



Individualized breast cancer follow-up

***Cost-effectiveness
of various programs***

Jesse van Elteren, MSc
Erwin Hans, Associate Professor
e.w.hans@utwente.nl



University of Twente
The Netherlands

Agenda

- Introduction
- Method
- Results
- Conclusions



Co-authors

Centre for Mammacare, MST Enschede:

- Joost Klaase, MD, PhD



Medisch Spectrum Twente

Comprehensive Cancer Centres:

- Sabine Siesling, PhD

iKCnet

University of Twente:

- Leo van der Wegen, PhD
- Nelly Litvak, PhD
- Maarten IJzerman, PhD

University of Twente
The Netherlands



Breast cancer

- Incidence: 1 in 9 females
 - In 2005: 12000 new patients,
3400 deaths
- Primary treatment
 - Mastectomy or breast conserving therapy
 - Combined with radio &/ chemo therapy

Follow-up after primary treatment for breast cancer

Aims of follow-up:

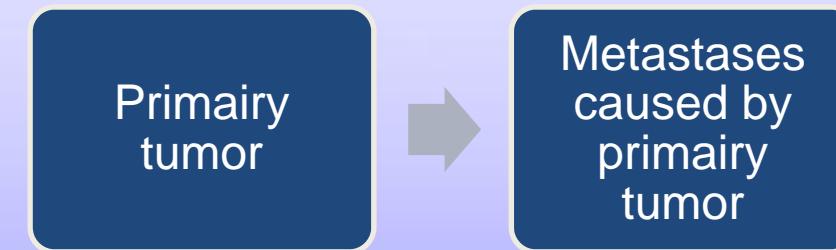
- scar check-up
- detection of recurrence (local, second primary)
 - physical examination, mammography, X-ray, blood
- evaluation of primary and adjuvant therapies
 - effectiveness + quality control
- psychosocial support
- collecting data for research

Importance of follow-up



- Breast cancer can recur in three ways: *local, contra-lateral* or as *metastases*
- Death from breast cancer is caused by *distant metastases* (e.g. bone, lung, liver)
- Metastases are caused by a tumor

scenario 1:



scenario 2:



Early detection of recurrences reduces risk of metastases

(In-)Effectiveness of follow-up



- Risk of metastases from primary tumor is not affected by follow-up
- Many women detect recurrence themselves before follow-up takes place
- Follow-up may only influence survival when recurrences are detected early

(In-)Effectiveness of follow-up (cont.)



- Collins *et al.* (2004) and many others:
There is no scientific evidence that justifies intensive follow-up (QOL, recurrence detection, survival)
- A minority of the recurrences is found in the asymptomatic stage
- Life expectancy of women who do get diagnosed earlier during a follow-up visit does not increase significantly

Importance of follow-up increases



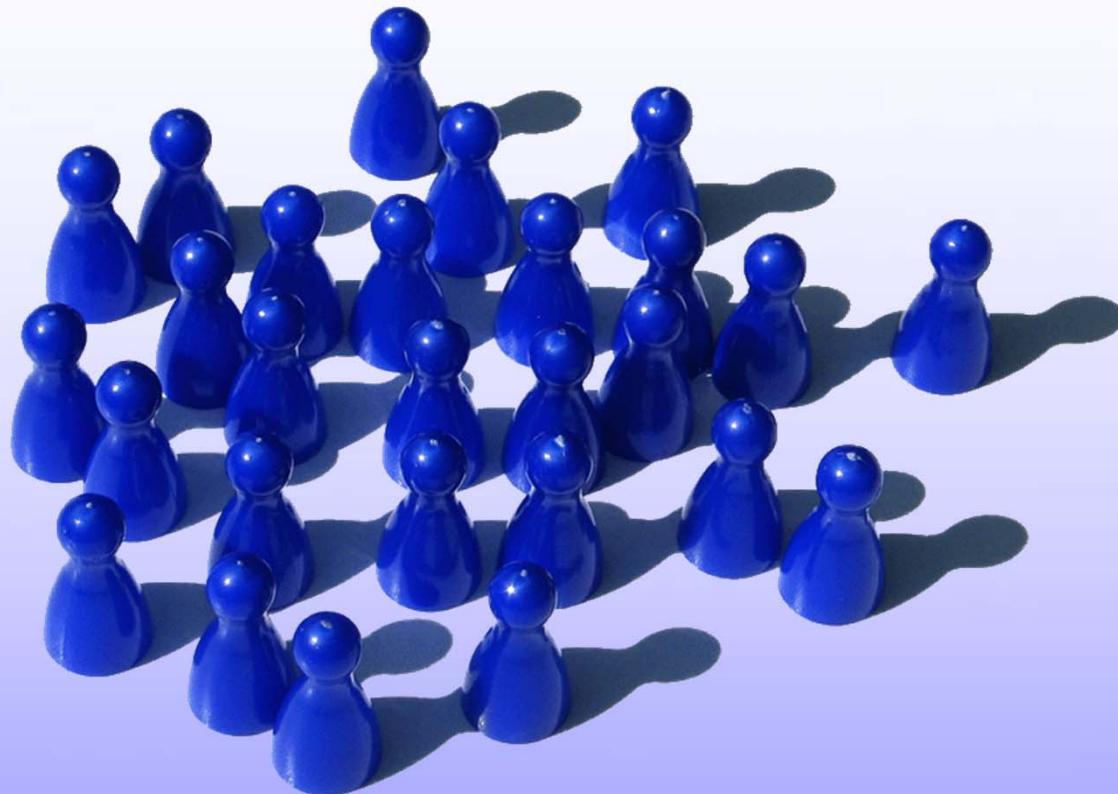
- Better treatments, increased life expectancy
- Increasing age of the population

Drawbacks of follow-up (FU)



- FU gives patients a false feeling of safety
- FU may cause stress and anxiety for patients
- High (increasing) workload for surgeons

All patients receive the same follow-up



**National guideline: 5 years, 2x per year
(not evidence based)**

...but not all patients are the same



- Age
- Tumor size
- # Infected lymph nodes
- Anxiety level

Expected advantages of individualized follow-up

- Better treatment of patients
- Lower work pressure for the hospital



Research question:

*How cost-effective is individualized follow-up
and what is the workload impact for the Centre
for Mammacare?*

- Hospital point-of-view (this study)
- Patient's point-of-view (parallel study)

Research method

- Define patient groups
- Define follow-up programs
- Develop breast cancer health state transition model
- Simulate follow-up programs in DES model,
calculate cost-effectiveness



Patient groups and follow-up programs

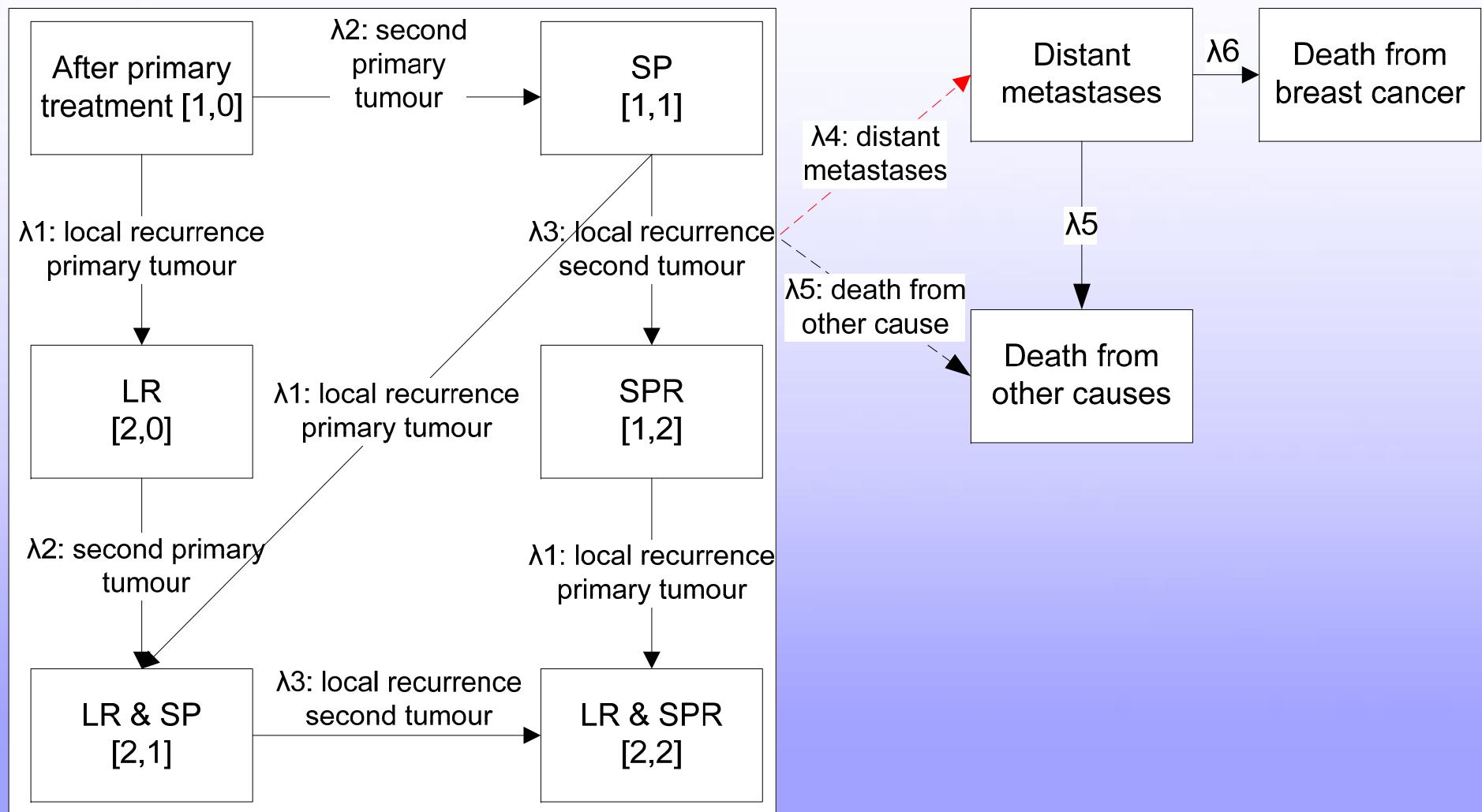
Patient groups:

- *120 categories*, based on:
 - age (<35, 35-40,..., 70-75, >75)
 - lymph node status (negative, 1-3 positive, >3 positive)
 - tumor size (0.1-1.0; 1.1-2.0; 2.1-3.0; >3.0 cm)

Follow-up programs:

- *6 programs*, based on:
 - duration (1, 3, or 5 years)
 - frequency (1 or 2 annual visits)

Health state transition model



Data for health state transition model

- Health state transitions λ_i are patient-specific
- Required data: distributions for *occurrence of* and *duration until transitions*
- Data from various sources:
 - Web-based decision making tools for hc professionals
 - Adjuvant! (www.adjuvantonline.org)
 - IBTR! (Sanghani *et al.*, 2007)
 - Literature (a.o. Engel *et al.*, 2003; Gao *et al.*, 2003)
 - Comprehensive Cancer Centre database

Data for health state transition model

- Quality of Life weights obtained by Lidgren *et al.* using the time-trade-off method (2007)
- The only transition influenced by follow-up is the risk of metastases

Cost-effectiveness analysis approach

Cost-effectiveness of a FU program:

Number of extra consults needed in order to gain one additional QALY, compared to the least intensive FU program (1y, 1x)

Approach:

Discrete event simulation of the health state transition model for many patients & FU programs

Discrete Event Simulation model

- Tecnomatix Plant Simulation 7.0
- Simulation of 150,000 patients per patient group, per follow-up program (5% error)
- Record life expectancy and number of consults
- Compare costs and effectiveness of follow-up programs



Results after ±200M patients

Simulation results for sample patient group
(age 40-44, lymph node status 1-3, tumor size 2.1-3.0 cm)

FU Program	QALY	# Consults	CE-ratio
1y: 1x	16.99	1.2	-
3y: 1x	17.11	3.3	17
5y: 1x	17.19	5.2	20
1y: 2x	17.00	2.4	74
3y: 2x	17.16	6.5	32
5y: 2x	17.24	10.3	36



But, *what is cost-effective?*

With CE-threshold = 10

With CE-threshold = 100

	lymph node status: 0 pos									
0 pos	< 35	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	> 74
0.1 - 1.0 cm	5y: 2x	1y: 1x								
1.1 - 2.0 cm	5y: 2x	5y: 2x	5y: 2x	5y: 2x	5y: 2x	5y: 2x	5y: 1x	5y: 1x	3y: 1x	1y: 1x
2.1 - 3.0 cm	5y: 2x	5y: 2x	5y: 2x	5y: 2x	5y: 2x	5y: 2x	3y: 2x	5y: 1x	3y: 1x	1y: 1x
> 3 cm	5y: 2x	5y: 2x	5y: 2x	5y: 2x	5y: 2x	5y: 2x	5y: 2x	5y: 2x	5y: 1x	3y: 1x

	lymph node status: 1-3 pos									
1-3 pos	< 35	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	> 74
0.1 - 1.0 cm	5y: 2x	5y: 2x	5y: 2x	5y: 2x	5y: 2x	3y: 2x	5y: 1x	3y: 1x	3y: 1x	1y: 1x
1.1 - 2.0 cm	5y: 2x	1y: 1x	1y: 1x	5y: 2x	5y: 1x	3y: 2x	3y: 1x	5y: 1x	1y: 1x	1y: 1x
2.1 - 3.0 cm	5y: 2x	5y: 2x	5y: 2x	5y: 2x	5y: 2x	5y: 2x	5y: 2x	5y: 2x	3y: 2x	5y: 1x
> 3 cm	5y: 2x	5y: 2x	5y: 2x	5y: 2x	5y: 2x	5y: 2x	5y: 2x	5y: 2x	5y: 2x	5y: 1x

	lymph node status: > 3 pos									
> 3 pos	< 35	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	> 74
0.1 - 1.0 cm	5y: 2x	5y: 2x	5y: 2x	5y: 2x	5y: 2x	5y: 2x	5y: 1x	5y: 1x	1y: 1x	1y: 1x
1.1 - 2.0 cm	5y: 2x	5y: 2x	5y: 2x	5y: 2x	5y: 2x	5y: 2x	5y: 1x	5y: 1x	3y: 1x	3y: 1x
2.1 - 3.0 cm	5y: 2x	5y: 2x	5y: 2x	5y: 2x	5y: 1x	5y: 1x	5y: 2x	5y: 2x	3y: 1x	1y: 1x
> 3 cm	5y: 2x	5y: 2x	5y: 2x	5y: 2x	5y: 2x	5y: 1x	5y: 2x	5y: 2x	1y: 1x	1y: 1x

With CE-threshold = 40

	lymph node status: 0 pos									
	< 35	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	> 74
0.1 - 1.0 cm	1y: 1x	1y: 1x	1y: 1x	1y: 1x	1y: 1x	1y: 1x	1y: 1x	1y: 1x	1y: 1x	1y: 1x
1.1 - 2.0 cm	5y: 2x	1y: 1x								
2.1 - 3.0 cm	5y: 1x	3y: 1x	3y: 1x	5y: 1x	5y: 1x	3y: 1x	1y: 1x	1y: 1x	1y: 1x	1y: 1x
> 3 cm	5y: 2x	5y: 2x	5y: 2x	5y: 1x	5y: 1x	5y: 1x	3y: 1x	3y: 1x	1y: 1x	1y: 1x

	lymph node status: 1-3 pos									
	< 35	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	> 74
0.1 - 1.0 cm	5y: 1x	1y: 1x	1y: 1x	1y: 1x	3y: 1x	1y: 1x				
1.1 - 2.0 cm	1y: 1x	1y: 1x	1y: 1x	1y: 1x	1y: 1x	3y: 1x	1y: 1x	1y: 1x	1y: 1x	1y: 1x
2.1 - 3.0 cm	5y: 2x	5y: 2x	5y: 2x	5y: 2x	5y: 2x	5y: 2x	5y: 1x	5y: 1x	1y: 1x	1y: 1x
> 3 cm	5y: 2x	5y: 2x	5y: 2x	5y: 2x	5y: 2x	5y: 2x	5y: 1x	5y: 1x	3y: 1x	1y: 1x

	lymph node status: > 3 pos									
	< 35	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	> 74
0.1 - 1.0 cm	5y: 2x	5y: 2x	5y: 2x	5y: 2x	5y: 1x	1y: 1x				
1.1 - 2.0 cm	5y: 2x	5y: 2x	5y: 2x	5y: 2x	5y: 1x	5y: 1x	1y: 1x	1y: 1x	1y: 1x	1y: 1x
2.1 - 3.0 cm	5y: 2x	5y: 2x	5y: 2x	5y: 2x	1y: 1x	1y: 1x	5y: 1x	3y: 1x	1y: 1x	1y: 1x
> 3 cm	5y: 2x	5y: 2x	5y: 2x	5y: 2x	1y: 1x	1y: 1x	5y: 1x	3y: 1x	1y: 1x	1y: 1x

Workload impact

<i>Follow-up-according to</i>	<i># consults in the Netherlands</i>	<i>Reduction</i>
<i>National guidelines (5y, 2× for all patients)</i>	78,700	
<i>National guidelines & 1y, 1× for patients with tumor size: 0.1-1.0 & 0 positive lymph nodes</i>	72,300	8%
<i>National guidelines & 1y, 1× for patients age > 70</i>	61,550	22%
<i>Individualised approach CE-threshold: 40</i>	24,000	70%

Individualized follow-up works!



- Minimal follow-up for:
 - Patients with good characteristics
 - Patients > 70 year
- Savings up to 90%
- Choosing threshold is up to policy makers
- Respect patient preferences



Further work



- Analytical model development using Markov Decision Theory (co-work Nelly Litvak)
 - Validation simulation model
 - Development online decision support tool
- Research into physical, psychological and social adverse needs of patients shows that patients prefer long and intensive follow-up by specialists
- Same methodology, other types of cancer



Questions

