Cost-effective screening for breast cancer

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Public Health
Cost-effective screening for breast cancer

WHY?

The global burden of cancer continues to increase;

12.7 million new cases &
7.6 million cancer deaths in 2008;

14.1 million new cases &
8.2 million cancer deaths in 2012

IARC, 12 Dec 2013.
Cost-effective screening for breast cancer

Why?

Sharp rise in breast cancer worldwide

1.7 million women were diagnosed with breast cancer (2012)

Since the 2008 estimates,
breast cancer incidence has increased by more than 20%,
while mortality has increased by 14%.

Br Ca is also the most common cause of cancer death among women
& the most frequently diagnosed cancer among women
in worldwide.

It now represents one in four of all cancers in women.

IARC, 12 Dec 2013.
Cost-effective screening for breast cancer

Br Ca incidence has been increasing in most regions of the world, but there are huge inequalities between rich and poor countries.

Incidence rates remain highest in more developed regions, but mortality is relatively much higher in less developed countries due to a lack of early detection & access to treatment facilities.

IARC, 12 Dec 2013.
Cost-effective screening for breast cancer

“An urgent need in cancer control today is to develop effective and affordable approaches to the early detection, diagnosis & treatment of breast cancer among women living in less developed countries,” explains Dr Christopher Wild, Director of IARC.
Cost-effective screening for breast cancer

It is possible to prevent at least one third of cases that occur every year throughout the world through better use of existing knowledge.

WHERE sufficient resources are available, current knowledge also allows the early detection and effective treatment of a further one-third of cases.

Cost-effective screening for breast cancer

The majority of cancers are preventable!

The aim of prevention is TO STOP THIS PROGRESSION!

The majority of cancers are preventable!

The goal of primary prevention is to avoid the development of cancer by reducing or eliminating exposure to cancer causing factors, or by increasing their resistance to them.

These include environmental carcinogens as well as lifestyle factors such as nutrition & physical activity.

Cost-effective screening for breast cancer

Secondary prevention (applied during the pre-clinical phase) aims

- at **early detection** at a stage
- when **curative treatment** is still possible.

This is achieved

- by frequent medical check-ups of individuals
- or
- by population-based screening programmes to which all those belonging to a certain age group are invited.
Screening for breast cancer

MMG can detect *preclinic cancer,* that is detect the tumor *before* it is *palpable* or before it causes symptoms.

Tumors detected and treated at an *early stage* can be expected to be associated with a *better survival stage* can be expected to be associated with a *better survival rate* that those detected symptomatically...>
Cost-effective screening for breast cancer

**Early diagnosis** may
- *permit breast conserving surgery*
- *reduce* the need for adjuvant therapy
- *decrease* complications related to intensive treatment & recurrence.

**Population based screening** programmes were introduced in this context!
Screening for breast cancer

The epidemic increase in breast cancer incidence LED to the introduction of population based mamography screening (MMG);

The analysis of large RT’s has shown that in women aged 50-69 years MMG screening can reduce mortality from breast cancer by 25-30%.

Cost-effectiveness

* The World Bank’s “Health Sector Priorities Review” (1993) principally low and middle income countries were undertaken “The disease control priorities”,

* And then updated and substantially extended in “The Disease Control Priorities Project” (DCPP) (2006)

Dividing interventions into two broad categories;

1- population based primary preventions
2- personal.
“Cost-Effectiveness Analyses in health” describe interventions in terms of their cost per unit of health gain.

- **CEA** typically use measures that take account of both years and quality of life gained.

- **Cost and effects** are typically measured from the perspective of society as a whole...
“Cost-Effectiveness Analyses” are used in two distinct ways:

1) CEA provides an input into (usually public sector) a decision maker about whether to alter intervention mix or change intervention coverage levels.

2) To inform broader generalizations about health policy.

CEA rests on a non-financial metric that will allow comparisons across the health sector!
Cost-effectiveness

As with any system financing health care, the national-health system has a limited budget and a vast number of potential spending options. Choices must be made as to how this limited budget is spent.
Cost-effectiveness

By choosing to spend the finite NHS budget upon those (treatment) options that provide the most efficient results, society can ensure it does not lose out on possible health gains through spending on inefficient treatments & neglecting those that are more efficient.
Threshold value of cost-effectiveness uses gross domestic product (GDP) as an indicator;

Three categories of cost-effectiveness

1) Highly cost-effective (less than GDP per capita)
2) Cost-effective (between 1 & 3 times GDP per capita)
3) Not cost-effective (more than 3 times GDP per capita)

The recommendations of the Commission on Macroeconomics and Health. 
http://www.who.int/choice/costs/CER_thresholds/en/
Cost-effectiveness

What is the common metric for CEAs comparisons?

“dolar cost per DALY gained”

Even after controlling for intervention quality,

This will vary across locales, because of differences

✓ in individuals

✓ in epidemiological conditions

✓ in delivery system characteristics

✓ in the initial degree of penetration of the intervention into the population

✓ in the range of available alternatives.
Some definitions related cost-effectiveness

Incremental cost-effectiveness ratio (ICER)

is an equation used commonly in health economics to provide a practical approach to decision making regarding health interventions.

ICER is the ratio of the change in costs to incremental benefits of an intervention or treatment.

The use of the ICER in informing decisions to maximize health subject to a budget constraint was originally proposed by Weinstein and Zeckhauser (1973).
Some definitions related cost-effectiveness

Incremental cost-effectiveness ratio (ICER)

The equation for ICER is: \( \text{ICER} = \frac{C_1 - C_2}{E_1 - E_2} \)

where \( C_1 \) and \( E_1 \) are the cost and effect in the intervention or treatment group and where \( C_2 \) and \( E_2 \) are the cost and effect in the control care group.

- Costs are usually described in monetary units while
- Effect /benefit in health status is measured in terms of quality-adjusted life years (QALYs) gained or lost.
Cost-effectiveness

“Cost-Effectiveness Analyses” used

QALY  the quality adjusted life year &
DALY  the disability adjusted life year

- Even focussing analysis to within the health sector cannot be completely done by CEA, however!

- Some interventions that may be undertaken principally for health reasons, such as reducing ambient air pollution...>
These outcomes elude the DALY metric but must explicitly be listed as inputs to the decision-making process!

Quality adjusted life years (QALY)
is a measure of disease burden, including both the quality and the quantity of life lived.

It is used in assessing the value for money of a medical intervention.

The QALY is based on the number of years of life that would be added by the intervention.

Each year in perfect health is assigned the value of 1.0 down to a value of 0.0 for being dead.

Dead: 0.0 . 1.0 Perfect Health
The QALY is a measure of the value of health outcomes. Since health is a function of length of life and quality of life, the QALY was developed as an attempt to combine the value of these attributes into a single index number.

The basic idea underlying the QALY is simple: it assumes that a year of life lived in perfect health is worth 1 QALY (1 Year of Life $\times$ 1 Utility value = 1 QALY) & that a year of life lived in a state of less than this perfect health is worth less than 1.
Cost-effectiveness

The DALY gain associated with averting a death at a given age is, simply, the life expectancy at that age with life years gained in the future discounted back to the present.

A workable measure for effectiveness for most CEAs will be DALYs gained...>
“Cost-Effectiveness”

For Breast Cancer

in the literature ....>
“Highquality single medio-lateral oblique view mammography has been shown to be an effective method in reducing mortality from breast cancer conclude that initially this is the preferred option for the development of mass population screening.

The priority of any screening programme should be given to offering an initial screen to as many women as possible aged between 50-64 years...>
The estimates for cost per life-year or cost per QALY gained for breast cancer screening are not dissimilar to other health service activities currently undertaken.

It was estimated that

- screening would cost £3309 per QALY gained
- the **annual revenue cost** to the NHS in the UK for running a screening service is about **18 million pound (1985-86 prices)**.”

**UK screening programme (1998): Shortening the screening interval from 3 to 2 years?**

The screening policy (1998) costs £2522 per life year gained;

**The marginal cost** per life year gained of shortening the screening interval is £3545...>

UK screening programme (1998):

extending the age of invitation to a final screen from 64 to 69?

The marginal cost per life year gained of extending the age range of the screening programme is £2990.

- The cost-effectiveness is estimated to be pound 27,400 per quality-adjusted life-year (QALY) with 29% probability of cost-effectiveness at a threshold of pound 20,000 per QALY.

- The deterministic estimate of benefit becomes negative if the anxiety due to a false-positive result is set at 0.028 QALYs,

- Including a small positive benefit from a negative screen has a dramatic impact on the cost-effectiveness of screening.
2010, Denewer A et al, Cost-effectiveness of clinical breast assessment-based screening in rural Egypt

25-65 year, volunteer women, from 3 urban areas of 1 of the country provinces

Cost per each detected cancer case:

- 415 $ (treatment cost -)
- 1015 $ - 1215 $ (with diagnostic & treatment cost)
- 2000 $ - 2500 $ (from asymptomatic – advanced forms of cancer, treatment cost)

“They estimated that the breast cancer screening program saved approximately 985-1285 cancer case compared to no-screening.”
2011, Schousboe JT et al. Personalizing mammography by breast density and other risk factors for breast cancer: analysis of health benefits and cost-effectiveness

Markov microsimulation model.

Biennial mammography cost less than $100,000 per QALY gained for women;
- aged 40-79 years with BI-RADS category 3-4 breast density
- aged 50-69 years with category 2 density;
- aged 60-79 years with category 1 density & either a family history of breast cancer or a previous breast biopsy;
- all women aged 40-79 years with both a family history of breast cancer and a previous breast biopsy, regardless of breast density...>
2011, Schousboe JT et al. Personalizing mammography by breast density and other risk factors for breast cancer: analysis of health benefits and cost-effectiveness

Biennial mammography cost less than $50,000 per QALY gained for women
- aged 40-49 years with category 3-4 breast density & either a previous breast biopsy or a family history of breast cancer.

Annual mammography was not cost-effective for any group, regardless of age or breast density.
2013, Pharoah PDP et al., from UK

Participants and interventions

364 500 women aged 50 years

—the population of 50 year old women in England and Wales who would be eligible for screening—

✓ were followed up for 35 years without screening,

compared with a similar cohort

who had regular mammographic screening between ages 50 and 70 years and

✓ were then followed for another 15 years. ..>
There were 1521 fewer deaths from breast cancer
2722 overdiagnosed breast cancers in the screened cohort than in the unscreened cohort

Discounting future costs and benefits at a rate of 3.5% resulted in an additional 6907 person years of survival in the screened cohort,

at a cost of 40 946 additional years of survival after a diagnosis of breast cancer...
Screening was associated with 2040 additional quality adjusted life years (QALYs) at an additional cost of £42.5m (€49.8m; $64.7m) in total or £20 800 per QALY gained.

The gain in person time survival over 35 years was 9.2 days per person and 2.7 quality adjusted days per person screened.
A systematic review was performed of 17 national mammography cost-effectiveness data sets

- Per capita gross domestic product (GDP)
- Breast cancer incidence rate
- The most optimal cost-effectiveness results [cost per life year saved (LYS)]

of a MMG screening strategy for each data set were extracted.

The CE/per capita GDP ratio is used to compare the cost-effectiveness of mammography by countries.

Non-parametric regression was used to find out cut-off point (which indicates the breast cancer incidence rate boundary line determining whether MMG screening is cost effective or not...)
It was found that;

the cost-effective cut-off point of breast cancer incidence rate was 45.04; it exactly divided countries into Western and Asian countries (p<0.0014).

✓ Mammography screening is cost-effective in most of Western countries, but not in Asian countries.

✓ The reason for this result may be the issues of incidence rate or racial characteristics, such as dense breast tissue.

✓ The results indicate that mammography screening should be adopted prudently in Asian countries and other countries with low incidence rates.
The **most cost-effective** strategies were

- biennial screening from ages **50 to 69**, with an ICER of $\ 28,921/QALY
- biennial screening from **40 to 69**, with an ICER of $\ 86,029/QALY
- Screening women ages **40–49** was **more** cost-effective than screening women ages **70–74**.

The introduction of the mammography screening programme does not seem to modify the mortality rate, which had been progressively declining since 1990.

*Swiss Federal Statistical Office. Death rates per 100 000, age standardised using European Standard Population.
In Switzerland;
1) French & Italian speaking region: systematic screening (in 1999..>)
2) German speaking region: opportunistic screening

“.. The analysis of the data provided by the Swiss Federal Statistical Office shows that
there is no difference in mortality between the two major regions of Switzerland (German-speaking vs French- and Italian-speaking),
despite the increased incidence of diagnosed breast cancer in the French- and Italian-speaking regions that could be secondary to the higher screening Coverage...” ..>
the Swiss Medical Board issued a report (15 Dec 2013) stating that

“systematic MMGR screening programmes for early detection of breast cancer are no longer reasonable for women to attend...>
the Swiss Medical Board’s report
(15 Dec 2013)

Board to conclude that

✓ the effectiveness of mammography is still **uncertain**,
✓ over-diagnosis & false positive tests cause **harm**,
✓ the screening programmes have an **unfavourable**
  cost-effectiveness ratio.

2014, Barfar E et al, Cost-Effectiveness of Mammography Screening for Breast Cancer in a Low Socioeconomic Group of Iranian Women

35 year +, 26 600 women, 10 cities, 1 year;

Total cost: **324 585 $**
**377 797 $** (+ non-clinical personal cost)

Breast Cancer Cases: **24** (1 year, n=26 600)
The incremental cost per identified case: **15 742 $**
   Minimum cost scenario: **13 524 $**
   Maximum cost scenario: **36 154 $**

“The screening program might **not** have been cost effective !”
Cost-effectiveness for Breast Cancer?

“Cost-Effectiveness Analyses” in the literature;
- vary substantially
- in their underlying methodologies
- assumptions

Yet without comparability of substantial numbers of interventions,
the relative attractiveness of individual interventions remains uncertain and
generalizations are difficult or impossible!
Cost-effectiveness calculations provide important insights into the economic attractiveness of an intervention, but other considerations such as consequences for financial protection & demands on health system capacity need to be borne in mind!
Why are we discussing cost effectiveness?

Health systems face a range of pressures from

- Within
- Outside

**External factors include;**

- The macro-economic climate
- Values of the society

**Internal factors include;**

- The changing pattern of health in population being served
- Upward pressures on expenditures arising from ageing population
- Technologic change
Cost-effective screening for breast cancer

Macroeconomic factors
Health system are influenced strongly by their economic environment.

What are the resources for healthcare system?
- overall state of economy
- share of the economy devoted to health!
The share of the economy devoted to health is inevitably, 
**The result of the interplay between**
- market forces and
- Political choices!

Regardless of the funding system in place, **governments** play an important role in determining how much will be spent!
Healthcare expenditure is viewed has changed;
In the mid 1990s countries suffered a major economic crisis,
However countries responded in different ways, providing a valuable natural public health experiment;

Thailand and Indonesia followed advice from the World Bank to cut back on public expenditure While Malaysia did not (Hopkins, 2006). ??
Cost-effective screening for breast cancer

There was a short – lived but detectable increase in mortality in Thailand and Indonesia

But not in Malaysia;

Highlighting the importance of maintaining social safety nets at times of economic crisis!
The share of the economy devoted to health is inevitably, 

The result of the interplay between
- market forces and
- Political choices!

Regardless of the funding system in place, governments play an important role in determining how much will be spent!
Health systems **must continually** adapt to changing circumstances, including

1. the economic situation
2. the burden of disease
3. public expectation.

Expenditure on improved health should be seen **not** as a drain on the economy but as **an investment in future growth**!
Cost-effective screening for breast cancer

ALL of us,

have a critical role to play in maximizing the health gain achieved by health system for ALL!
THANK YOU

nozaydin@gmail.com
How Much Does a Mammogram Cost?

- Typical full-price cost of a mammogram ranges from $80 to $120 or more, with an average of about $102*.

- In Turkey,
  - In private health facility; MMGR 735 TL (= $331)**
  - In Governmental health facility;
    - MMGRs are covered by National Health Insurance for women in the recommended age bracket (40-69 y);
    - SGK: (17 TL X 2= 34 TL) + (25-29 TL)= 59-63 TL (= $27-29)
    - No-SGK: (34 TL X 2=68 TL) + (30 TL)= 98 TL (= $45)

* According to Blue Cross Blue Shield of North Carolina...
** In Istanbul, in a private Hospital...
Cost-effective screening for breast cancer
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<thead>
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<th>Yaş Grupları</th>
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Bahçeşehir Tarama Programında Meme Kanseri Tanı Yaşı (2009-2012)

- Tanı Yaşı: %44 (22) 40-49
- Tanı Yaşı: %36 (18) 50-59
- Tanı Yaşı: %20 (10) 60-69

n=50
2009-2010 ve 211-2012 tarama turlarında, ilk kez taraanan kadınlarında Yaşaya Özel Meme Kanseri Hızları

Tanı yaş grupları (n=5938)
Mamografik Tarama Programında, 2 kez taranan kadınlarda Yaşा Özel Meme Kanseri Hızları
Yaşa Uyarlanmış Standart Meme Kanseri İnsidans Hızları, binde, Bahçeşehir

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- WHO 2000-2025 Dünya standart nüfusu
- Avrupa Std Milyon (Scandinavian 1960)
- Türkiye nüfusu, TUİK.