NUEVAS TECNOLOGÍAS EN IMAGEN DE LA MAMA Y SU IMPACTO EN LAS DOSIS

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Jefe del Servicio de Radiofísica y Prot. Rad.

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Santa Cruz de Tenerife

IMAGEN DE LA MAMA

"El objetivo de la mamografía es obtener imágenes que aporten la máxima visibilidad de la anatomía la mama y de los signos de enfermedad sin someter a la paciente a una exposición innecesaria a la radiación" (IAEA)

Radiation Doses and Cancer Risks from Breast Imaging Studies[1]

R. Edward Hendrick, PhD

Radiology: Volume 257: Number 1—October 2010 ▪ *radiology.rsna.org*

Risk of Radiation-induced Breast Cancer from Mammographic Screening[1]

Martin J. Yaffe, PhD
James G. Mainprize, PhD

Radiology: Volume 258: Number 1—January 2011 ▪ *radiology.rsna.org*

DIRECTIVA 2013/59/EURATOM DEL CONSEJO

de 5 de diciembre de 2013

por la que se establecen normas de seguridad básicas para la protección contra los peligros derivados de la exposición a radiaciones ionizantes, y se derogan las Directivas 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom y 2003/122/Euratom

Obliga a todos los EEMM a que, en el año 2018:

- **se establezcan requisitos más estrictos en cuanto a la información que debe proporcionarse a los pacientes**
- **el registro y la notificación de las dosis de los procedimientos médicos**
- **el uso de niveles de referencia**
- **la disponibilidad de dispositivos indicadores de dosis**

Radiation Protection Dosimetry (2013), Vol. 157, No. 2, pp. 181–192 doi:10.1093/rpd/nct136
Advance Access publication 14 June 2013

NEW DIAGNOSTIC REFERENCE LEVEL FOR FULL-FIELD DIGITAL MAMMOGRAPHY UNITS

I. H. R. Hauge[1,2,*], K. Bredholt[2] and H. M. Olerud[2,3]
[1]Faculty of Health Sciences, Department of Radiography and Dental Technology, Oslo and Akershus University College of Applied Sciences, P. O. Box 4, St. Olavs plass, NO-0130 Oslo, Norway
[2]Norwegian Radiation Protection Authority, P. O. Box 55, NO-1332 Østerås, Norway
[3]Faculty of Mathematics and Natural Sciences, Department of Physics, University of Oslo, P. O. Box 1048 Blindern, NO-0316 Oslo, Norway

Art. 61 Considera practicas especiales, entre otros**, a los programas de cribado y especifica que en ellos se prestará especial atención a los programas de garantía de calidad y la evaluación de la dosis**





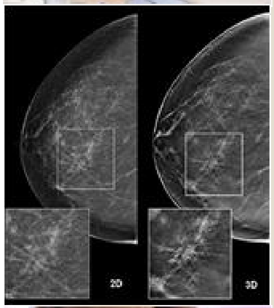



IMAGEN DE LA MAMA. REQUISITOS

- **ALTO CONTRASTE**

  diferencias mínimas de atenuación entre los tejidos de baja densidad

CALIDAD

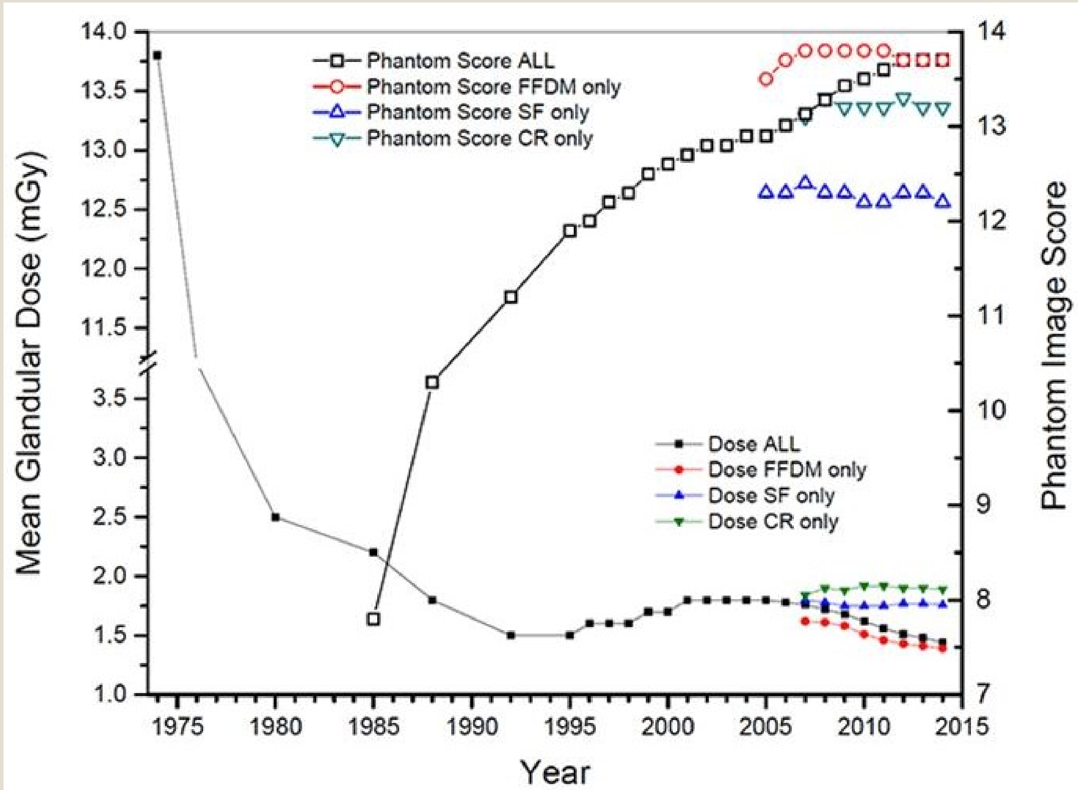
- **ALTA RESOLUCION ESPACIAL**

  visualizar las micro

- **BAJO RUIDO** **No ocultar los detalles**

DOSIS

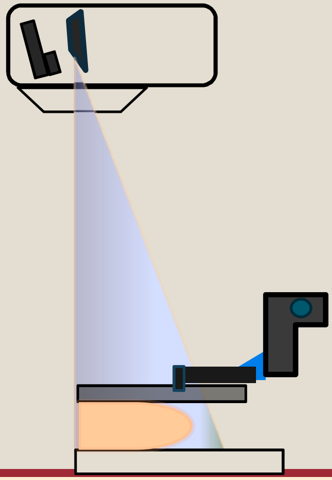
La mama es radiosensible y hay un riesgo asociado con la técnica



http://www.fda.gov/Radiation-EmittingProducts/MammographyQualityStandardsActandProgram/FacilityScorecard/ucm326264.htm

…¿¿QUE DOSIS ??

- Parte de la Energía de RX ***se absorbe en los tejidos***
- La probabilidad de inducir un daño es proporcional a la energía absorbida por unidad de masa: ***dosis absorbida***
- **No todos los tejidos son igualmente sensibles a los efectos de la radiación**
  - ***El tejido glandular*** *es el tejido de mayor riesgo*



DOSIS GLANDULAR

Estima el riesgo de carcinogenesis radioinducida (ICRP 1987)

FUNDAMENTAL
ESTIMAR DOSIS : Para valorar el riesgo de carcinogénesis
REDUCIR DOSIS : Disminuir la probabilidad de inducción de cáncer

DOSIS GLANDULAR

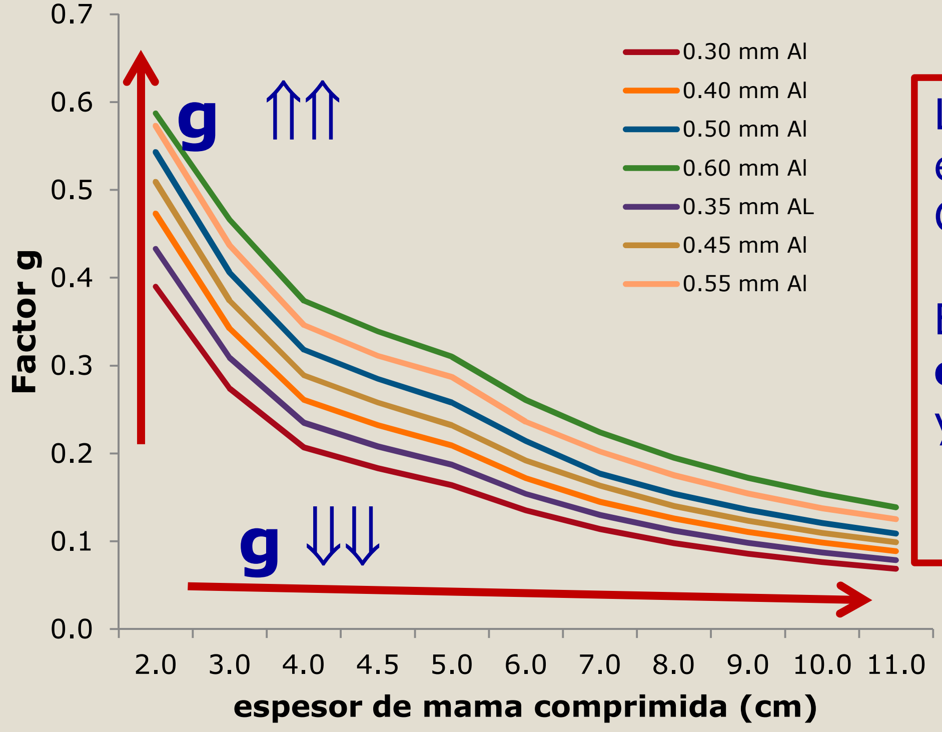
PROBLEMA!!! No se puede medir directamente

Se estima a partir de la DSE (mGy) y factores de conversión

$$\mathbf{DSE(mGy)} = R_{kVp}\left({}^{mGy}/_{mAs} \right) * \mathbf{carga(mAs)} * \left(\mathbf{1}/\left(\mathbf{D_{fsem}}\right)\right)^{2} * Fr$$

dependen de la calidad del haz

DGM=DSE.g.c.s



Los coeficientes **g** convierten el kerma incidente en Dosis Glandular.

Están tabulados para una **composición del 50%-50%** y dependen de:

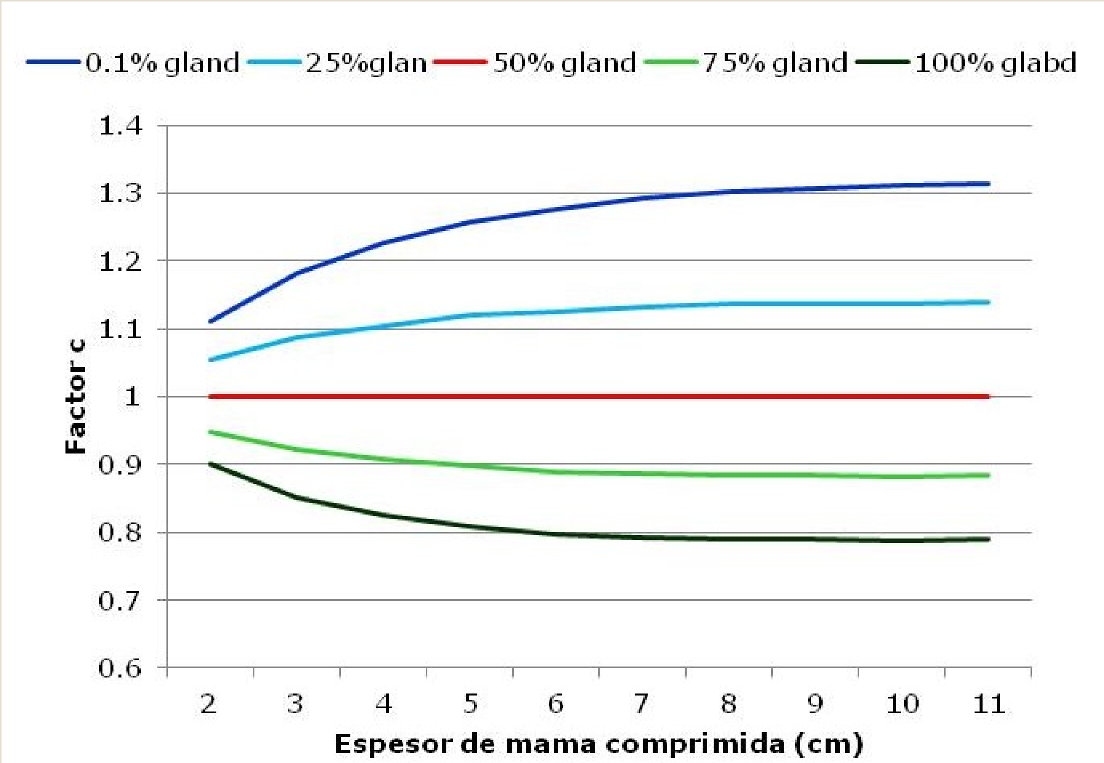
- De la calidad del haz
- Del espesor de mama

DGM=DSE.g.c.s

El coeficiente **S** tiene en cuenta el uso de las distintas combinaciones ánodo/Filtro

Anodo/ Filtro	**s**
Mo / Mo	1.000
Mo / Rh	1.017
Rh / Rh	1.061
Rh / Al	1.044
W / Rh	1.042
W / Ag	1.042
W / Al	1.050

Los coeficientes **C** tiene en cuenta la distinta composición en tejido glandular de la mama



FACTORES QUE AFECTAN A LA DOSIS

- **Factores técnicos (espectro, kVp, ajuste del CAE, compresión)**
- **Composición de la mama (% Glandularidad)**
- **Tecnología utilizada (película/pantalla, CR, FFDM, TOMO, CT…)**

COMPRESIÓN

$DGM = DSE.g.c.s.$

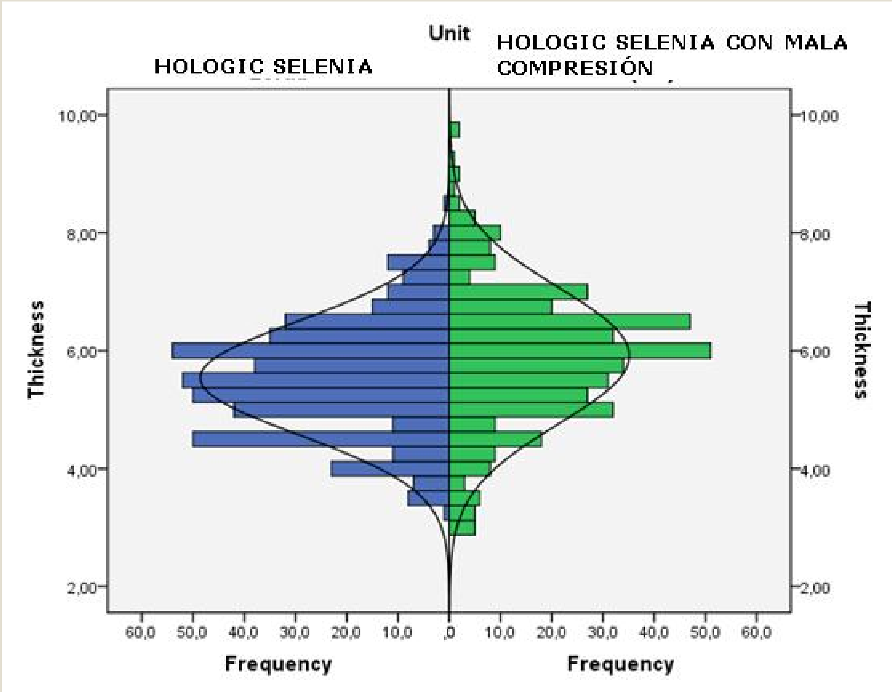
dependen del espesor de mama

Patient dose in a breast screening program: Digital versus film mammography

IB - http://www.iaea.org/inis/collection/NCLCollectionStore/_Public/42/026/42026419.pdf

by Ramirez-Munoz, A.; Dominguez-Folgueras, A.; Chapel-Gomez, M.L. (Medical Physics Department, Ntra. Sra. de Candelaria University Hospital, Tenerife (Spain)), E-mail: tonir.ecm@gmail.com

from International Symposium on Standards, Applications and Quality Assurance in Medical Radiation Dosimetry (IDOS). Book of Extended Synopses



COMPOSICIÓN DE LA MAMA

1. MAMAS DENSAS

Mayor probabilidad de desarrollar un cáncer
Mayor probabilidad de radioinducir cáncer
Mayor dificultad para diagnosticar cáncer

N Engl J Med 2007;356:227-36.

Mammographic Density and the Risk and Detection of Breast Cancer

Norman F. Boyd, M.D., D.Sc., Helen Guo, M.Sc., Lisa J. Martin, Ph.D., Limei Sun, M.Sc., Jennifer Stone, M.Sc., Eve Fishell, M.D., F.R.C.P.C., Roberta A. Jong, M.D., F.R.C.P.C., Greg Hislop, M.D., F.R.C.P.C., Anna Chiarelli, Ph.D., Salomon Minkin, Ph.D., and Martin J. Yaffe, Ph.D.

Boyd *et al. Breast Cancer Research* 2011, 13:223
http://breast-cancer-research.com/content/13/6/223

Breast Cancer RESEARCH

REVIEW

Mammographic density and breast cancer risk: current understanding and future prospects

Norman F Boyd*[1,2], Lisa J Martin[1,2], Martin J Yaffe[3] and Salomon Minkin[2]

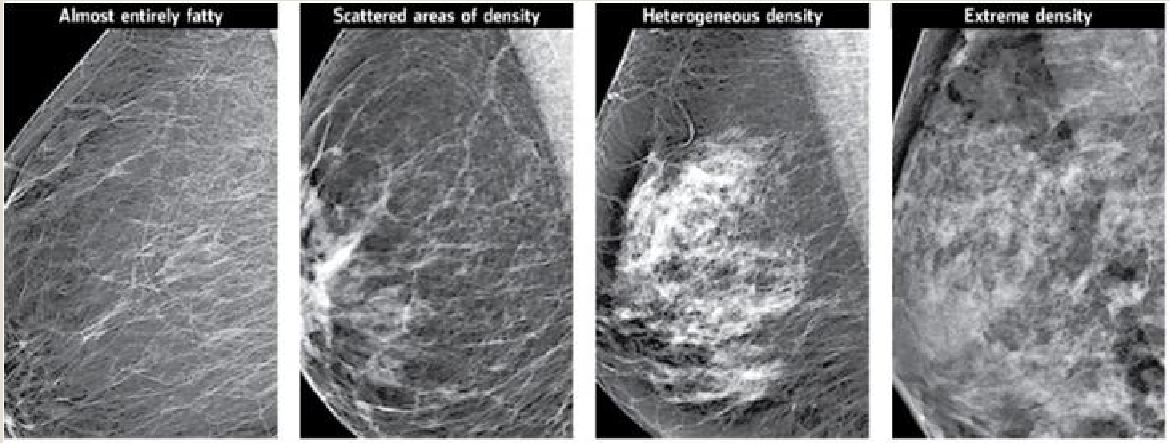
2. MAMAS GRANDES

Mayor dosis

COMPOSICIÓN DE LA MAMA

PRINCIPAL FACTOR DE INCERTIDUMBRE

ADIPOSO **GLANDULAR**



McGill University Department of Medicine Online Mamography Tutorial

American College of Radiology (4)

FUNDAMENTAL PARA CÁLCULO DE LA DE DOSIS

DGM=DSE.g.c.s

PARA OPTIMIZACIÓN Y CALCULO SE USABA 50%-50%

Med Phys. 2009 Dec;36(12):5437-43.

The myth of the 50-50 breast

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C. L. Peressotti
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(Received 30 April 2009; revised 23 September 2009; accepted for publication 29 September 2009; published 5 November 2009)

COMPOSICIÓN DE LA MAMA

FUNDAMENTAL PARA CÁLCULOS DE DOSIS

MISMO ESPESOR ≠GLANDULARIDAD → ≠ DOSIS

$$DGM = DSE.g.c.s$$

¿Cómo estimar la composición de la mama?

VISUAL

(Problema-Gran variabilidad de datos y resultados)

The British Journal of Radiology, 85 (2012), 1465–1470

Inter- and intraradiologist variability in the BI-RADS assessment and breast density categories for screening mammograms

[1,2]A REDONDO, MD, MPH, [1,3,4]M COMAS, MSc, PhD, [1,3,4]F MACIÀ, MD, MPH, [5]F FERRER, MD, PhD, [1,3,4]C MURTA-NASCIMENTO, MD, PhD, [5]M T MARISTANY, MD, [1]E MOLINS, MSc, [1,3,4]M SALA, MD, PhD and [1,3,4]X CASTELLS, MD, PhD

Table 3. Inter- and intra-observer variability in final assessment and breast density

	Interobserver variability			Intra-observer variability		
Category	% agreement	κ^a	95% CI	% agreement	κ^a	95% CI
BI-RADS assessment categories						
6 categories	55.74	0.37	(0.36–0.38)	66.72	0.53	(0.50–0.55)
Weighted	92.16	0.58	(0.56–0.59)	94.95	0.72	(0.69–0.75)
Recall *vs* no recall	77.16	0.53	(0.52–0.54)	83.76	0.66	(0.63–0.70)
Density[b]	61.40	0.44	(0.43–0.45)	74.87	0.64	(0.61–0.67)
Weighted	95.25	0.73	(0.72–0.74)	96.77	0.82	(0.80–0.84)

BI-RADS, American College of Radiology Breast Imaging Reporting and Data System; CI, confidence interval.
[a]κ-values: poor agreement, <0.01; slight agreement, 0.01–0.20; fair agreement, 0.21–0.40; moderate agreement, 0.41–0.60; substantial agreement, 0.61–0.80; and almost perfect agreement, 0.81–1.00.
[b]Four categories: fatty, fibroglandular, heterogeneous and extremely dense.

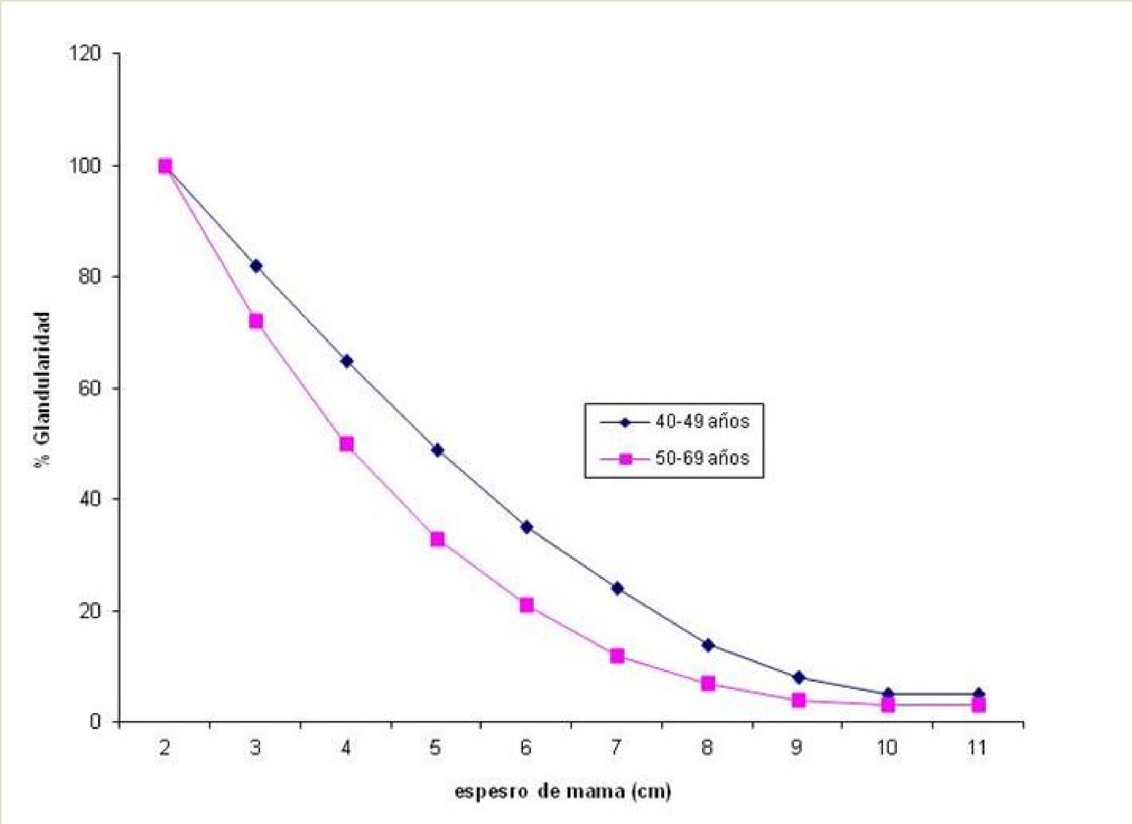
¿Cómo estimar la composición de la mama?

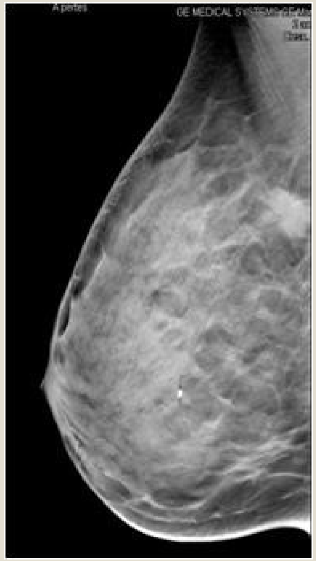
MANIQUÍES DE TEJIDO EQUIVALENTE Y

FACTORES RADIOGRÁFICOS

Para simplificar establecer = composición por grupos de edad

DGM=DSE.g.c.s





¿Cómo estimar la composición de la mama?


February 2015, Volume 204, Number 2

FOCUS ON: Women's Imaging

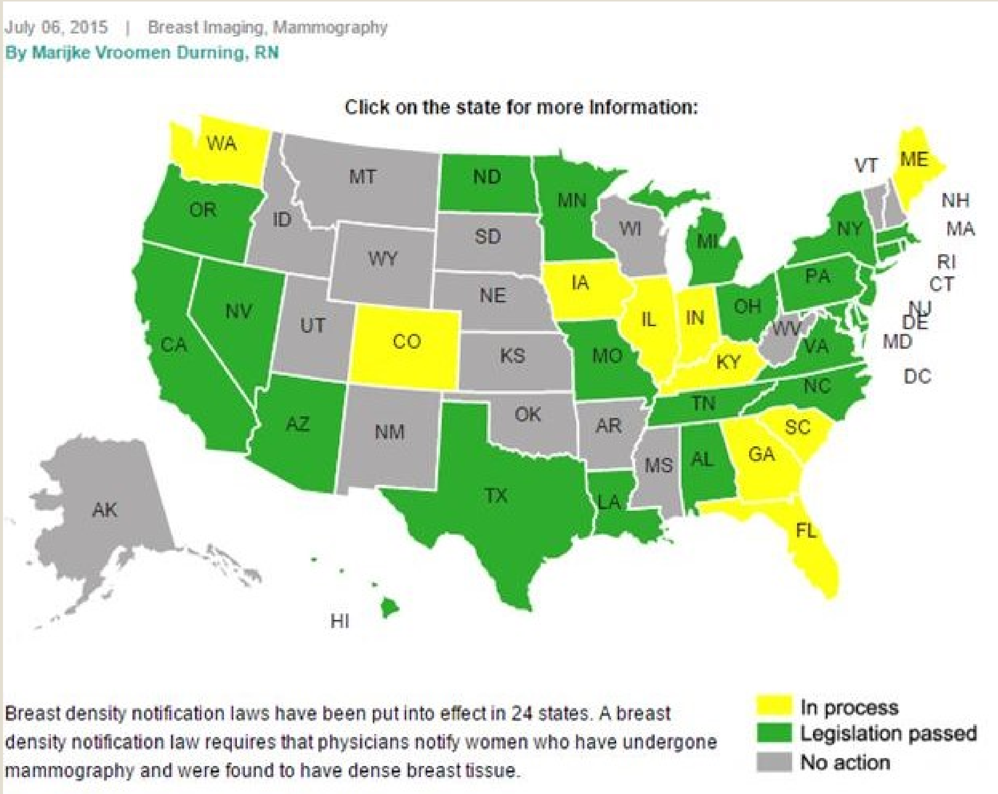
Review

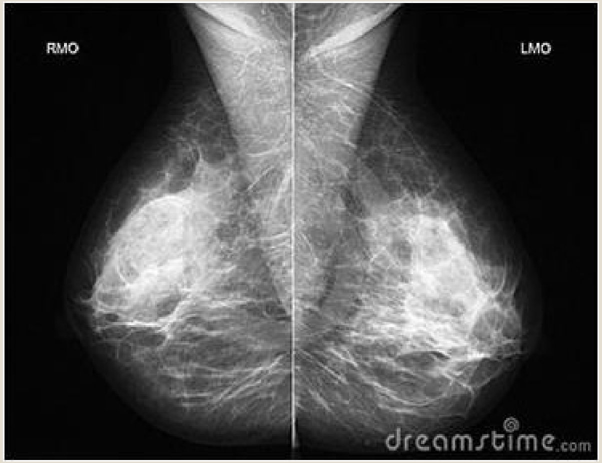
« Previous Article | Next Article »

Breast Density Legislation: Mandatory Disclosure to Patients, Alternative Screening, Billing, Reimbursement

Kimberly M. Ray[1], Elissa R. Price[1] and Bonnie N. Joe[1]

Share





http://www.diagnosticimaging.com/breast-imaging/breast-density-notification-laws-state-interactive-map

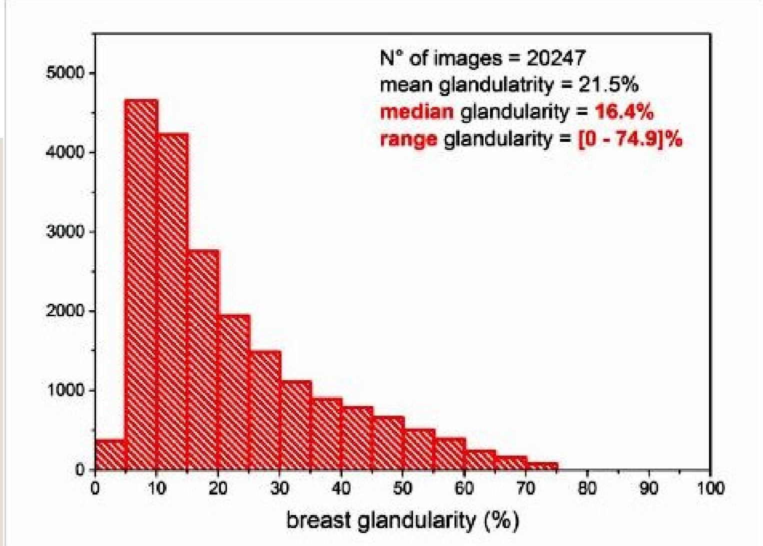
¿Cómo estimar la composición de la mama?

CÁLCULOS VOLUMÉTRICOS

ECR 2015

Impact of objective volumetric breast density estimates on mean glandular dose calculations in digital mammography

G. Gennaro[1], I. Sechopoulos[2], L. Gallo[3], V. Rossetti[4], R. Highnam[5]; [1]Padova/IT, [2]Atlanta, GA/US, [3]Castelfranco Veneto/IT, [4]Torino/IT, [5]Wellington/NZ

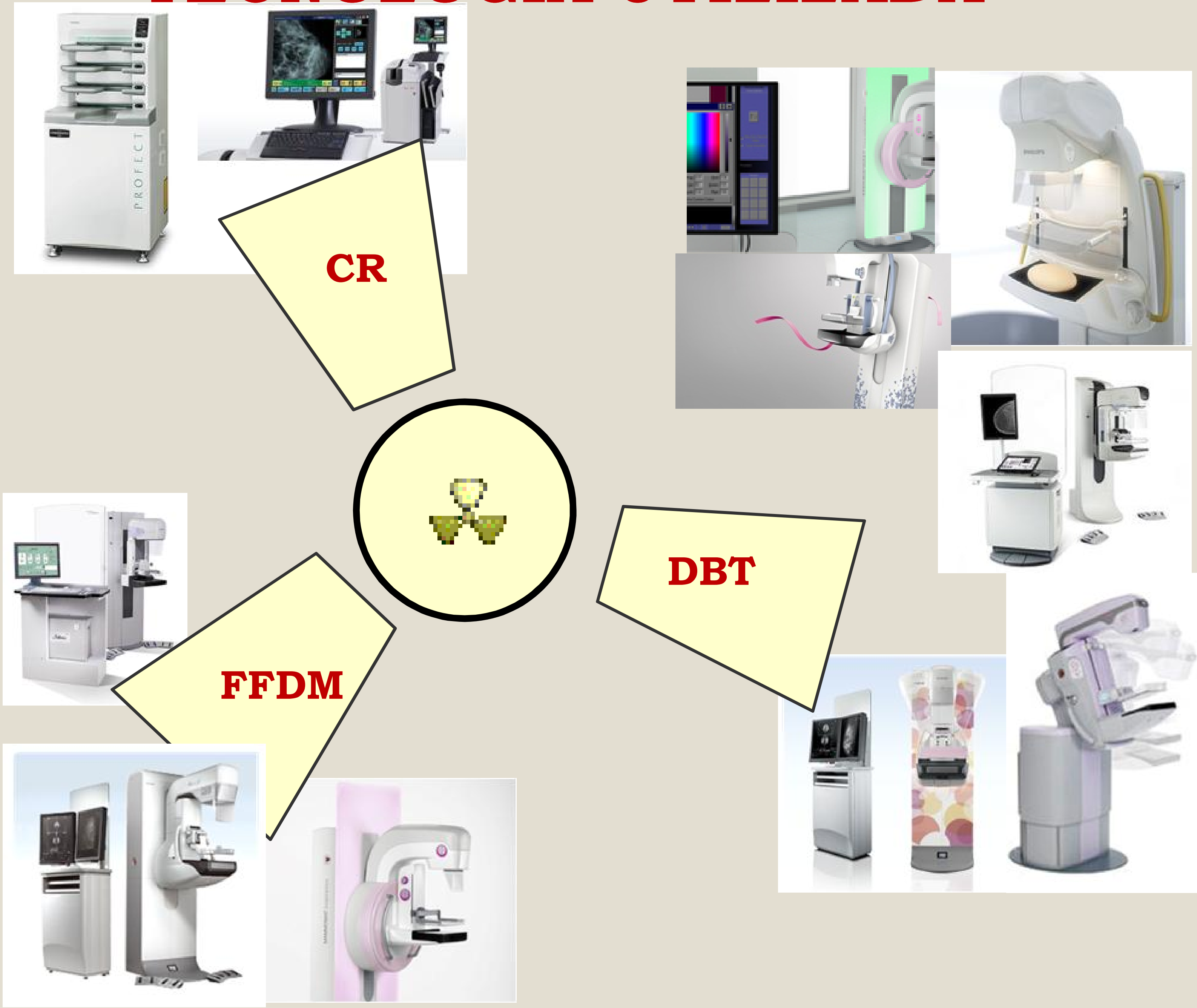


Estima la VBD a partir de las imágenes Raw procesandolas con Volpara 1.5.0 (Volpara, Matakina Ltd, NZ)

Estima la MGD

System	N° images	Median MGD_{system}	Median MGD_{BDadj}	P-value	% DIF $MGD_{sys-Bdadj}$
GE Senographe DS	3335	1.169	1.399	< 0.0001	-16.45
GE Senographe Essential	3802	1.146	1.234	< 0.0001	-7.13
HOLOGIC Dimensions 1	3934	1.260	1.244	< 0.0001	1.3
HOLOGIC Dimensions 2	2150	1.250	1.467	< 0.0001	-14.8
IMS Giotto Image 3DL	3263	1.600	1.809	< 0.0001	-11.6
PHILIPS Microdose	3763	0.749	0.527	< 0.0001	42.13

TECNOLOGÍA UTILIZADA



¿Se pueden optimizar los sistemas CR para mamografía?

Eur Radiol (2013) 23:2891–2898
DOI 10.1007/s00330-013-2876-0

PHYSICS

Technical and clinical breast cancer screening performance indicators for computed radiography versus direct digital radiography

Hilde Bosmans · An De Hauwere · Kim Lemmens · Federica Zanca · Hubert Thierens · Chantal Van Ongeval · Koen Van Herck · Andre Van Steen · Patrick Martens · Luc Bleyen · Gretel Vande Putte · Eliane Kellen · Griet Mortier · Erik Van Limbergen

Programa de screening de mama de Flandes

INDICADORES CLINICOS

(Tasa de rellamadas, tasa de deteccion de cancer, % de Ca ductal in situ, valor predictivo positivo)

No hay diferencias estadísticamente significativas entre sistemas CR y FFDM

PERO…… **Con CR se da un 60 % más de DOSIS**

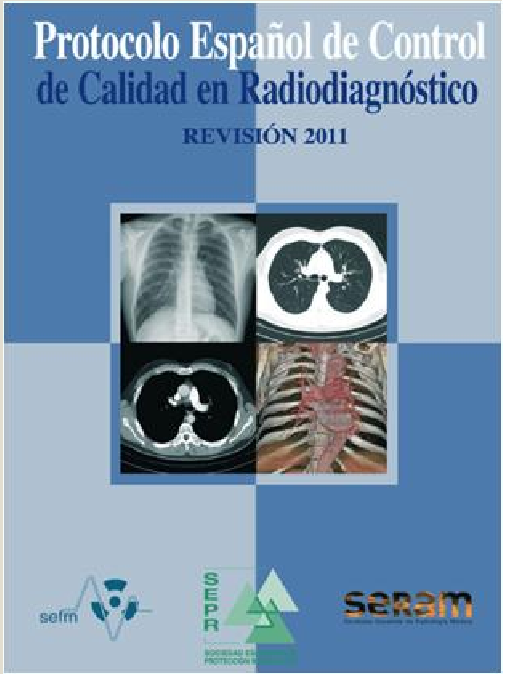
¿Se pueden optimizar los sistemas CR para mamografía?

- **Lector de CR de doble lectura**

- **Placas IP de fósforos estructurados**

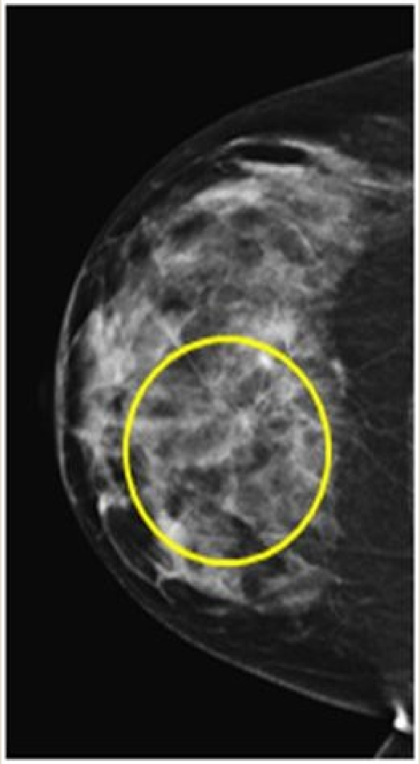
- **Renovar los IP aprox cada 2 años !!!!!**

- **Ajuste correcto del control automático de exposición**
  (Estrecha colaboración entre los técnicos de la casa fabricante del mamógrafo y del CR)



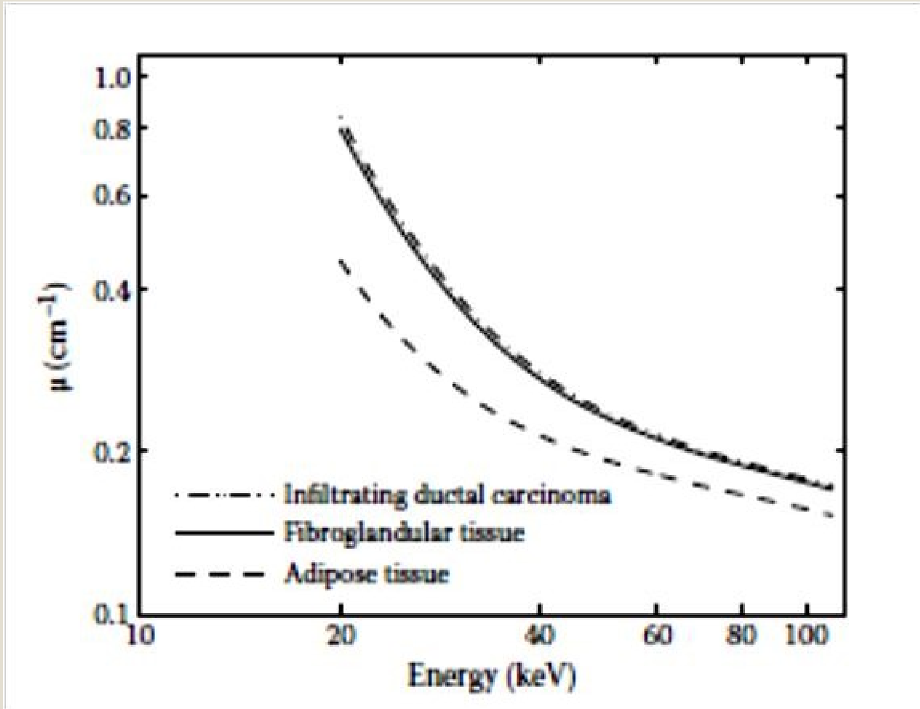
Limitaciones de la imagen 2D

Ruido estructural (fondo anatómico)



BAJO CONTRASTE

Entre tejidos normales y carcinoma



Sensibilidad de la mamografía

62% - 88%

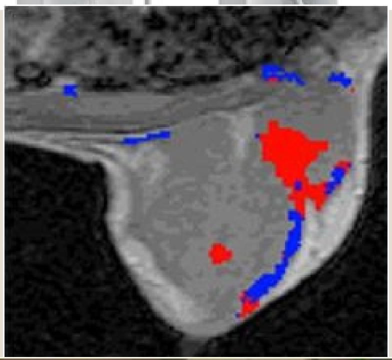
Menor en algunos grupos

(mamas densas, mujeres jóvenes)

NUEVAS MODALIDADES

Tomosíntesis
Digital de Mama

Técnicas de realce
de contraste
(2D y 3D)

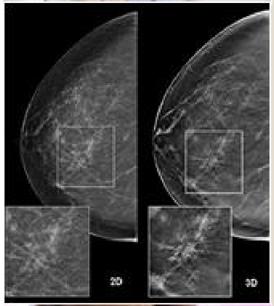


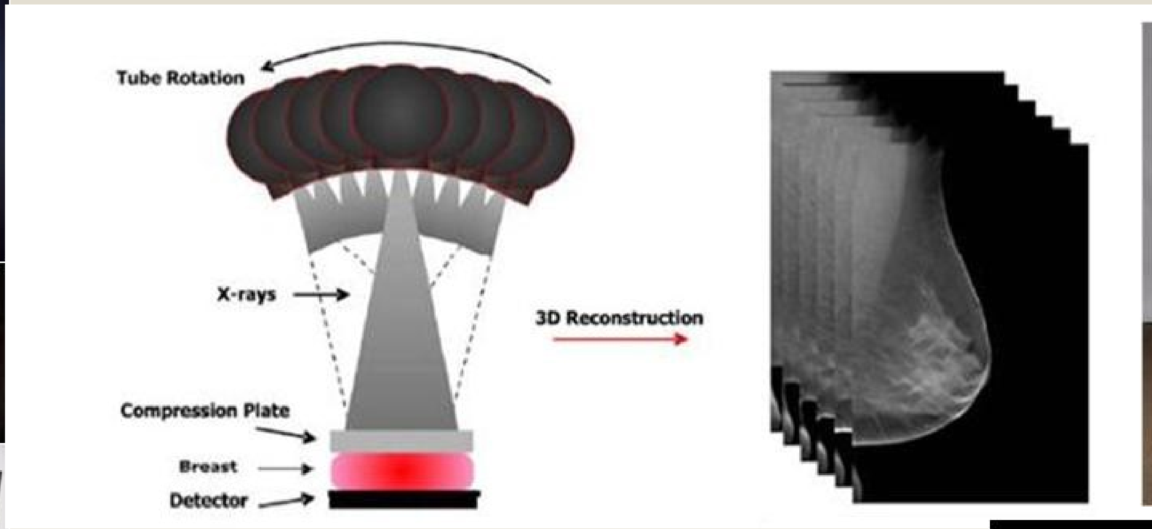
Tomografía
Computarizada
de mama

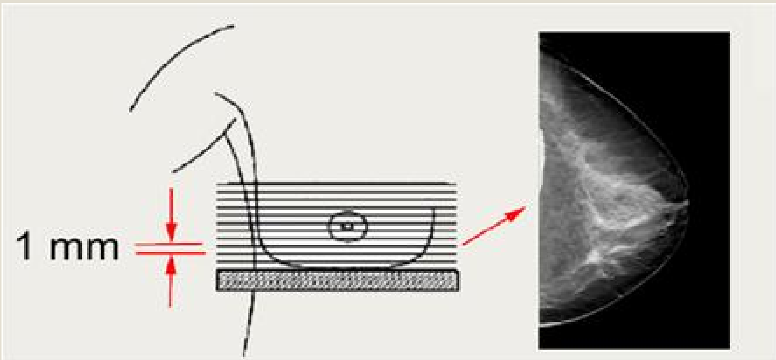
TOMOSÍNTESIS DIGITAL DE MAMA

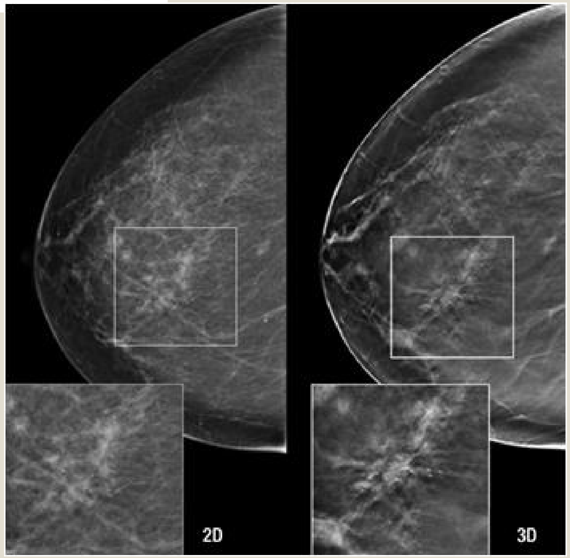










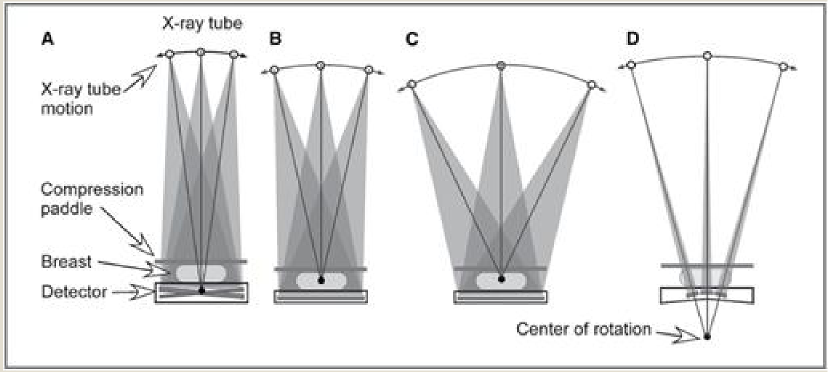


Mamografía digital **Tomosíntesis**

TOMOSÍNTESIS DIGITAL DE MAMA

Sistemas actualmente comercializados

Fujifilm Amulet Innovality
GE SenoClaire
Giotto Tomo
Hologic Selenia Dimensions
Planmed Clarity 3D
Phillips Microdose
Siemens Mammomat Inspiration



http://www.rsna.org/uploadedImages/RSNA/Content/News/2015/12Dec/RAD_2015_Dec_Vedantham_fig_1_[P].jpg

Presentan diferencias importantes en las opciones de funcionamiento elegidas

Rango angular o ángulo de barrido (θ)
Número de proyecciones
Dosis por proyección - Ruido
Características del funcionamiento del detector
Algoritmos de reconstrucción – Artefactos
Dosis del examen

DOSIS GLANDULAR MEDIA (DGM) POR BARRIDO DE TOMOSINTESIS

Estimation of mean glandular dose for breast tomosynthesis: factors for use with the UK, European and IAEA breast dosimetry protocols

Phys. Med. Biol. 56 (2011) 453–471

D R Dance[1,2], K C Young[1,2] and R E van Engen[3]

DGM por barrido

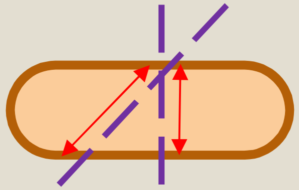
$$DGM_T = DSE_T . g.c.s.T$$

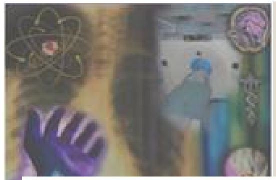
K_T = Dosis total aire a la entrada de la mama medido en θ = 0º

Factores de conversión de la dosis a la entrada en DGM dependen del Espesor y densidad de la mama y de la calidad del haz de radiación

Suma de las contribuciones a la dosis total de cada proyección

La dosis es distinta para cada proyección ya que los espesores de mama atravesados por el haz de rayos X son distintos





DOSIS GLANDULAR MEDIA (DGM)
POR BARRIDO DE TOMOSÍNTESIS

3D	FUJI		HOLOGIC		SIEMENS		VALORES ACEPTABLES†
ESPESOR DE MAMA (mm)	Mediana	Cuartil Inf.- Cuartil Sup.	Mediana	Cuartil Inf.- Cuartil Sup.	Mediana	Cuartil Inf.- Cuartil Sup.	Por imagen
>30 - ≤40	1,18	1,12 – 1,21	0,98	1,05 – 1,15	1,01	0,91 – 1,24	<1,5
>40 - ≤50	1,23	1,15 – 1,52	1,34	1,32 – 1,60	1,37	1,25 – 1,51	<2,0
>50 - ≤60 *	1,71	1,41 – 1,87	1,71	1,84 – 2,16	1,50	1,44 – 1,78	<2,5
>60 - ≤70	1,96	1,89 – 2,28	2,13	2,48 – 2,93	1,63	1,55 – 2,22	<3,0
>70 - ≤80	2,37	2,32 – 2,37	2,68	3,34 – 3,64	2,22	1,98 – 2,81	<4,5
>80 - ≤90			3,2	4,20 – 4,40	2,07	1,94 – 2,19	<6,5

*: Espesor de mama más habitual

Fuente: Chevalier y col. (en prensa)
Con permiso de la autora

† : Protocolo Español de Control de Calidad en Radiodiagnóstico. Rev. 2011 (SEFM-SEPR-SERAM)
Guías Europeas. 2006

DOSIS GLANDULAR MEDIA (DGM) POR EXAMEN DE TOMOSINTESIS MODO COMBO

Valores para la mama estándar (50-60 mm de espesor)

SISTEMA	EXAMEN COMBO (Por mama)	DGM EXAMEN (mGy)
FUJI	2D (CC+MLO) + **UN** BARRIDO TOMO (MLO)	4,2 ± 0,3
HOLOGIC	2D (CC+MLO) + **DOS** BARRIDOS TOMO (CC+MLO)	7,1 ± 0,4
SIEMENS	2D (CC+MLO) + **UN** BARRIDO TOMO (MLO)	4,4 ± 0,5

Fuente: Chevalier y col. (en prensa)
Con permiso de la autora

IMPACTO DE LAS NUEVAS TECNOLOGIAS EN IMAGEN DE LA MAMA EN LOS VALORES DE DOSIS

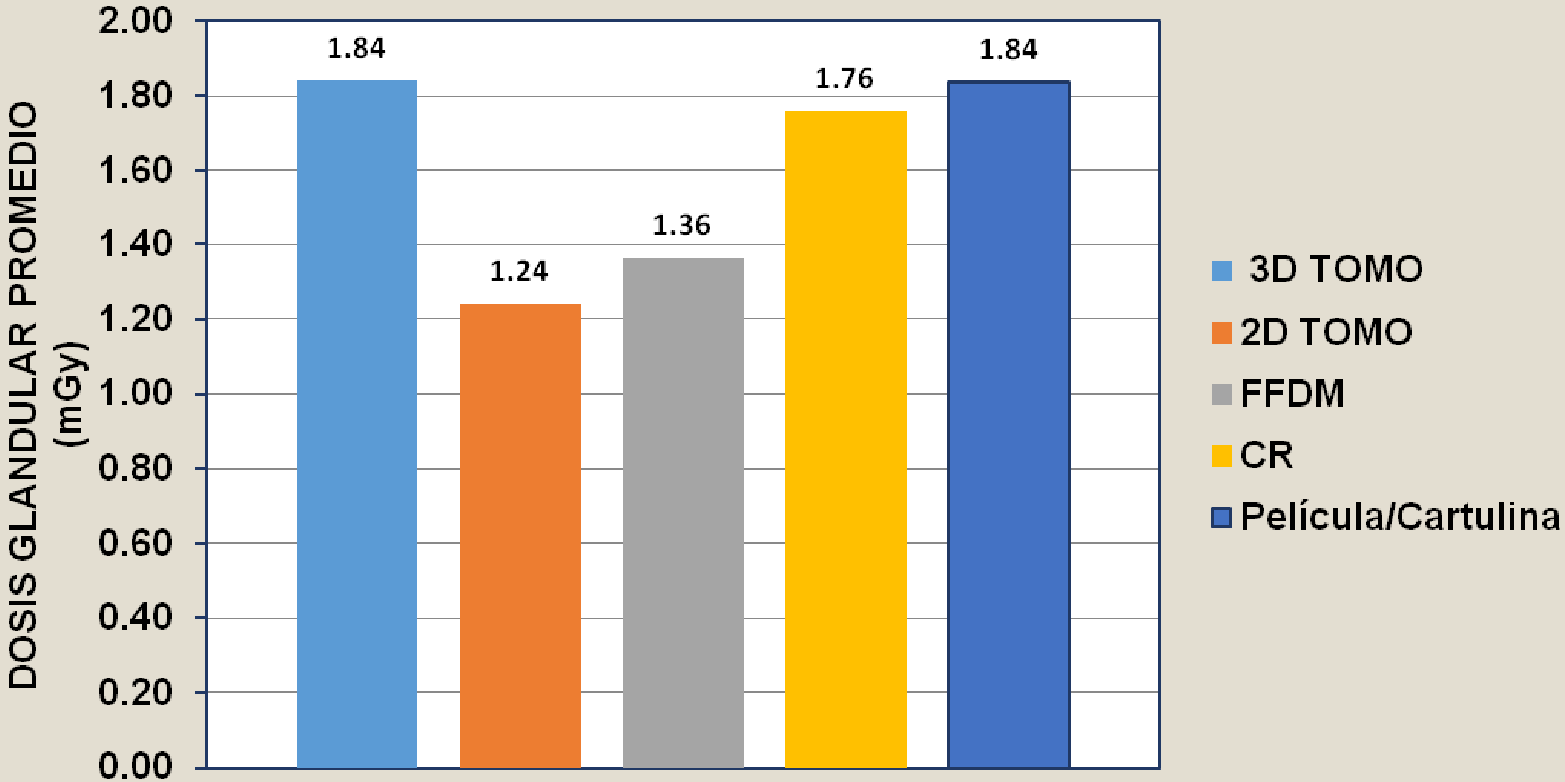
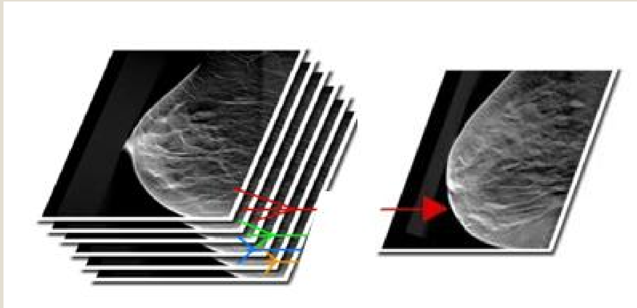


IMAGEN SINTETIZADA

- Sustituye a la imagen 2D convencional
- Imagen "construida" a partir de los planos de tomosíntesis

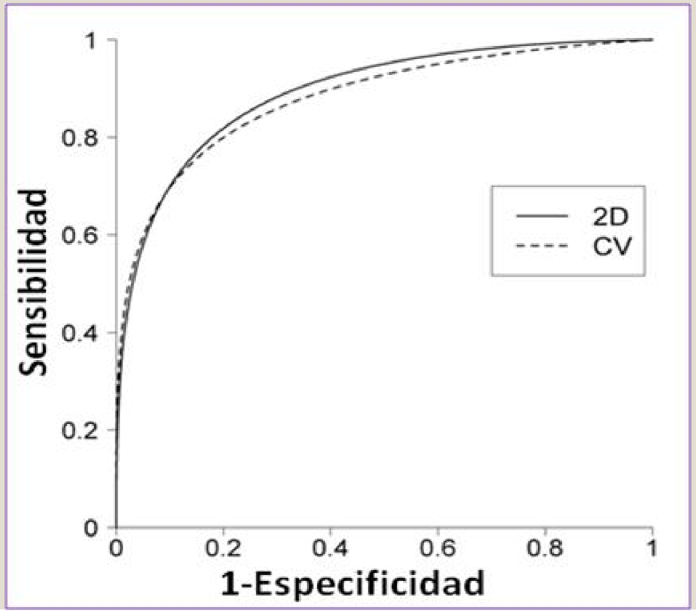
HOLOGIC DIMENSIONS

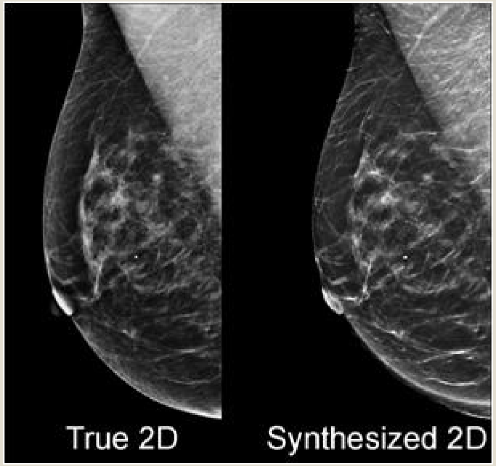
AHORRO DE DOSIS MAMAS CON ESPESOR ENTRE 5-6 cm (Espesores más habituales)	
TOMO/ COMBO	41%



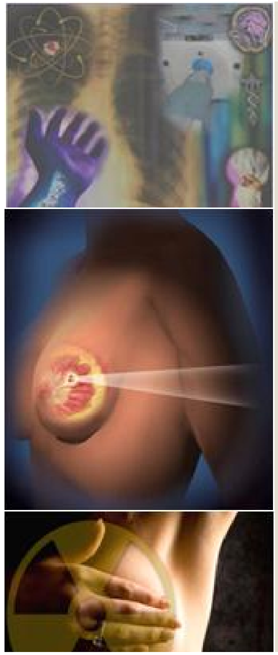
Castillo y col. Rev Senol 2015
Garayoa y col. IWDM 2014

Comparación imágenes clínicas 2D vs C-View





Castillo y col.
II Congreso de la Mama
2015



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Review

Digital breast tomosynthesis (DBT): a review of the evidence for use as a screening tool

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[b] Cambridge University Hospitals NHS Trust, Addenbrooke's Hospital, Cambridge CB2 0QQ, UK
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Table 1
Impact of digital breast tomosynthesis (DBT) on sensitivity: evidence from retrospective reading studies.

Author	Year	System	N	Single or two-view DBT	Summary
Gilbert *et al.*	2015	Hologic	7060	Two view	Borderline improvement in sensitivity (FFDM alone 87%; DBT+FFDM 89%)
Michell *et al.*	2012	Hologic	738	Two view	Increased sensitivity using DBT (58%) compared to FFDM (40%)
Wallis *et al.*	2012	Sectra	130	Single view Two view	Single view DBT comparable with FFDM; modest improvement with two-view DBT compared with FFDM
Svahn *et al.*	2012	Siemens	185	Single view	Increased sensitivity with DBT (90%) compared to FFDM (79%)
Gennaro *et al.*	2010	GE	200	Single view	Similar sensitivity for DBT compared with FFDM
Teerstra *et al.*	2010		513	Two view	Similar sensitivity for DBT and FFDM
Gur *et al.*	2009	Hologic	125	Two view	No increase in sensitivity shown
Rafferty *et al.*	2007	Hologic	1083	two view	Increased sensitivity using DBT+FFDM (76.2%) compared with FFDM alone (65.5%)

FFDM, full-field digital mammography.

En general DBT aumenta sensibilidad

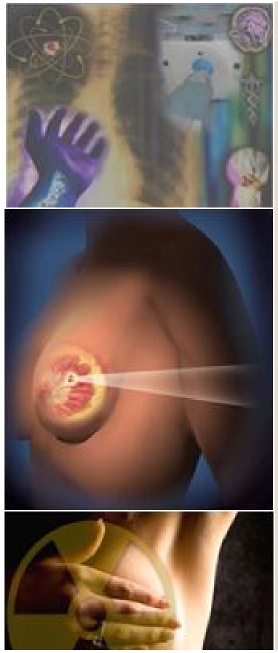

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Table 2
Impact of digital breast tomosynthesis (DBT) on specificity: evidence from retrospective reading studies.

Author	Year	System	n	Single or two-view DBT	Summary
Gilbert *et al.*	2015	Hologic	7060	Two view	Specificity significantly higher for DBT+FFDM (69%) compared with FFDM alone (58%)
Bernardi *et al.*	2012	Hologic	158		Recall would have been avoided in 74% of cases using DBT compared with FFDM
Michell *et al.*	2012	Hologic	738	Two view	Increased specificity using DBT (74%) compared to FFDM (51%)
Wallis *et al.*	2012	Sectra	130	Single view Two view	Reduced recall rate of 11% for two-view DBT and 9.5% for single view DBT compare with FFDM
Svahn *et al.*	2012	Siemens	185	Single view	Diagnostic accuracy significantly better with DBT
Gennaro *et al.*	2010	GE	200	Single view	No significant difference in specificity for DBT compared with FFDM
Zuley *et al.*	2010	Hologic	125		No change in recall rates with DBT
Gur *et al.*	2009	Hologic	125	Two view	30% reduction in recall rate using DBT+FFDM compared with FFDM alone
Rafferty *et al.*	2007	Hologic	1083	Two view	30% reduction in recall rate using DBT in addition to FFDM

FFDM, full-field digital mammography.

En general DBT aumenta especificidad.

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Table 3
Impact of digital breast tomosynthesis (DBT) on diagnostic accuracy in dense breasts: evidence from retrospective reading studies.

Author	Year	System	N	Single or two-view DBT	Summary
Gilbert *et al.*	2015	Hologic	7060	Two view	Higher specificity for all breast densities with the addition of DBT to FFDM. For breast density 50% or more sensitivity increased from 86% with FFDM alone to 93% with the addition of DBT
Michell	2012	Hologic	738	Two view	Improved diagnostic accuracy found was independent of breast density – fatty breasts AUC, 0.934 with FFDM and 0.990 for DBT ($p<0.0002$); dense breasts AUC, 0.886 with FFDM and 0.962 for DBT ($p<0.0001$)
Bernardi *et al.*	2012	Hologic	158		Improved specificity shown irrespective of breast density. Reduction in recall rate was larger in denser breasts
Rafferty *et al.*	2014	Hologic	310	Two view Single view	Increase in diagnostic accuracy for non-dense (AUC, 0.035; $p=0.001$) and dense breasts (AUC, 0.091; $p<0.001$) with addition of two-view DBT

FFDM, full-field digital mammography; AUC, area under receiver operating characteristic curve.

En general DBT aumenta sensibilidad y especificidad

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Table 4
Impact of digital breast tomosynthesis (DBT) in detection of microcalcification: evidence from reading studies.

Author	Year	System	N	Single or two-view DBT	Summary
Gilbert *et al.*	2015	Hologic	7060	Two view	No difference in sensitivity but 3% increase in specificity with DBT+FFDM compared with FFDM
Tagliafico *et al.*	2015	Hologic	107	Two view	Sensitivity for DBT 91.1% compared with 100% for FFDM. Specificity for DBT 100%; FFDM 94.6%
Michell *et al.*	2012	Hologic	738	Two view	Detection of microcalcification equal for both DBT+FFDM and FFDM alone
Kopans *et al.*	2011	GE	119	Single view	Detection of microcalcification better with DBT
Spangler *et al.*	2011	Hologic	100	Two view	DBT worse in the detection of microcalcification than FFDM alone
Poplack *et al.*	2007	Hologic	98	Up to three views matched to mammograms	DBT and FFDM equal in the detection of microcalcification

FFDM, full-field digital mammography.

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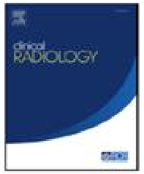

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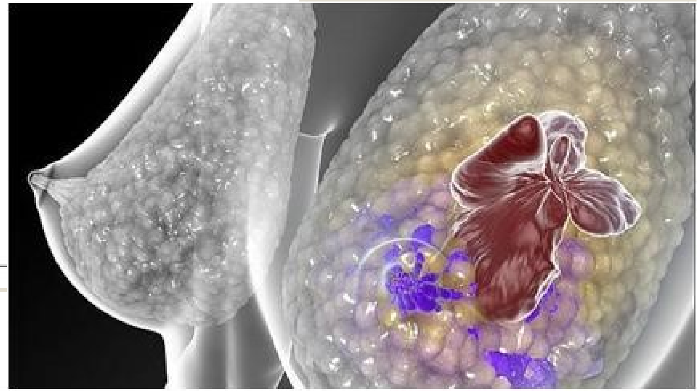

Table 5
Comparison of evidence from prospective screening trials.

Author	Year	System	N	Single or two-view DBT	Summary
Skaane *et al.*	2013	Hologic	12,631	Two view	Increase in cancer detection rate of 27% (with double reading this increased to 30%) Predicted 13% reduction in recall rate (with double reading a reduction of 18% in recall rate was predicted)
Ciatto *et al.*	2013	Hologic	7,292	Two view	Increase in cancer detection rate of 40% Predicted reduction in recall rate of 17%
Lång *et al.*	2015	Siemens	7,500	Single view	40% increase in cancer detection rate 46% increase in recall rate (although actual recall rate is still low at 3.8%)
Friedewald *et al.*	2014	Hologic	173,663		Increase in cancer detection rate of 41% 15% reduction in recall rate

DBT, digital breast tomosynthesis.

DBT aumenta la detección y disminuye la tasa de rellamadas

PROBLEMAS A TENER EN CUENTA SI SE UTILIZA LA DBT COMO HERRAMIENTA DE CRIBADO

- **Curvas de aprendizaje de los radiologos (tiempos de lectura).**
- **IT Almacenamiento y conectividad**
- **Sobrediagnostico**
- **Dosis (si se usa con FFDM)**

RENTABILIDAD

¡ Muchas gracias !