done
  - Brnić Z: IQ NBCSP
  - Brnić Z. Satisfaction of pts
- Consider the specific shape of the territory of Croatia – multicentric coordination is needed (County centers!)
- Consider the uneven population density – mobile units for scarcely populated and islands
- Consider the already excellent centers as a source of sharing skills

Control audits in Croatian NBSP (1)

- Acceptance, periodically control and extraordinary audits
- Audit unannounced to find a real state
- The items evaluated by the auditor
  - Rooms and spaces and architectonic circumstances adequacy
  - Accessibility of the facility, and reception of the women
  - Privacy and change room
  - Working conditions, organization
  - Equipment, visual check-up
  - Basic technical test which does not need any speciific control tools (compression plate integrity, cassette brakes, AEC chambers, cables and controls, footswitch…)

Control audits in Croatian NBSP (2)

- Official record of the found state at the unit is written, signed by auditor and head of the unit
- Necessary **corrective actions** and **terms to carry out** were discussed and suggested
- Extraordinary control audits were not done until now
- Only one MU temporarily suspended because of serious problem, resolved in 2 weeks
- Education on site, very good accepted by the staff, especialy RTs concerning positioning technique
- The most frequent problems found:
  - Unacceptably low compression force (8 daN), unstable compression paddle
  - Documentation of equipment unavailable, no service regularly done
  - Identification, no id. of cassettes, unstandard view labels
  - No QAQC procedures in a majority of units

Control audits/visits in the future

- Continue wits **regular audits** once a year
- **Acceptance audit** for every new entry MU
  - INCLUDING test done by medical physcists (Rijeka team)
- **Extraordinary control check** if critical defficiency is detected in an unit
  - Suggested corrections should be checked for execution by another auditor
- **Auditors' meeting** quarterly to discuss the state and decide about MU suspensions in the case of serius defficiency
- Every two years – redistribution of the list of MUs supervized among auditors to achieve objectiveness

What should be done in the future?

- Equipment renewal – urgent task!
- Reduction of the number of participating MUs by 40-50%
- Certification – voluntarily in 5th cycle, oligatory in 6th cycle
- Mobile units
- Education esp. RTs
- QAQC implementation – centralized with consecutive sharing the system to regional centres
  - 1st step (2017): referral centre (radiologist+RT+medical physicist+administrator) for QAQC in BC screening program based on the staff and experience of QC teams in Rijeka and Osijek; introduction of consistent QAQC in UH Mus and organization of education teams (R+QCRT+MF); voluntary cerification
  - 2nd step (2018): sharing the QAQC activities to regional centres (SB, Vž, Čk, Zb, Ka, Zd, St, Du) with stimulation of enthusiastic staff with appropriate QC equipment
  - 3rd step: (2019-): consistent centrally coordinated regionally supported NBSP w. QAQC, 4-8 QAQC teams equipped and trained for sharing the knowledge and skills, cerification compulsory
  - Regularly control audits should be continued

Mammography equipment renewal in Croatia - the proposed plan

- 6-8 **new FFDMs with the option of tomosynthesis**, complete QA-QC devices and software included
- Disengagement of **small volume SFM units >10ys** w/o evidence of acceptable quality of films, radiation dose and QA-QC. Presumed number 30-40 units
- If neccessary the area can be covered w
  - mobile unit (fixed appointments every month e.g. Delnice each 12th)
  - redistribution of women to nearby facilities, possibly w organized transportation
- Optimalization of existing **SFM units <10 g** to be in function next 4-5 ys in large volume Mus with QA-QC. Presumed number 20 units
- Optimalization of existing **CR** and **FFDM units** with consistent implementation of QA-QC supported by medical physicist(s) of the Program. Presumed number 10 units

Organization of QA-QC service in Croatia in the future

- Centralized QA-QC service covering all FFDMs
  - Centralized radiological audit
- Centralized QA-QC service for SFM and CR units:
  - Medical physicists
  - RTs perform daily / weekly QA duties
  - Education of RTs in referent screening units
  - Physicist perform external physical/technical audit yearly or on demand
  - QC of mammogram done as a part of control audits

- QA-QC of the programme should have **an office**
  - Administrator
  - Communication tools (PC, mail, phone/fax)
  - Med. physicist and experienced RT – coordinator of radiographic QA-QC
  - Radiologist – system coordinator and radiology QC

The role of medical physicists in Croatia

- Legally obliged in each UHC radiology, but they are usually on radiotheraphy, diagnostic radiology has full-time MP only in Rijeka and Osijek
- Full-time MP is a pre-requisite for consistent QA-QC in a large radiology department, which enables benefits and savings that overcome outcomes
  - trained RTs as a temporary supplements for MPs is unavailable?
- Croatian NPBS should have in charge highly experienced „head MP" dedicated for implementation and coordination of phsycal-technical aspects of QA-QC to
  - offer support and education in monthly/quarterly/anually QAQC tasks for small local MUs which will never have MP in charge
  - audit and revise QAQC records of daily/weekly QAQC duties performed by QAQC RTs
  - control mobile units
  - enable independent acceptance equipment testing for new MUs entering Program
  - Financing? - from the money assigned for QA-QC activities?

Mobile units are indispensible part of NBSP in the future

- Considereing the shape of Croatian teritory and uneven population density it is impractical and too expensive to maintain local MUS in small urban centres (Gs, Og, D. resa…)
- Two FFDM trailers are necessary
  - ONE MOBILE UNIT continuosly operating Istra – Cres/Lošinj – Krk – Pag – Lika - Benkovac – Knin – Sinj – Makarska – Brač – Hvar – Korčula – Metković and vice versa, based on reading the mammograms by radiologists in Rijeka, Zadar and Split on a weekly basis
  - ONE MOBILE UNIT for Slawonien and Posavina, and as a replacement unit in the case of fault

The locations of mobile mammography unit which can be covered monthly

Certification

- Four certification categories and two specialised visits
- 1. Diagnostic Breast Imaging Unit
- 2. Diagnostic Breast Assessment Unit
- 3. Loco-regional Breast Screening Programme
- 4. European Reference Centre for Breast Screening
- 5. Advisory Visit
- 6. Pre-certification Visit