

Seminario di studio  
LA SORVEGLIANZA EPIDEMIOLOGICA DELLO  
SCREENING DEI TUMORI DELLA MAMMELLA NELLA  
REGIONE EMILIA-ROMAGNA  
Bologna, 18 marzo 2013

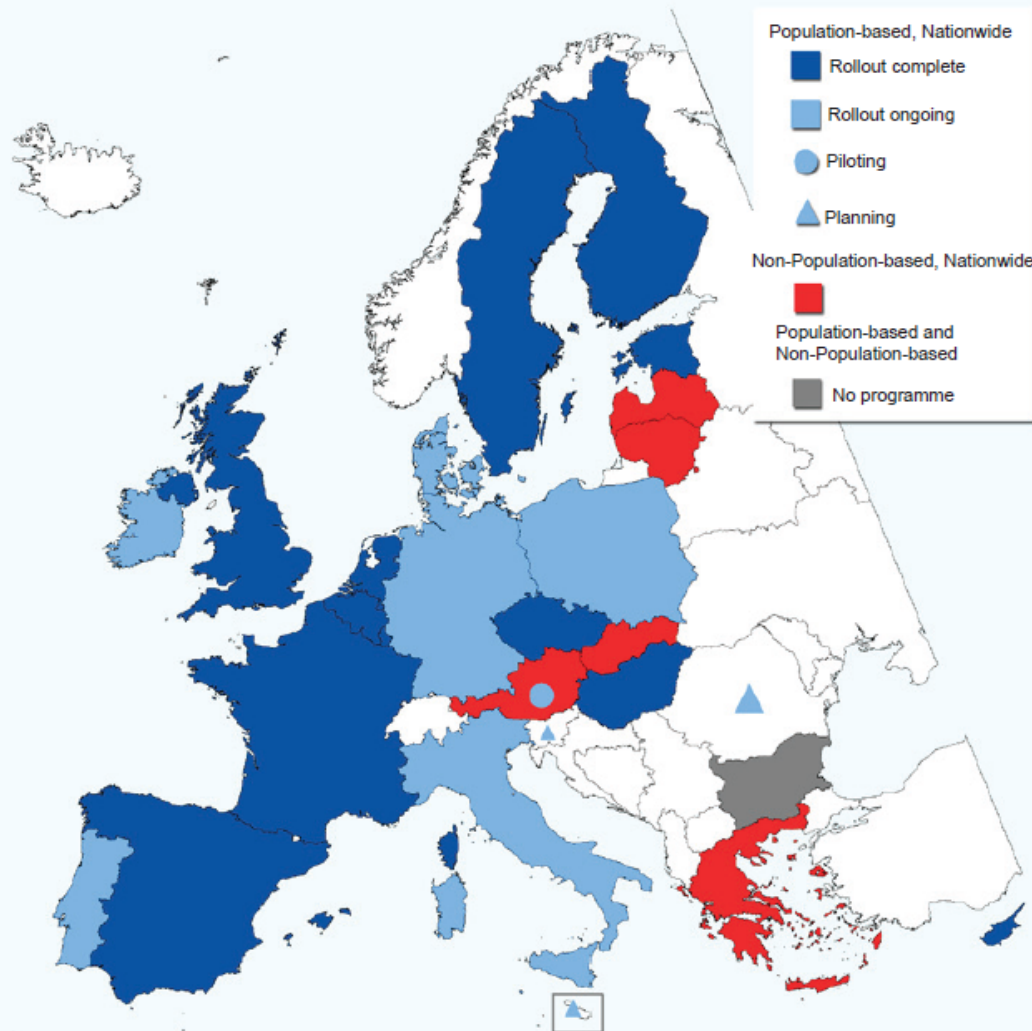
# IL Balance Sheet dei programmi di screening mammografici dell'Unione Europea

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## BACKGROUND

- § Randomised clinical trials in the 1970s and 1980s
- § Population-based screening programmes were implemented in most European countries at the beginning of the 1990s
- § In 2007 the total population targeted by a mammographic screening programme comprised 26.9 million women, predominantly aged 50-69.

## Breast Cancer Screening Programmes in the EU in 2007



von Karsa L et al.  
*Cancer screening in the European Union.  
Report on the implementation of the  
council recommendation on cancer  
screening. First report.*  
IARC 2008

## BACKGROUND

- § Randomised clinical trials in the 1970s and 1980s
- § Population-based screening programmes were implemented in most European countries at the beginning of the 1990s
- § In 2007 the total population targeted by a mammographic screening programme comprised 26.9 million women, predominantly aged 50-69.

## THE CRITICISMS OF MAMMOGRAPHY SCREENING

- § The effectiveness in reducing breast cancer mortality was recently questioned on the basis of two observational studies  
(Jorgensen et al, BMJ 2009; Kalager et al, New Engl J Med 2010)
- § The problem of overdiagnosis and other side-effects have been raised by some authors who have tried to quantify them  
(Esserman et al, JAMA 2009; Gotzsche et al, BMJ 2009)

# Breast screening: the facts— or maybe not

**Peter Gøtzsche and colleagues** argue that women are still not given enough, or correct, information about the harms of screening

## Summary from evidence based leaflet

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- It may be reasonable to attend for breast cancer screening with mammography, but it may also be reasonable not to attend because screening has both benefits and harms
- [redacted] as she will avoid dying from breast cancer
- [redacted] These women will have either a part of their breast or the whole breast removed, and they will often receive radiotherapy and sometimes chemotherapy
- Furthermore, about 200 healthy women will experience a false alarm. The psychological strain until one knows whether it was cancer, and even afterwards, can be severe

Karsten Juhl Jørgensen, MD  
John D. Keen, MD, MBA  
Peter C. Gøtzsche, MD

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## Is Mammographic Screening Justifiable Considering Its Substantial Overdiagnosis Rate and Minor Effect on Mortality?

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**P**roponents of mammographic screening generally say that the benefit is large and established beyond doubt, that there is little overdiagnosis, and that screening leads to less invasive treatment (1–3). The truth is that the benefit is doubtful, that overdiagnosis is substantial and certain, and that screening increases the number of mastectomies performed.

# Rethinking Screening for Breast Cancer and Prostate Cancer

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Laura Esserman, MD, MBA

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Yiwey Shieh, AB

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Ian Thompson, MD

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**B**REAST CANCER AND PROSTATE cancer account for 26% of all cancers in the United States, with an estimated 386 560 patients diagnosed annually: 194 280 for breast cancer and 192 280 for prostate cancer<sup>1</sup> For both, there are remarkable differences between outcomes of localized vs advanced disease (breast cancer: 5-year relative survival rates of 98.1% vs 27.1%; prostate cancer: 100% vs

After 20 years of screening for breast and prostate cancer, several observations can be made. First, the incidence of these cancers increased after the introduction of screening but has never returned to prescreening levels. Second, the increase in the relative fraction of early stage cancers has increased. Third, the incidence of regional cancers has not decreased at a commensurate rate. One possible explanation is that screening may be increasing the burden of low-risk cancers without significantly reducing the burden of more aggressively growing cancers and therefore not resulting in the anticipated reduction in cancer mortality. To reduce morbidity and mortality from prostate cancer and breast cancer, new approaches for screening, early detection, and prevention for both diseases should be considered.

*JAMA. 2009;302(15):1685-1692*

[www.jama.com](http://www.jama.com)

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## EUROSCREEN WORKING GROUP

EUROSCREEN is a cooperative group that includes experts involved in planning and evaluating most of the population-based screening programmes in Europe.

### *Coordinators:*

E. Paci (Italy), M. Broeders (Netherlands), S. Hofvind (Norway) and SW Duffy (UK)

### *Members:*

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## THE PROJECT

We aimed to present a 'balance sheet' based on estimates of breast cancer mortality reduction as the primary benefit, and overdiagnosis of breast cancer and false-positive screening tests as the most important harms.

Five literature reviews were conducted based on the observational published studies in Europe evaluating:

- 1) breast cancer mortality reduction (trend studies, incidence-based mortality studies and case-control studies)
- 2) breast cancer overdiagnosis
- 3) false-positive results



## THE PROJECT

The project was supported by the National Centre for Screening Monitoring (ONS).

The project has started on November 2010 and there were two international meeting in Florence.

The results of this project for the evaluation of service screening in Europe are published in a supplement of the *Journal of Medical Screening* :

Weighing up the benefits and harms of  
breast cancer service screening in Europe.  
J Med screen 2012; 19(Suppl1)

# Journal of Medical Screening

Guest Editors: Allan Hackshaw and Stephen Duffy

Review co-ordinators: E Paci, M Broeders, S Hofvind and SW Duffy

## Editorial

- 1 The benefits and harms of mammographic screening for breast cancer: building the evidence base using service screening programmes *Allan Hackshaw*

## Commentary

- 3 Introduction *Marco Zappa and Anton*

## Original Articles

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### ORIGINAL ARTICLE

Summary of the evidence of breast cancer service screening outcomes in Europe and first estimate of the benefit and harm balance sheet

EUROSCREEN Working Group

*J Med Screen* 2012;00:1-9  
DOI: 10.1258/jms.2012.012077

### ORIGINAL ARTICLE

Communicating the balance sheet in breast cancer screening

Livia Giordano, Carla Cogo, Julietta Patnick, Eugenio Paci and the Euroscreen Working Group (members listed at the end of the paper)

*J Med Screen* 2012;00:1-5  
DOI: 10.1258/jms.2012.012084

# The impact of mammographic screening on [REDACTED] [REDACTED] a review of observational studies

Mireille Broeders, Sue Moss, Lennarth Nyström, Sisse Njor, Håkan Jonsson, Ellen Paap, Nathalie Massat, Stephen Duffy, Elsebeth Lynge and Eugenio Paci, for the EUROSCREEN Working Group

*J Med Screen* 2012;19 Suppl 1:14–25  
DOI: 10.1258/jms.2012.012078

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**Objectives** To assess the impact of population-based mammographic screening on breast cancer mortality in Europe, considering different methodologies and limitations of the data.

**Methods** We conducted a systematic literature review of European trend studies ( $n = 17$ ), incidence-based mortality (IBM) studies ( $n = 20$ ) and case-control (CC) studies ( $n = 8$ ). Estimates of the reduction in breast cancer mortality for women invited versus not invited and/or for women screened versus not screened were obtained. The results of IBM studies and CC studies were each pooled using a random effects meta-analysis.

**Results** Twelve of the 17 trend studies quantified the impact of population-based screening on breast cancer mortality. The estimated breast cancer mortality reductions ranged from 1% to 9% per year in studies reporting an annual percentage change, and from 28% to 36% in those comparing post- and prescreening periods. In the IBM studies, the pooled mortality reduction was 25% (relative risk [RR] 0.75, 95% confidence interval [CI] 0.69–0.81) among invited women and 38% (RR 0.62, 95% CI 0.56–0.69) among those actually screened. The corresponding pooled estimates from the CC studies were 31% (odds ratio [OR] 0.69, 95% CI 0.57–0.83), and 48% (OR 0.52, 95% CI 0.42–0.65) adjusted for self-selection.

**Conclusions** Valid observational designs are those where sufficient longitudinal individual data are available, directly linking a woman's screening history to her cause of death. From such studies, the best 'European' estimate of breast cancer mortality reduction is 25–31% for women invited for screening, and 38–48% for women actually screened. Much of the current controversy on breast cancer screening is due to the use of inappropriate methodological approaches that are unable to capture the true effect of mammographic screening.

We reviewed all the observation studies evaluating the impact of a population-based mammographic screening programme in Europe on breast cancer mortality.

**Trend studies (n=17)**: the analysis of breast cancer mortality trends is not adequate for evaluating the impact of screening

**Incidence-based mortality studies (n=20)**: the pooled estimate of breast cancer mortality reduction from IBM studies was 38% among screened women.

**Case-control studies (n=8)**: the pooled estimate of breast cancer mortality reduction from case-control studies was 48% among screened women, after adjustment for self-selection bias.

# Overdiagnosis in mammographic screening for breast cancer in Europe: a literature review

Donella Puliti, Stephen W Duffy, Guido Miccinesi, Harry de Koning, Elsebeth Lynge, Marco Zappa, Eugenio Paci and the EUROSCREEN Working Group (members listed at the end of the paper)

*J Med Screen* 2012;19 Suppl 1:42–56  
DOI: 10.1258/jms.2012.012082

See end of article for authors' affiliations

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Accepted for publication 21 June 2012

**Objectives** Overdiagnosis, the detection through screening of a breast cancer that would never have been identified in the lifetime of the woman, is an adverse outcome of screening. We aimed to determine an estimate range for overdiagnosis of breast cancer in European mammographic service screening programmes.

**Methods** We conducted a literature review of observational studies that provided estimates of breast cancer overdiagnosis in European population-based mammographic screening programmes. Studies were classified according to the presence and the type of adjustment for breast cancer risk (data, model and covariates used), and for lead time (statistical adjustment or compensatory drop). We expressed estimates of overdiagnosis from each study as a percentage of the expected incidence in the absence of screening, even if the variability in the age range of the denominator could not be removed. Estimates including carcinoma *in situ* were considered when available.

**Results** There were 13 primary studies reporting 16 estimates of overdiagnosis in seven European countries (the Netherlands, Italy, Norway, Sweden, Denmark, UK and Spain). Unadjusted estimates ranged from 0% to 54%. Reported estimates adjusted for breast cancer risk and lead time were 2.8% in the Netherlands, 4.6% and 1.0% in Italy, 7.0% in Denmark and 10% and 3.3% in England and Wales.

**Conclusions** The most plausible estimates of overdiagnosis range from 1% to 10%. Substantially higher estimates of overdiagnosis reported in the literature are due to the lack of adjustment for breast cancer risk and/or lead time.

## Overdiagnosis and breast cancer

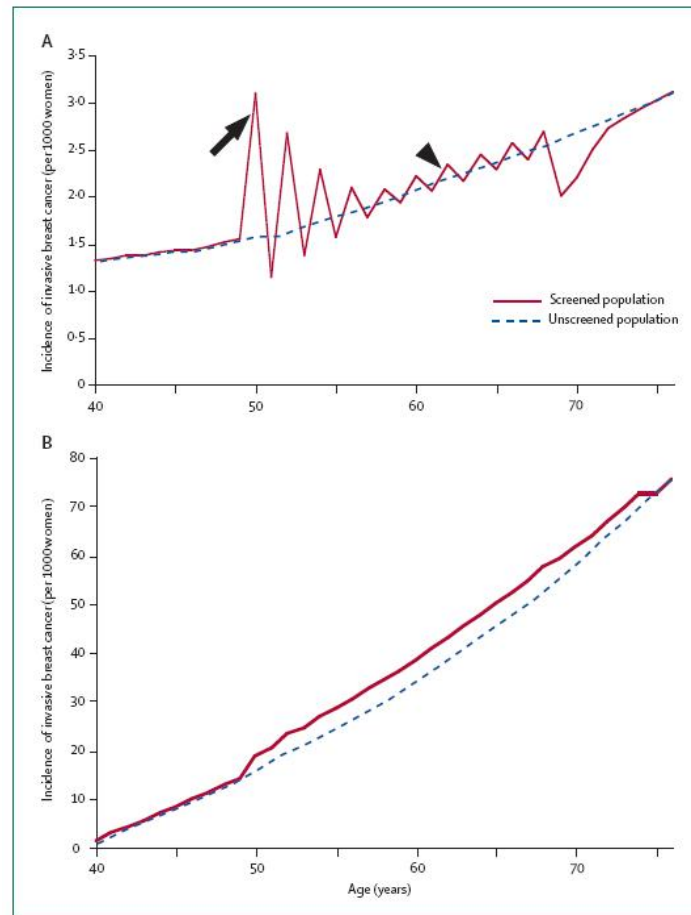
“Detection of in situ or invasive breast cancers at screening that would have never clinically surfaced in the absence of screening”

It's the combination of two causes:

1. the natural history of the disease (low or no potential to progress to symptomatic disease)
2. the presence of competing causes of death (potentially progressive cancer in a subject who is going to die of other causes in the near future)

## Figure 1.

Effect of biennial screening of women 50-68 years on incidence of invasive breast cancer in the absence of overdiagnosis.



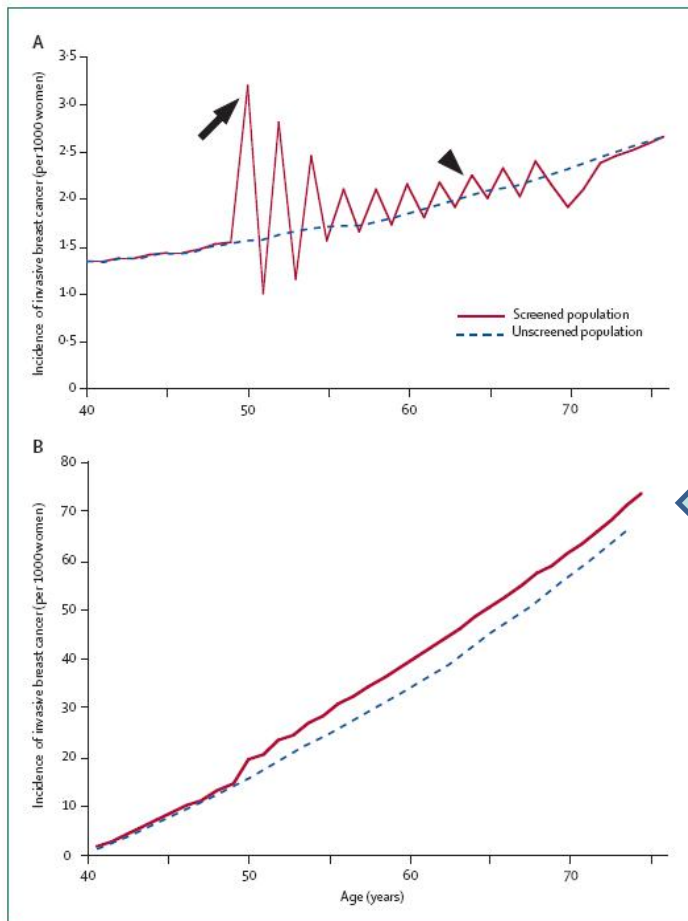
Several years after screening ends, if there's no overdiagnosis, the cumulative incidence will be identical in the two groups.

Biesheuvel et al, Lancet Oncology, 2007



Figure 2.

Effect of biennial screening of women 50-68 years on incidence of invasive breast cancer in the presence of overdiagnosis.



The comparison of cumulative incidence in the two groups several years after screening stops is a valid estimate of overdiagnosis

Biesheuvel et al, Lancet Oncology, 2007

## ELIGIBLE ARTICLE

Primary research articles that gave explicit estimates of breast cancer overdiagnosis in European population-based mammographic screening programmes published in English.

## SEARCH STRATEGY

133 English language abstract were considered

We excluded:

- 36 editorials or commentary
- 22 reviews
- 14 letters
- 44 papers because they did not report an original estimate of overdiagnosis
- 1 paper because it pertained to a non-European country
- 4 papers related to randomized trials only

On the basis of the references in the articles identified, one more paper was also included.

à 13 SELECTED PAPERS  
(reporting 16 estimates of overdiagnosis)

## List of 13 selected papers:

Paper	Country	Calendar period	Estimate of overdiagnosis
Peeters, 1989	The Netherland	1970-1986	11.0%
Paci, 2004	Italy	1985-1999	5.0%
Zahl, 2004	Norway; Sweden	1971-2000	45%-54%
Jonsson, 2005	Sweden	1971-2000	0-54%
Olsen, 2006	Denmark	1991-1996	7.0%
Paci, 2006	Italy	1986-2001	4.6%
Waller, 2007	England and Wales	1971-2001	10.0%
Jorgensen, 2009 (BMJ)	England and Wales; Sweden; Norway	1971-1999	31%-41%
Puliti, 2009	Italy	1986-2004	1.0%
Jorgensen, 2009 (BMC)	Denmark	1971-2003	33.0%
Duffy, 2010	England	1974-2004	3.3%
Martinez-Alonso, 2010	Spain	1980-2004	0.4%-46.6%
de Gelder, 2011	The Netherlands	1989-2006	2.8%

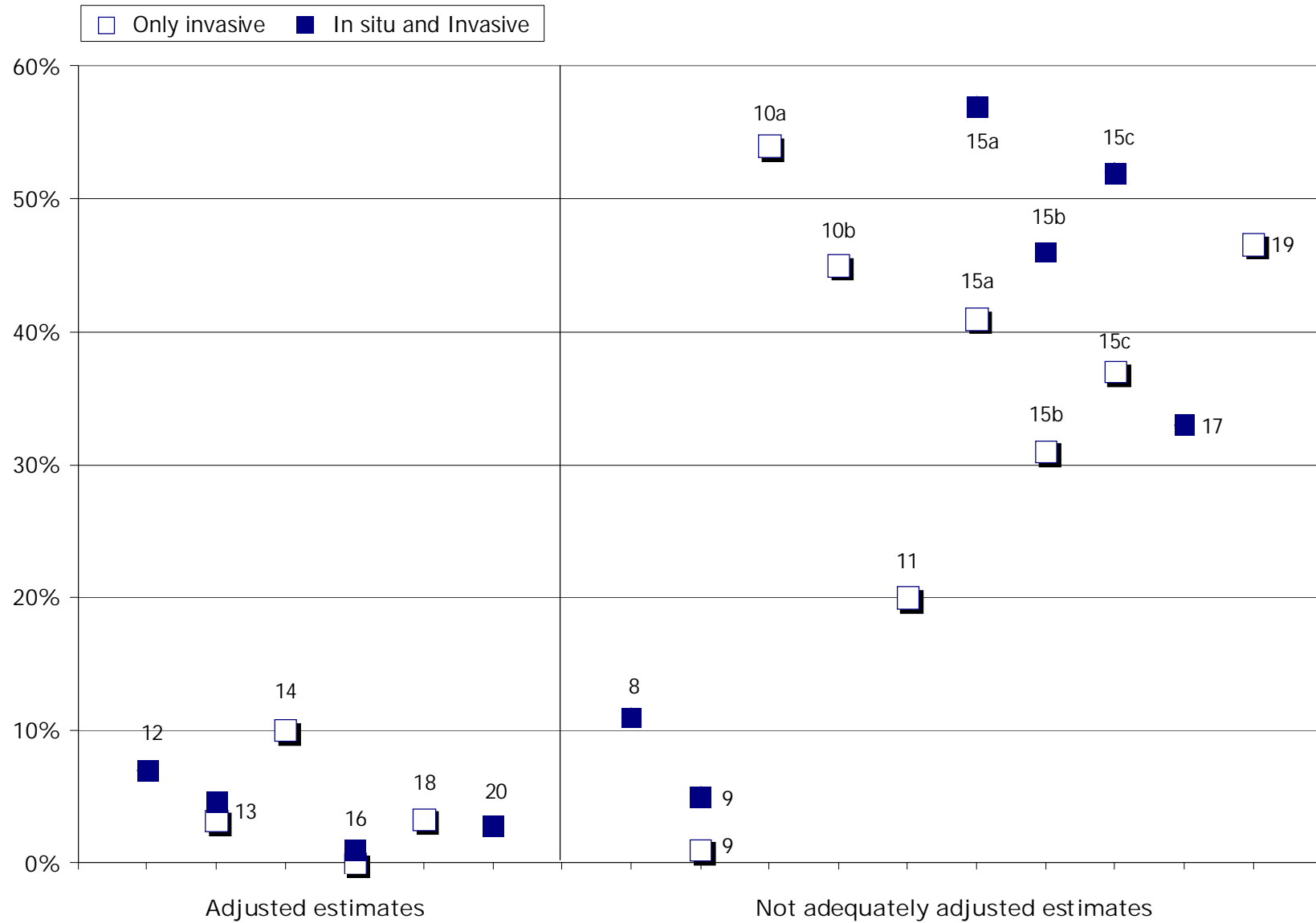
## METHODOLOGICAL FRAMEWORK

The methodological framework used in this review for the evaluation of overdiagnosis estimates in observational studies is based on identifying the two main potential biases that can affect the estimates:

- 1) Breast cancer risk
- 2) Lead time bias

- All selected studies were classified according to the presence of the adjustment for breast cancer risk and lead time bias.
- We expressed estimates of overdiagnosis from each paper as a percentage of the expected incidence in the absence of screening, in order to make them more comparable.

# OVERDIAGNOSIS ESTIMATES CLASSIFIED ACCORDING TO THE PRESENCE/ABSENCE OF BOTH THE ADJUSTMENTS



## CONCLUSIONS of OVERDIAGNOSIS REVIEW

On the basis of this classification, the most plausible estimates of overdiagnosis range from 1% to 10%:

2.8% in the Netherlands,  
4.6% and 1.0% in Italy,  
7.0% in Denmark  
10% and 3.3% in United Kingdom

Unadjusted estimates range from 0 to 54%.

## Six selected estimates adjusted for the major sources of variability:

**Table 3** Population, age range and cancer referred to of the six most reliable estimates of over-diagnosis, with unadjusted and adjusted over-diagnosis estimates

Study	Population	Age range	Cancers	Estimated excess due to over-diagnosis	Adjusted estimates*
Olsen <i>et al.</i> <sup>26</sup>	Screened	Screening ages	Invasive + <i>in situ</i>	7.0%	4.4%
Paci <i>et al.</i> <sup>27</sup>	Invited	Screening ages	Invasive + <i>in situ</i>	4.6%	5.9%
Waller <i>et al.</i> <sup>28</sup>	Screened	Lifetime	Invasive	10.0%	17.0%
Puliti <i>et al.</i> <sup>25</sup>	Invited	Screening ages and older	Invasive + <i>in situ</i>	1.0%	1.0%
Duffy <i>et al.</i> <sup>29</sup>	Invited	Screening ages	Invasive	3.3%	4.3%
de Gelder <i>et al.</i> <sup>30</sup>	Invited	Lifetime	Invasive + <i>in situ</i>	2.8%	6.3%

\*Adjusted to apply to screened women, to 50–79 ages and to include carcinoma *in situ*

average estimate = 6.5%

This is a measure for overdiagnosis in screened women between 50 and 69 years and followed until 79 years, including, carcinoma *in situ*, based on the studies which adequately adjusted for underlying risk and lead time.

# False-positive results in mammographic screening for breast cancer in Europe: a literature review and survey of service screening programmes

Solveig Hofvind, Antonio Ponti, Julietta Patnick, Nieves Ascunce, Sisse Njor, Mireille Broeders, Livia Giordano, Alfonso Frigerio and Sven Törnberg The EUNICE Project and Euroscreen Working Groups (Members of the EUNICE Project and Euroscreen Working Groups listed at end of paper)

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Accepted for publication  
22 June 2012

**Objective** To estimate the cumulative risk of a false-positive screening result in European mammographic screening programmes, and examine the rates and procedures of further assessment.

**Methods** A literature review was conducted to identify studies of the cumulative risk of a false-positive result in European screening programmes (390,000 women). We then examined aggregate data, cross-sectional information about further assessment procedures among women with positive results in 20 mammographic screening programmes from 17 countries (1.7 million initial screens, 5.9 million subsequent screens), collected by the European Network for Information on Cancer project (EUNICE).

**Results** The estimated cumulative risk of a false-positive screening result in women aged 50–69 undergoing 10 biennial screening tests varied from 8% to 21% in the three studies examined (pooled estimate 19.7%). The cumulative risk of an invasive procedure with benign outcome ranged from 1.8% to 6.3% (pooled estimate 2.9%). The risk of undergoing surgical intervention with benign outcome was 0.9% (one study only). From the EUNICE project, the proportions of all screening examinations in the programmes resulting in needle biopsy were 2.2% and 1.1% for initial and subsequent screens, respectively, though the rates differed between countries; the corresponding rates of surgical interventions among women without breast cancer were 0.19% and 0.07%.

**Conclusion** The specific investigative procedures following a recall should be considered when examining the cumulative risk of a false-positive screening result. Most women with a positive screening test undergo a non-invasive assessment procedure. Only a small proportion of recalled women undergo needle biopsy, and even fewer undergo surgical intervention.



A **false-positive screening test** was defined as any screening test requiring further diagnostic assessment in which neither invasive breast cancer nor DCIS was diagnosed.

The **cumulative risk of a false-positive screening** result in women aged 50-69 undergoing 10 biennial screening tests **was 20%**

The specific investigate procedures following a recall should be considered when examining the cumulative risk of a false-positive screening result.

Invasive procedure:

3%

Non-invasive procedure:

17%

## ORIGINAL ARTICLE

# Summary of the evidence of breast cancer service screening outcomes in Europe and first estimate of the benefit and harm balance sheet

EUROSCREEN Working Group

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*J Med Screen* 2012;19 Suppl 1:5–13  
DOI: 10.1258/jms.2012.012077

**Objectives** To construct a European ‘balance sheet’ of key outcomes of population-based mammographic breast cancer screening, to inform policy-makers, stakeholders and invited women.

**Methods** From the studies reviewed, the primary benefit of screening, breast cancer mortality reduction, was compared with the main harms, over-diagnosis and false-positive screening results (FPRs).

**Results** Pooled estimates of breast cancer mortality reduction among invited women were 25% in incidence-based mortality studies and 31% in case-control studies (38% and 48% among women actually screened). Estimates of over-diagnosis ranged from 1% to 10% of the expected incidence in the absence of screening. The combined estimate of over-diagnosis for screened women, from European studies correctly adjusted for lead time and underlying trend, was 6.5%. For women undergoing 10 biennial screening tests, the estimated cumulative risk of a FPR followed by non-invasive assessment was 17%, and 3% having an invasive assessment. For every 1000 women screened biennially from age 50–51 until age 68–69 and followed up to age 79, an estimated seven to nine lives are saved, four cases are over-diagnosed, 170 women have at least one recall followed by non-invasive assessment with a negative result and 30 women have at least one recall followed by invasive procedures yielding a negative result.

**Conclusions** The chance of saving a woman’s life by population-based mammographic screening of appropriate quality is greater than that of over-diagnosis. Service screening in Europe achieves a mortality benefit at least as great as the randomized controlled trials. These outcomes should be communicated to women offered service screening in Europe.

See end of article for authors’ affiliations

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13 June 2012

## COMMUNICATING THE THE BALANCE SHEET

Communication of benefits and harms is central to screening, and should provide the invitee with the information needed to make an informed choice about participation.

The usual measures are estimates of the absolute number of lives saved and the number of breast cancer cases overdiagnosed in a given decision-making scenario.

No judgement is made as to the relative value of a breast cancer death avoided or a case overdiagnosed – this is matter for individual judgement.



## Essential components of the decision-making scenario

Components	Value	Comments and communicative implications
Number of women	1000	The average number of women aged 50-51 years in a small city
Age at the start of the risk period (years)	50	Recommended starting age for service screening in Europe
Status in regard to screening	Screened	The outcomes in terms of benefits and harms to screened women are informative to invited women who are making the decision whether or not to attend
Number of screening mammograms expected in the screening period	10 (every 2 years)	Recommended number for service screening in Europe
Age span for screening (years)	50 to 69	Recommended age range for service screening in Europe
Age at the end of follow up (years)	79	The outcomes in terms of benefits and harms refer to the period from 50 to 79 years.

## Estimates of screening effects

Estimation	Parameter	Reference	Comment
Reduction in BC mortality	38%-48%	Review of IBM studies and case-control studies	Pooled estimates for screened versus unscreened (adjusted for self-selection bias)
Estimate of overdiagnosis (proportion of the incidence in the absence of screening)	1%-10% (average corrected estimate = 6.5%)	Review of overdiagnosis	Range of the six estimates adjusted for BC risk and lead time bias
Cumulative risk of a false positive result with or without invasive assessment	3% and 17%, respectively	Review of false positive results	Estimated for women who participate in all of the 10 expected biennial screening tests

Balance sheet for 1000 women aged 50-51 years, screened biennially until 69 years and followed until 79 years

Balance sheet	
Benefits	Harms
7-9 women's lives are saved (out of 30 deaths expected in the absence of screening)	4 women are overdiagnosed (out of 67 cancers expected in the absence of screening)
	170 women have at least one recall with no-invasive assessment giving a negative result
	30 women have at least one recall with invasive assessment giving a negative result

## CONCLUSIONS (EUROSCREEN WG)

- Available cumulative evidence from population-based service screening in Europe shows that the chance of a woman's life being saved by mammographic screening is greater than that of being overdiagnosed by screening.
- These results are intended to help a woman who is invited to screening to make an informed personal choice about the possible outcomes and the implications of participating in screening.

## THE UK INDEPENDENT BREAST SCREENING REVIEW

Professor Marmot was asked to convene and chair an independent Panel to review the evidence on benefits and harms of breast screening in the context of the UK breast screening programmes.

The Panel thought that the best evidence came from the RCTs and did not consider estimates from observational studies:

*" [...] the Panel was concerned that residual bias could inflate the estimate of benefit " " [...] the Panel concluded that observational studies could give no reliable estimate of the extent of overdiagnosis."*



**A report jointly commissioned by  
Cancer Research UK and the Department of Health (England).**

**October 2012**



## THE UK INDEPENDENT BREST SCREENING REVIEW

In the Panel's judgement the best evidence comes from randomised trials. Estimates from observational studies are considered no reliable and prone to bias.

Mortality benefit:

Meta-analysis of 11 randomised trials estimated a 20% reduction in breast cancer mortality in women invited for screening.

Overdiagnosis:

Meta-analysis of 3 randomised trials estimated a 11% overdiagnosis (as proportion of OD cases in invited women over whole follow-up period) and 19% (as proportion of OD cases in invited women during screening period)

The BALANCE OF BENEFIT AND HARMS:

For 10 000 women invited to screening from age 50 for 20 years, it is estimated that 681 cancers will be diagnosed of which 129 will represent overdiagnosis and 43 deaths from breast cancer will be prevented.

**1 life saved: 3 overdiagnosis cases**



## Independent Review on Breast Cancer Screening Published

*Published 30th October, 2012*

The Independent Breast Screening Review, commissioned by Cancer Research UK (CRUK) and the Department of Health, has been published today [Tuesday 30 October]. The Review concludes that the NHS Breast Screening Programmes "confer significant benefit and should continue". Their best estimate is that the Programme prevents 1,300 deaths a year.

The full report can be found on the [Cancer Research UK website](#).

Richard Winder, Deputy Director of the NHS Cancer Screening Programmes said: "This was a robust review and we appreciate the rigour and efforts of the panel in conducting it. We are pleased that the panel concluded the NHS Breast Cancer Screening Programme confers significant benefit and should continue. Where the panel has made recommendations, we will work with all partners to take these forward."

For further information, please contact the NHS Cancer Screening Programmes' press office on 020 7400 4499 or e-mail [press.office@nhscancerscreening.co.uk](mailto:press.office@nhscancerscreening.co.uk).

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Grazie per  
l'attenzione