Influence des différentes technologies sur la détection des microcalcifications

Les résultats de l’enquête de l’INCa sur la détection des CCIS

Patrice Heid (ARCADES, Marseille)
Florian Lançon (INCa, Paris)
Mammographie numérique

Différentes technologies
Technologie CR

✧ Ecrans Radio-Luminescents à Mémoire (ERLM, plaques photo-stimulables) :

✧ Classiques, technologie « à poudre » : PIP (en 2016, reste uniquement FUJI et PHILIPS)

✧ Depuis 2012, nouvelles plaques (cristal) : technologie « aiguille » : NIP (en 2016, 100% des plaques AGFA, CARESTREAM et KONICA)
Technologie DR

▫ Capteurs plans ou « Plein champ »

▫ Systèmes à balayage ou Compteur de photons
La détection en question ....
Facteurs influençant la détection

- En premier lieu, le type de détecteur et ses caractéristiques physiques qui ont une influence majeure sur la détection :

  - Si une structure (microcalcification, masse, ...) n’est pas présente dans l’image acquise, elle ne sera pas visible pour le radiologue : problème de détection

  - Si une structure (microcalcification, masse, ...) n’est pas correctement acquise, l’image affichée ne permettra pas une caractérisation correcte
Facteurs influençant la détection

- La qualité du traitement d’images (ou post-traitement) :
  - Après l’acquisition, un algorithme de traitement est appliqué sur l’image pour permettre l’affichage ou l’impression
  - Chaque constructeur applique son propre traitement d’image, traitement d’image qui peut faire disparaître une inclusion (non détection) ou modifier l’aspect cette inclusion (erreur de caractérisation)
Facteurs influençant la détection

- La qualité du support de lecture (films ou écrans) et des conditions d’interprétation

- Evidemment :
  - l’expertise du radiologue
  - la courbe d’apprentissage pour les nouvelles technologies (max 6 mois)
Les résultats de l’enquête INCa
Enquête INCa

- Plusieurs enquêtes menées par l’INCa depuis l’introduction du numérique dans le dépistage

- Enquête menée entre juillet et septembre 2015 :
  
  - Période de recueil : années 2013 et 2014
  
  - Informations recueillies par marques pour les dispositifs CR et DR et par type de plaques pour les dispositifs CR
  
  - Un effectif de 83 structures de gestion (sur 89) a répondu
Résultats

*L’analyse des données porte sur :

<table>
<thead>
<tr>
<th>Nbre examens</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
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<tr>
<td></td>
<td>2 033 680</td>
<td>2 223 729</td>
<td>2 227 401</td>
<td>2 135 825</td>
<td>2 137 815</td>
<td>2 179 139</td>
<td>2 234 246</td>
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</table>
Situation en France

Dépistages par type de technologie numérique

Résultats Nationaux

Nouveau CQ
Taux de détection des cancers (‰)

DR  
CR  
Total
## Résultats cliniques

<table>
<thead>
<tr>
<th></th>
<th>2012</th>
<th>2013</th>
<th>2012-2013</th>
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<tr>
<td></td>
<td>Nbr dépistages</td>
<td>Nbr Cancers</td>
<td>Nbr dépistages</td>
</tr>
<tr>
<td><strong>CR</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FUJI</td>
<td>475 316</td>
<td>7,6</td>
<td>3629</td>
</tr>
<tr>
<td>CARESTREAM</td>
<td>179 093</td>
<td>7,5</td>
<td>1341</td>
</tr>
<tr>
<td>AGFA</td>
<td>133 640</td>
<td>6,7</td>
<td>892</td>
</tr>
<tr>
<td>KONICA</td>
<td>65 615</td>
<td>6,2</td>
<td>408</td>
</tr>
<tr>
<td>PHILIPS</td>
<td>56 739</td>
<td>7,3</td>
<td>414</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>928 814</td>
<td>7,3</td>
<td>6 795</td>
</tr>
<tr>
<td><strong>DR</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FUJI</td>
<td>252 534</td>
<td>7,3</td>
<td>1842</td>
</tr>
<tr>
<td>GE</td>
<td>224 926</td>
<td>8</td>
<td>1806</td>
</tr>
<tr>
<td>HOLOGIC</td>
<td>205 256</td>
<td>8,3</td>
<td>1696</td>
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<tr>
<td>PHILIPS</td>
<td>136 745</td>
<td>7,2</td>
<td>981</td>
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<tr>
<td>SIEMENS</td>
<td>104 641</td>
<td>8,1</td>
<td>843</td>
</tr>
<tr>
<td>PLANMED</td>
<td>11 630</td>
<td>6,5</td>
<td>75</td>
</tr>
<tr>
<td>IMS GIOTTO</td>
<td>7 840</td>
<td>5,4</td>
<td>42</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>967 366</td>
<td>7,7</td>
<td>7 456</td>
</tr>
</tbody>
</table>
Taux de détection des cancers par type de système CR (‰)

- FUJI
- CARESTREAM
- AGFA
- KONICA
- PHILIPS
Taux de détection des cancers par type de système DR (‰)

- FUJI
- GE
- HOLOGIC
- PHILIPS/SECTRA
- SIEMENS
Proportion des CCIS (%)

- DR
- CR
- Total
Enquête INCa

- Depuis 2008, la proportion globale de CCIS est d’environ 14%

- La proportion la plus élevée est celle correspondante aux technologies numériques DR

- Au cours de l’année 2014, on relève des variations de proportions de CCIS de 12,1 à 16 % en fonction des différentes marques CR, et de 12,6 à 16 % en fonction des marques DR (pour les marques réalisant + 100 000 examens)
Taux de CCIS (‰)

DR  
CR  
Total

2011  1,31
2012  1,14
2013  1,16
Les résultats des Bouches du Rhône pour les CCIS
Résultats des Bouches du Rhône pour les CCIS

- Matériels DR les plus utilisés (3 constructeurs), plaques CR PIP et NIP
- Années 2011 à 2014
- Programme de dépistage des cancers du sein ARCADES
- Etude réalisée par Dr B. Séradour
Taux de détection des CCIS par constructeur dans les Bouches du Rhône (2011-2014)

Nbre d'examens

<table>
<thead>
<tr>
<th>TYPE DE SYSTÈME</th>
<th>Nbre examens</th>
<th>Taux de détection CCIS (%)</th>
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<tr>
<td>DR A</td>
<td>24956</td>
<td>0,48</td>
</tr>
<tr>
<td>DR B</td>
<td>33384</td>
<td>1,4</td>
</tr>
<tr>
<td>DR C</td>
<td>16385</td>
<td>1,28</td>
</tr>
<tr>
<td>CR PIP</td>
<td>56075</td>
<td>1,14</td>
</tr>
<tr>
<td>CR NIP</td>
<td>56401</td>
<td>1,22</td>
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</table>
Les publications

Contrôle Qualité et détection
Effect of image quality on calcification detection in digital mammography

Lucy M. Warren and Alistair Mackenzie
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(Received 31 January 2012; revised 12 April 2012; accepted for publication 27 April 2012; published 17 May 2012)
<table>
<thead>
<tr>
<th>Image quality</th>
<th>Image processing</th>
<th>Reader-averaged FoM (95% confidence intervals)</th>
<th>Reader-averaged LLF at NLF of 0.1</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Normal dose DR</td>
<td>Hologic</td>
<td>0.83 (0.78, 0.88)</td>
</tr>
<tr>
<td>2</td>
<td>Normal dose DR</td>
<td>Agfa (Musica-2)</td>
<td>0.84 (0.80, 0.88)</td>
</tr>
<tr>
<td>3</td>
<td>Half dose DR</td>
<td>Agfa (Musica-2)</td>
<td>0.68 (0.60, 0.75)</td>
</tr>
<tr>
<td>4</td>
<td>Quarter dose DR</td>
<td>Agfa (Musica-2)</td>
<td>0.52 (0.43, 0.62)</td>
</tr>
<tr>
<td>5</td>
<td>Normal dose CR</td>
<td>Agfa (Musica-2)</td>
<td>0.63 (0.56, 0.70)</td>
</tr>
<tr>
<td>6</td>
<td>Half dose CR</td>
<td>Agfa (Musica-2)</td>
<td>0.55 (0.45, 0.64)</td>
</tr>
</tbody>
</table>

Fig. 7. Reader-averaged AFROC curves showing performance at all six image qualities.

Fig. 9. Threshold gold thickness at five different image qualities: DR at normal, half, and quarter dose levels shown with disc points, and CR at normal and half dose levels shown with square points: (a) 0.1 mm gold disc diameter and (b) 0.25 mm gold disc diameter. Acceptable and achievable standards as set in the European protocol (Ref. 15) are also shown along with dose limit for a depth thickness equivalent to 50 mm PMMA.
corresponds to the change in calcification detection found in this study. We have shown that a good physical performance measured using the CDMM phantom was matched to good performance in the observer study. This would imply that CDMM-determined threshold gold thickness is a good predictor of microcalcification detection. All image qualities apart from half-dose CR passed the minimum acceptable image quality standard as set in the European Protocol CPR for both the 0.1 and 0.25 mm gold disc diameters of 9. However, statistical analysis demonstrated significant differences in detection between several image quality pairs (Fig. 8). When considering the optimal use of new imaging technology in breast cancer screening it is important to consider both risk and benefits. These results provide clear data from which to estimate the risks and benefits of using either a lower dose radiation dose levels. For example, it would seem unwise to operate equipment at relatively low dose levels where the risk of radiation risk may be more than offset by a reduction in cancer detection. Similarly, these results suggest that the use of better quality detectors may improve cancer detection at the same dose levels. Such considerations are likely to lead to a revision of the standards in the European Guidelines to ensure adequate detection of calcifications. One option would be to decide that systems are good or better than the achievable image quality level to optimize calcification detection while meeting existing dose limits. It is expected that most modern DR systems could meet such a standard.

Our study has two major limitations. Only calcification clusters were inserted and not other radiological features such as masses. The relationship between image quality and detection may differ for various radiological features, and so investigating both microcalcification and mass detection is important. Also, the calculations inserted were all malignant. Introducing benign calcification clusters would allow more accurate results in terms of the correlation between the feature as well as detection) between the different image qualities to be assessed.

V. CONCLUSIONS

Significant differences were found between detection of subtle calcification clusters in CR and DR images at the same dose level. There was also a significant reduction in detection with reduced resolution for both CR and DR images. There was no significant difference in detection between the two imaging process algorithms investigated.

When relating the results of the observer study to the measured threshold gold thickness for 0.15 and 0.25 mm gold disc diameters, a similar threshold gold thickness correlated with better performance in the observer study. A significant new finding and demonstrates that threshold gold thickness measurements using the CDMM phantom relate to calcification detection. However, when relating measured threshold gold thickness measurements to European standards for mammographic image quality, image qualities with significantly lower calcification detection rates still gave better performance than the current minimum acceptable standard. This suggests that the current EU standards may need revising.

ACKNOWLEDGMENTS

This work was part of the GRF 2011 project and was supported by Research Council, UK, and the Engineering and Physical Sciences Research Council Cancer Imaging Programme to Surrey, in association with the Medical Research Council and Department of Health (England). One of the authors (JRC) was supported in part by grants from the Department of Health and Health Services, National Institute of Health, RO1 EB003253 and RO1 EB00688. The authors are grateful to Anna Cumming, Carole Kliger, Caroline Taylor, Karen Mitchell, Susan Doherty, Vincent Coudrier, and Vanessa Newman for taking part in the survey. The authors thank the Department of Radiology, University College Hospital, London, for access to the CDMM system, the staff who have kindly provided support and assistance, and the technical staff of the Medical Physics Service, University of Surrey, who have so kindly provided access to the CDMM system.

The authors also thank the Physics Research Support Unit, Cancer Research UK, for access to the CDMM system, the staff who have kindly provided support and assistance, and the technical staff of the Medical Physics Service, University of Surrey, who have so kindly provided access to the CDMM system.

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V. CONCLUSIONS

- Significant differences were found between detection of subtle calcification clusters in CR and DR images at the same dose level. There was also a significant reduction in detection with reduced dose for both CR and DR images.
- There was no correlation between gold disc diameters, a smaller threshold gold thickness correlated with better performance in the observer study. This is an important new finding and demonstrates that threshold gold thickness measurements using a CDMAM phantom relate to calcification detection.
- However, when relating measured threshold gold thickness measurements to European standards for mammographic image quality, image qualities with significantly poorer calcification detection rates still gave better performance than the current minimum acceptable standard. This suggests that the current EU standards may need revising.
Comparative performance of modern digital mammography systems in a large breast screening program.

Yaffe MJ\textsuperscript{1}, Bloomquist AK, Hunter DM, Mawdsley GE, Chiarelli AN, Muradali D, Mainprize JG.

Abstract

PURPOSE: To compare physical measures pertaining to image quality among digital mammography systems utilized in a large breast screening program. To examine qualitatively differences in these measures and differences in clinical cancer detection rates between CR and DR among sites within that program.

METHODS: As part of the routine quality assurance program for screening, field measurements are made of several variables considered to correlate with the diagnostic quality of medical images including: modulation transfer function, noise equivalent quanta, $d'$ (an index of lesion detectability) and air kerma to allow estimation of mean glandular dose. In addition, images of the mammography accreditation phantom are evaluated.

Results: The breast cancer detection rates at sites employing CR technology were, on average, 30.6\% lower than those that used DR mammography.

CONCLUSIONS: While the clinical study was not large enough to allow a statistically powered system-by-system assessment of cancer detection accuracy, the physical measures expressing spatial resolution, and signal-to-noise ratio are consistent with the published finding that sites employing CR systems had lower cancer detection rates than those using DR systems for screening mammography.
Digital Compared with Screen–Film Mammography: Performance Measures in Concurrent Cohorts within an Organized Breast Screening Program

Radiology September 2013 268:3 684-693; Published online May 14, 2013,
Cancer detection with digital mammography that involves direct radiography technology was similar to that with screen film mammography in women aged 50-74 years; however, for computed radiography, the risk of cancer detection is significantly lower—by 21%—among all screening techniques.
Comparison of Direct Digital Mammography, Computed Radiography, and Film-Screen in the French National Breast Cancer Screening Program

Brigitte Séradour, Patrice Heid, Jacques Estève

OBJECTIVE. The purpose of this article was to compare the performance of digital mammography using hardcopy image reading against film-screen mammography in a French national routine population-based screening program with a decentralized organization. The French context offered the opportunity to examine separately computed radiography and direct digital mammography performances in a large cohort.

MATERIALS AND METHODS. The study includes 23,423 direct digital mammography, 73,320 computed radiography, and 65,514 film-screen mammography examinations performed by 123 facilities in Bouches du Rhône, France, for women 50–74 years old between 2008 and 2010. We compared abnormal mammography findings rate, cancer detection rate, and tumor characteristics among the technologies.

RESULTS. Abnormal finding rates were higher for direct digital mammography (7.78% vs 6.11% for film-screen mammography and 5.34% for computed radiography), particularly in younger women and in denser breasts. Cancer detection rates were also higher for direct digital mammography (0.71% vs 0.66% for film-screen mammography and 0.55% for computed radiography). The contrast between detection rates was stronger for ductal carcinoma in situ. Breast density was the main factor explaining the differences in detection rates. For direct digital mammography only, the detection rate was clearly higher in dense breasts whatever the age (odds ratio 2.20). Except for grade, no differences were recorded concerning tumor characteristics in which the proportion of high-grade tumors was larger for direct digital mammography for invasive and in situ tumors.

CONCLUSION. Direct digital mammography has a higher detection rate than film-screen mammography in dense breasts and for tumors of high grade. This latter association warrants further study to measure the impact of technology on efficacy of screening. The data indicate that computed radiography detects fewer tumors than film-screen mammography in most instances.
Digital compared to screen-film mammography: breast cancer prognostic features in an organized screening program

Maegan V. Prummel · Susan J. Done · Derek Muradali · Vicky Majpruz · Patrick Brown · Hedy Jiang · Rene S. Shumak · Martin J. Yaffe · Claire M. B. Holloway · Anna M. Chiarello

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Abstract Our previous study found cancer detection rates were equivalent for direct radiography compared to screen-film mammography, while rates for computed radiography were significantly lower. This study compares prognostic features of invasive breast cancers by type of mammography. Approved by the University of Toronto Research Ethics Board, this study identified invasive breast cancers diagnosed among concurrent cohorts of women aged 50–74 screened by direct radiography, computed radiography, or screen-film mammography from January 1, 2008 to December 31, 2009. During the study period, 816,232 mammograms were performed on 668,418 women, and 3,323 invasive breast cancers were diagnosed. Of 2,642 eligible women contacted, 2,041 participated (77.3%). The final sample size for analysis included 1,405 screen-detected and 418 interval cancers (diagnosed within 24 months of a negative screening mammogram). Polytomous logistic regression was performed to evaluate the association between tumour characteristics and type of mammography, and between tumour characteristics and detection method. Odds ratios (OR) and 95% confidence intervals (CI) were recorded. Cancers detected by computed radiography compared to screen-film mammography were significantly more likely to be lymph node positive (OR 1.94, 95%CI 1.01–3.73) and have higher stage (II, OR 2.14, 95%CI 1.11–4.13 and III/IV, OR 2.97, 95%CI 1.02–8.59). Compared to screen-film mammography, significantly more cancers detected by direct radiography (OR 1.64, 95%CI 1.12–2.38) were lymph node positive. Interval cancers had worse prognostic features compared to screen-detected cancers, irrespective of mammography type. Screening with computed radiography may lead to the detection of cancers with a less favourable stage distribution compared to screen-film mammography that may reflect a delayed diagnosis. Screening programs should re-evaluate their use of computed radiography for breast screening.
Digital Compared with Screen-Film Mammography: Measures of Diagnostic Accuracy among Women Screened in the Ontario Breast Screening Program.

Prummel MV¹, Muradali D¹, Shumak R¹, Majpruz V¹, Brown P¹, Jiang H¹, Done SJ¹, Yaffe MJ¹, Chiarelli AM¹.

Abstract

Purpose To compare measures of diagnostic accuracy between large concurrent cohorts of women screened with digital computed radiography (CR), direct radiography (DR), and screen-film mammography (SFM). Materials and Methods This study was approved by the University of Toronto Research Ethics Board; informed consent was not required. Three concurrent cohorts of women aged 50-74 years who were screened from 2008-2009 in the Ontario Breast Screening Program with SFM (487 334 screening examinations, 403 688 women), DR (254 758 screening examinations, 220 520 women), or CR (74 140 screening examinations, 64 210 women) were followed for 2 years or until breast cancer diagnosis. Breast cancers were classified as screening-detected or interval on the basis of the woman's final screening and assessment results. Interval cancer rate (per 10 000 negative screening examinations), sensitivity, and specificity were compared across the cohorts by using mixed-effects logistic regression analysis. Results Interval cancer rates were higher, although not significantly so, for CR (15.2 per 10 000; 95% confidence interval [CI]: 12.8, 17.8) and were similar for DR (13.7 per 10 000; 95% CI: 12.4, 15.0) compared with SFM (13.0 per 10 000; 95% CI: 12.1, 13.9). For CR versus SFM, specificity was similar while sensitivity was significantly lower (odds ratio [OR] = 0.62; 95% CI: 0.47, 0.83; P = .001), particularly for invasive cancers detected at a rescreening examination, for women with breast density of less than 75%, for women with no family history, and for postmenopausal women. For DR versus SFM, sensitivity was similar while specificity was lower (OR = 0.92; 95% CI: 0.87, 0.98; P = .01), particularly for rescreening examinations, for women aged 60-74 years, for women with breast density of less than 75%, for women with a family history, and for women who were postmenopausal. Conclusion Given the 38% lower sensitivity of CR imaging systems compared with SFM programs should assess the continued use of this technology for breast screening. © RSNA, 2015.
National Cancer Institute-funded Breast Cancer Surveillance Consortium (BCSC), with a cancer detection rate of 4.8 (3895 of 816232) in the OBSP versus a rate of 4.3 (8774 of 200169) in the BCSC per thousand women screened (1.9) during a comparable time frame (2006–2009 for the OBSP and through 2000 for the BCSC). Reported sensitivities for all three cohorts were lower than those reported in the United States, with the BCSC reporting a sensitivity of 84.9% and the Canadian cohort sensitivities ranging from 70.9% (95% confidence interval [CI]: 66.7%, 74.8%) for CR to 80.2% (95% CI: 79.0%, 81.4%) for DR. These differences are most likely attributable to the longer screening intervals in Canada. More cancers would be expected to manifest as interval cancers in the 2-year interval between screening examinations in Canada compared with the numbers manifesting in the 1-year interval between screening examinations in the United States. This same trend in lower sensitivity is also seen in the BCSC data as screening intervals lengthen (10).

Importantly, CR performed the worst of all systems included in the OBSP study in terms of sensitivity and interval cancer rates. The authors attribute their results to the physical imaging performance metrics of CR mammography, with CR having a lower modulation transfer function, noise equivalent quanta, signal difference to noise ratio, and phantom image scores than DR (1,11).

Specificity in all three cohorts also differed from that in the BCSC, which reported a specificity of 90.3%, while in the OBSP, specificity ranged from 92.8% (95% CI: 92.7%, 92.9%) for DR to 93.8% (95% CI: 93.9%, 93.9%) for CR. Again, the differences in specificity are most likely attributable to the longer screening intervals in Canada, with more false-positive results identified when screening is performed more frequently, as it generally is in the United States. The higher specifcity of CR again could be attributed to the differences in its physical performance metrics, leading to the detection of fewer benign lesions compared with DR.

Despite these differences in screening performance between the Canadian and U.S. cohorts, given the differences in physical characteristics of the CR and DR systems, it is this writer’s judgment that the comparisons between CR and DR are highly likely to be reproducible in a U.S. patient cohort screened yearly intervals. Such a study could be readily undertaken by a large-screening consortium such as the BCSC, and I hope that group will consider evaluating their results for similar patient cohorts in the United States.

In the meantime, I encourage those who are currently using CR for screening mammography to consider converting to DR.

Disclosures of Conflicts of Interest: E.D.P. Activities related to the present article: disclosed no relevant relationships. Activities not related to the present article: is a party to contracts for research activities from Fuji Medical, Philips, and Konings. Other relationships: disclosed no relevant relationships.

References
2. Lipasti S, Antilla A, Pannito M. Mammographic findings of women recalled for diagnostic work-up in digital versus pre- and perimenopausal (24). The area under the ROC
Breast cancer detection rates using four different types of mammography detectors

Alistair Mackenzie1,2, Lucy M. Warren1,2, Matthew G. Wallis3, Julie Cooke4, Rosalind M. Given-Wilson5, David R. Dance1,3, Dev P. Chakraborty6, Mark D. Halling-Brown7, Padraig T. Looney1, Kenneth C. Young1,3

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Abstract

Objective To compare the performance of different types of detectors in breast cancer detection.

Methods A mammography image set containing subtle malignant non-calcification lesions, biopsy-proven benign lesions, simulated malignant calcification clusters and normals was acquired using amorphous-selenium (a-Se) detectors. The images were adapted to simulate four types of detectors at the same radiation dose: digital radiography (DR) detectors with a-Se and cadmium iodide (CdI) converters, and computed radiography (CR) detectors with a powder phosphor (PP) and a needle phosphor (NIP). Seven observers marked suspicious and benign lesions. Analysis was undertaken using jackknife alternative free-response receiver operating characteristics weighted figure of merit (FoM). The cancer detection fraction (CDF) was estimated for a representative image set from screening.

Results No significant differences in the FoMs between the DR detectors were measured. For calcification clusters and non-calcification lesions, both CR detectors' FoMs were significantly lower than for DR detectors. The calcification cluster's FoM for CR NIP was significantly better than for CR FPP. The estimated CDFs with CR FPP and CR NIP detectors were up to 15% and 22% lower, respectively, than for DR detectors.

Conclusion Cancer detection is affected by detector type, and the use of CR in mammography should be reconsidered.

Key Points

- The type of mammography detector can affect the cancer detection rates.
- CR detectors performed worse than DR detectors in mammography.
- Needle phosphor CR performed better than powder phosphor CR.
- Calcification clusters detection is more sensitive to detector type than other cancers.

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5 School of Physics and Astronomy, University of Manchester
6 University of Sheffield
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The relationship between cancer detection in mammography and image quality measurements


PHYSICA MEDICA, APRIL 2018

Purpose
To investigate the relationship between image quality measurements and the clinical performance of digital mammographic systems.

Methods
Mammograms containing subtle malignant non-calciﬁcation lesions and simulated malignant calciﬁcation clusters were adapted to appear as if acquired by four types of detector. Observers searched for suspicious lesions and gave these a malignancy score. Analysis was undertaken using jackknife

Images conformance was measured using the same FoM (FoM), the same four detectors, and the same FoMs used. The relationship between FoMs was signiﬁcant.

Conclusions
There is a strong link between the clinical effectiveness of mammography for the task of detecting calciﬁcation clusters and the image quality measurement and standards in the European Guidelines. There is a weak link for non-calciﬁcation lesions. Systems operating at the minimum acceptable limit for image quality may have unacceptably low cancer detection rates and in the light of this evidence, the European image quality standards should be reviewed with a view to raising them.

Results
The detection gradient for the 3.0 mm diameter disk was signiﬁcantly different from zero for calciﬁcation clusters (p = 0.027), but not for non-calciﬁcation lesions (p = 0.11). Systems performing just above the minimum image quality level set in the European Guidelines for Quality Assurance in Breast Cancer Screening and Diagnosis resulted in reduced cancer detection rates compared to systems performing at the achievable level.

Conclusions
The clinical effectiveness of mammography for the task of detecting calciﬁcation clusters was found to be linked to image quality assessment using the CDMAM phantom. The European Guidelines should be reviewed as the current minimum image quality standards may be too low.
Evaluation en France

- En utilisant les images réalisées lors des CQE en 2014 et 2015.
- Sur des systèmes conformes en dose.
Evaluation en France

- 10 installations par marque et type
- 16 images CDMAM par système
- Utilisation du logiciel EUREF CDMAM Analyser V1.55 (www.euref.org)
- 10 doses par marque
Introduction
CDMAM
Résultats pour les systèmes CR

CDMAM
Predicted Threshold Contrast Measurements système C (NIP)
Predicted Threshold Contrast Measurements système D (PIP)

Mauvais

Bon
Résultats pour les systèmes DR

CDMAM
Predicted Threshold Contrast Measurements système F1

Threshold gold thickness (um) vs. Detail Diameter (mm)

- **Bon**
- **Mauvais**
Predicted Threshold Contrast Measurements système F2

Threshold gold thickness (um) vs. Detail Diameter (mm) graph.

- Mauvais
- Bon
Predicted Threshold Contrast Measurements système G

- **Bon**
- **Mauvais**

Threshold gold thickness (um) vs Detail Diameter (mm) graph.
Predicted Threshold Contrast Measurements système H

Threshold gold thickness (um)

Detail Diameter (mm)

Mauvais

Bon
Predicted Threshold Contrast Measurements système I

- **Mauvais**
- **Bon**

Threshold gold thickness (µm) vs. Detail Diameter (mm) graph.
Predicted Threshold Contrast Measurements système J

Threshold gold thickness (µm)

Detail Diameter (mm)

Mauvais

Bon
Conclusions
Conclusion

- Ecart entre les différents systèmes important
  - En Dose
  - Et en Qualité image (détection)
Conclusion

◊ Infériorité des CR sur les DR

◊ Infériorité des CR PIP sur les CR NIP

◊ Dans une même marque, sur 2 modèles DR différents, variations importantes en terme de qualité image

◊ Variation importante de la détection en fonction des systèmes DR
Le type de détecteur a un impact direct sur la détection des CCIS
Merci pour votre attention