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SCOR inFORM

THE IMPACT OF DIFFERENT SCREENING SCENARIOS ON BREAST CANCER INCIDENCE

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Abstract

The trend of cancer incidences is one of the key questions for developing critical illness (CI) and cancer insurance products with a sustainable price. One of the identified (risk) factors is the availability and/or introduction of screening programs for cancer, which will impact the level of detection of early cancers and can lead to strong increases in incidences. Among the common cancer screenings available, breast cancer is one of the key cancer types representing around 25% of all female cancer incidences. In cooperation with the Department of Public Health of the Erasmus Medical Center University (Erasmus MC), a leading institute on modelling cancer screening effects, SCOR Global Life gives a deeper insight on the effect of breast cancer screening.

In the first part SCOR Global Life provides a short overview on cancer and breast cancer developments.

In the second part P.A. van Luijt, E.A.M. Heijnsdijk and H.J. de Koning (Department of Public Health of the Erasmus MC) present an overview on screening, the situation in the Netherlands, the (cancer modelling) tool MISCAN and results on various screening scenarios.

In the last part SCOR Global Life highlights some key results on selected time series and shows what this means for sample insurance product designs with early detection benefits (cover for carcinoma in situ) or other staged benefits (products with different benefits by severity of breast cancer). The results from this work give a deeper insight into the risk of changes in screening practice both from a forward looking perspective for countries without existing screening programs and retroactively to understand population data and claims experience not only in the Netherlands and on breast cancer but also worldwide with a more general view on products where breast cancer is only one of many covered conditions.

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The Department of Public Health of the Erasmus Medical Center was established in 1969. In 2009, Dr. Harry de Koning held his inaugural lecture as professor of Screening Evaluation. Today more than 30 researchers belong to the research section for Screening Evaluation, among them Paula van Luijt and Eveline Heijnsdijk.

Their research quantifies the health benefits, harms, impact on quality of life, and cost consequences of screening. Based on their research, they advise to introduce, or not introduce, screening for a specific disease. Sometimes the advice can be to introduce screening in a specific way, e.g., for selective groups of the population only.

The department is well-known on this research and SCOR Global Life is very pleased to tap on their worldwide experience and the results based on the Microsimulation Screening Analysis (MISCAN) developed and performed by them.



Introduction to (breast) cancer morbidity and trend

(by Stefan König from SCOR Global Life)

Cancer and in particular breast cancer is one of the most present severe illnesses in the world. Based on WHO figures it is the leading cause of death with around 13% of all deaths related to cancer [1]. Of this breast cancer is in most countries the leading cancer for females with an estimated 1.7 million new cases (25% of all cancers in women) and 0.5 million deaths (15% of all cancer deaths in women) in 2012 [2]. In critical illness and cancer insurance products it is similar, with breast cancer usually accounting for more than one quarter of critical illness insurance claims for females (see e.g. for the UK CMI WP 52 [3]).

Even more worrying perhaps are the projections from the WHO which estimate a rise in all cancer cases by 75% over the next two decades. Although this is predominantly as a result of demographic change an increasing trend still exists that is not attributable to demographics

This development is of course also relevant to the insurance industry, in all of its many facets of life insurance (cancer mortality), cancer insurance and critical illness insurance (cancer incidence) and other morbidity driven products like disability insurance (mainly cancer incidence but also mortality) and health insurance (both aspects plus the development in treatment expenditures).

FIGURE 1 [4].

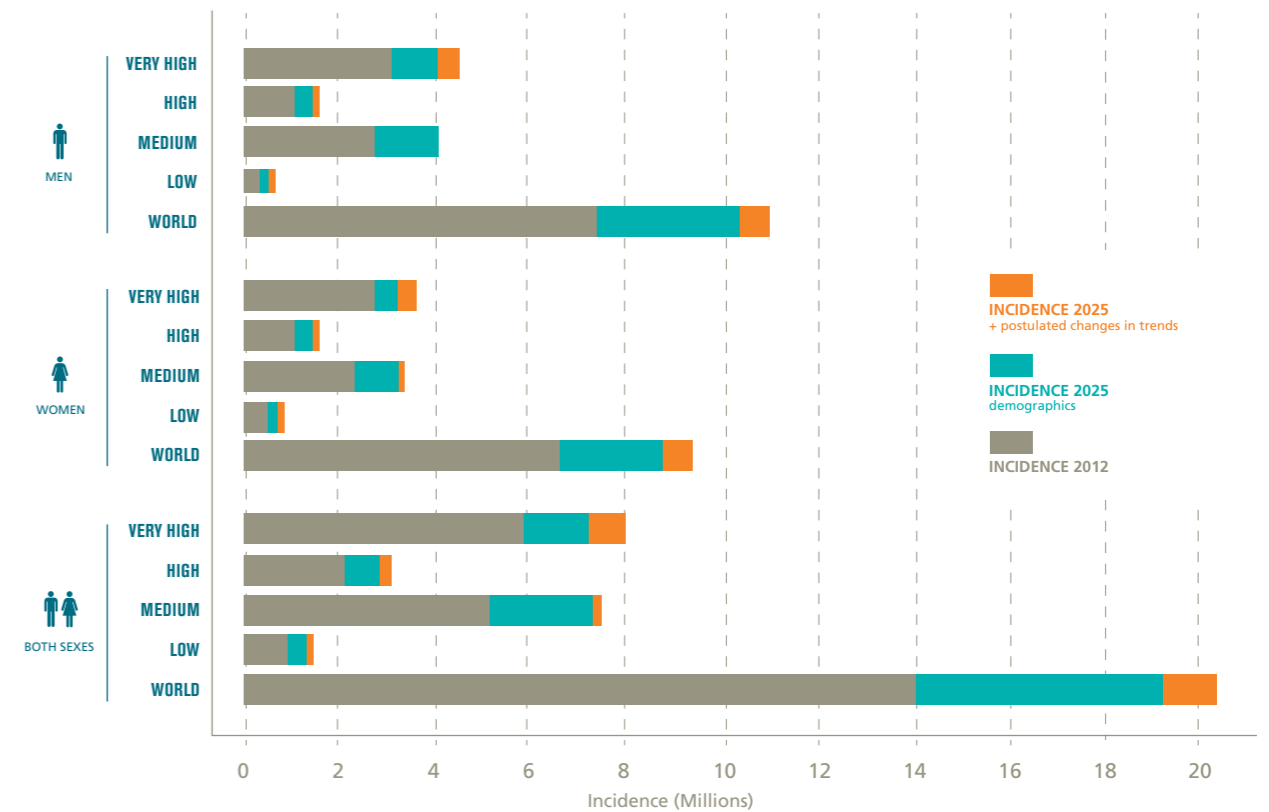


FIGURE 1 From Stewart BW, Wild CP, eds (2014). World Cancer Report 2014. Lyon, France: International Agency for Research on Cancer Fig. 1.2.14. Population estimates for 2012 and predictions for 2025; (B) incident cancer burden based on demographic changes and demographic + incidence rate changes, by sex and four-level HDI.



The new figures and projections of the global cancer burden presented in this edition of World Cancer Report starkly highlight the problem: the incidence of cancer has increased from 12.7 million in 2008 to 14.1 million in 2012, and this trend is projected to continue, with the number of new cases expected to rise a further 75%. This will bring the number of cancer cases close to 25 million over the next two decades.”

Excerpt from Stewart BW, Wild CP, eds (2014). World Cancer Report 2014. Lyon, France: International Agency for Research on Cancer, ISBN 978-92-832-0432-9, Preface, Page 15)

Fortunately, at least in the developed countries, the medical advancements and earlier detection of cancer has led to a reduction in mortality in most cancers and in particular in breast cancer. In England for example the breast cancer mortality decreased between the 70s to the first century of the new millennium from 40 per 100,000 to 25 per 100,000

FIGURE 2 [5].

Unfortunately the same is not true for the cancer and breast cancer morbidity. With the same example from England above the breast cancer incidence highly increased from 70 per 100,000 to 125 per 100,000 in the same period [5].

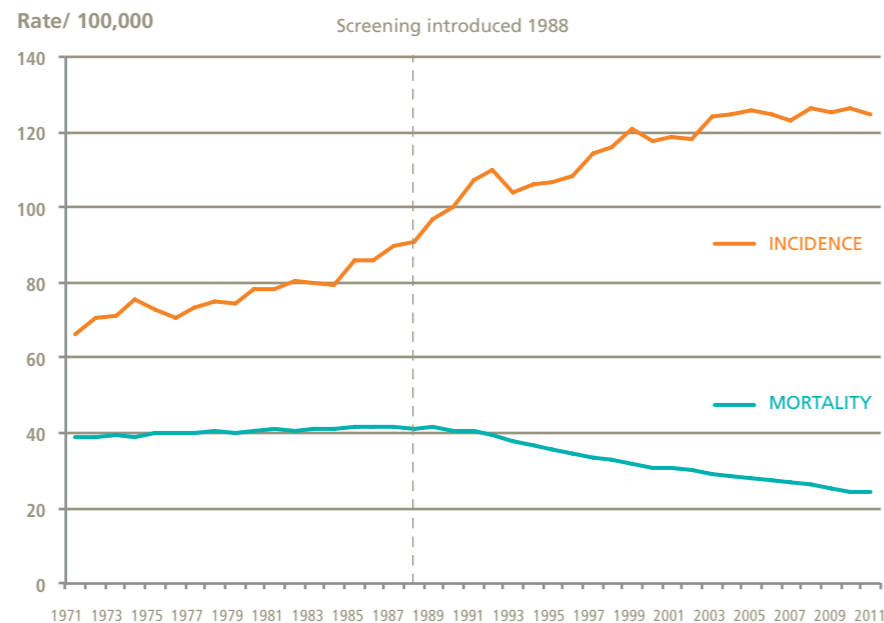


FIGURE 2 Breast cancer incidence and mortality rates, females, England, 1971–2011. Source: Office for National Statistics licensed under the Open Government Licence v.3.0 [5]

From the insurance perspective, especially for guaranteed products with lump sum benefits like CI, this trend needs to be anticipated in pricing. The usual approach would be to continue with the current observed trend and most such projections are even sophisticated enough to model different trends not just by the overall CI or cancer product but by each covered (cancer) condition.

Other countries, for example Korea, have developed cancer products where the benefit of breast cancer (and of some other high trend cancers like thyroid and prostate cancer) was reduced to 20% of the lump sum benefit of other cancer sites. Clearly in this example the need for a stable price has overruled the need for an adequate protection, but it also shows how drastic the methods to reduce trend risk and increasing claims in some countries are.

Less understood and not always modelled is the effect of trends by cancer severity, the effect of introducing new detection methods like mass digital screening and the combination of both. In particular, the big hope and reason of screening programs, to prevent advanced cancers, and the effect of this on different insurance products and concepts is less well understood.

We try to give a deeper insight into this question with this paper and our cooperation with the Department of Public Health of the Erasmus MC.

Since breast cancer is one of the dominant causes of CI claims we focussed our research on this condition and in particular on the following questions:

- How are the different breast cancer stages effected by different screening scenarios?
- In particular how is non-invasive breast cancer effected, with a focus on Ductal carcinoma in situ (DCIS)?
- What is the (mid-term) trend effect by cancer size?
- What is the price impact of the introduction wave of (a new) breast cancer screening based on different product designs?
- How sensitive are different product designs on different screening scenarios?

In addition to the direct application the models for breast cancer screening introduction might also help to understand other cancer sites better.

Obviously the effect of a screening introduction in a given country depends on many aspects, not only on the given morbidity in the population which again depends on many risk factors, but also on the way screening is introduced. Only a few countries show an introduction wave as prominent as seen in England where breast cancer screening was introduced countrywide within a short period around 1988. In other countries the effect might be more diluted, as different age groups are invited at different times (as in the

Netherlands) or screening programs are not introduced countrywide at the same time (as in Canada from 1988 till 2003 [6]).

Also the statistics before screening introduction might already be diluted because even before mass screening introduction individual programs, for example private programs or programs for certain risk groups (like in Germany) exist. Last but not least screening behaviour will have an effect as we can see for example in France, where participation statistics show a difference between Paris and the rest of the country with much lower participation in Paris [7].

All of this also needs to be taken into account by evaluating the available source data and we are very happy that with the Department of Public Health of the Erasmus MC we had such an experienced partner for this project with a deep inside into the background in the Netherlands. In the next chapter we would like them to present the results, which we later used to apply to the needs of an insurance portfolio.

The MISCAN model and the predictions for the Netherlands

(by P.A. van Luijt, E.A.M. Heijnsdijk and H.J. de Koning
from the Department of Public Health of the Erasmus MC)

EVALUATION OF SCREENING

The Department of Public Health of the Erasmus MC has gathered much experience in the field of evaluation of screening as a participant in the National Evaluation Team for Breast cancer screening in the Netherlands [8-9]. In this role we collect data from the Dutch screening organisations and assess these data to monitor the breast cancer screening programme. The data entail information on the number of women invited, attendance rate, recall rate, detection rate and stage distribution of the screen-detected cancers.

The data by itself provides insight in the performance of the programme, but it lacks the ability to compare the situation with screening to a hypothetical situation without screening in the Netherlands. To allow for this comparison, we use a microsimulation model called MISCAN. The MISCAN model has been used extensively in the past to assess screening programmes [10-12].

The recent decision to implement a nationwide programme for colorectal cancer screening in the Netherlands as well as the USPSTF guidelines for breast cancer screening and colon cancer screening in the US were partly based on MISCAN studies.

Ductal carcinoma in situ (DCIS) is a non-invasive precursor of breast cancer. DCIS is often detected by screening [13]. Possibly DCIS constitutes overdiagnosis [14-15]. Overdiagnosis is a measure for the number of cases detected in a screening situation, which would never have led to a diagnosis in the absence of screening. There is much debate in international literature on the amount of overdiagnosis [16-21]. The basic idea of screening and overdiagnosis is explained below **FIGURE 3**. In the absence of screening a woman would get a diagnosis when symptoms become apparent. With screening her diagnosis should be advanced. In this situation she has lost some quality-of-life-adjusted years, but she has

also gained some lifeyears by early detection and therefore better treatment outcomes. Overdiagnosis is the event when a woman has an onset of the disease, but no diagnosis in the absence of screening; when this woman is screened, she may have a diagnosis of breast cancer, but no gain in lifeyears.

Whether or not DCIS is overdiagnosed depends on its natural behaviour. More aggressive DCIS is less likely overdiagnosed than less aggressive DCIS. We assessed the pathology reports [22] from 2007, 2008 and 2009 of 5,463 DCIS cases to ascertain the proportion of aggressive (III), intermediate (II) and less aggressive (I) DCIS. We found that 50% of DCIS cases were aggressive, 32% were intermediate and 18% were less aggressive. We implemented these findings in our MISCAN model.

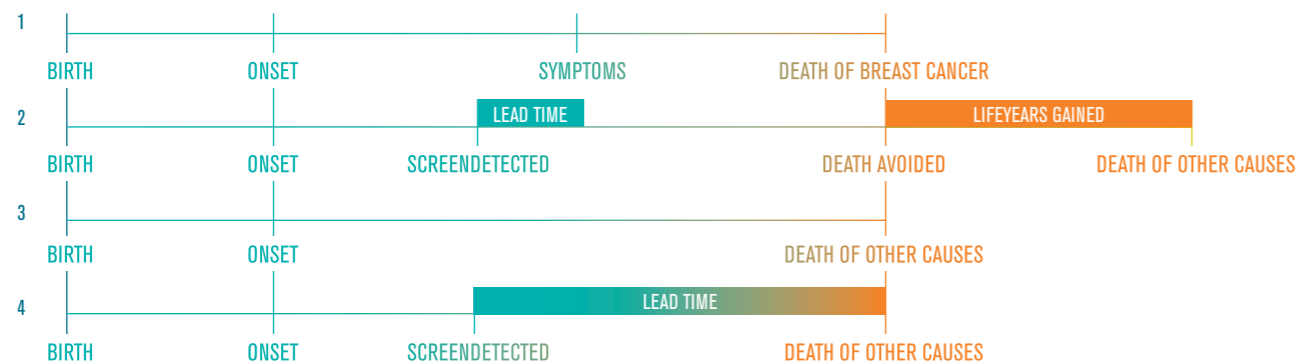


FIGURE 3 This illustrates the impact of screening on two different women. In scenario 1 the woman will have a diagnosis of breast cancer in her lifetime. Screening may advance this diagnosis and improve her prognosis, this is indicated in scenario 2. In scenario 3 the woman will have an onset of breast cancer, i.e. a tumour will develop, but she will never know this in the situation without screening. Screening may detect this tumour, but it will not improve her prognosis, because this was never dependent on breast cancer. This is shown in scenario 4 and depicts overdiagnosis.

BREAST CANCER SCREENING IN THE NETHERLANDS

Population based breast cancer screening was initiated in the Netherlands in 1990 [8] for women aged 50-69 years old. In 1998 the programme was extended to cover all women aged 50-74. Women are selected by the central municipal administration in the year in which they turn 50 up to the year in which they turn 75. The selected women are invited biennially for a screening examination, free of charge. In 2004 the conversion of all screening units to digital mammography equipment was started and since 2010 all examinations have been performed and assessed digitally. Attendance rate is usually approximately 80%. Annually 900,000 women are screened and about 5,000 cases of breast cancer are detected.

MISCAN METHODOLOGY

The model generates individual life histories based on Dutch birth tables and life tables. Breast cancer incidence rate is increased by 2.2% each year, in accordance to international literature on rising incidence of breast cancer. Based on this incidence rate some of the women will have an onset of preclinical breast cancer. Preclinical means that there is a tumour, but it has not yet been diagnosed. From each onset women can get a preclinical DCIS type I, II or III.

Each preclinical disease state can go in one of three directions: progress to the next preclinical stage, become clinically detected or, in the presence of screening, become screen-detected **FIGURE 4**. In addition, the preclinical DCIS stages have the possibility to regress to normal. It is assumed that there is no progression or regression between the different DCIS types [23]. The progression through different stages is modelled by a Markov-progression model. The output of the model is breast cancer incidence with and without screening by calendar year and by ten year age-group.

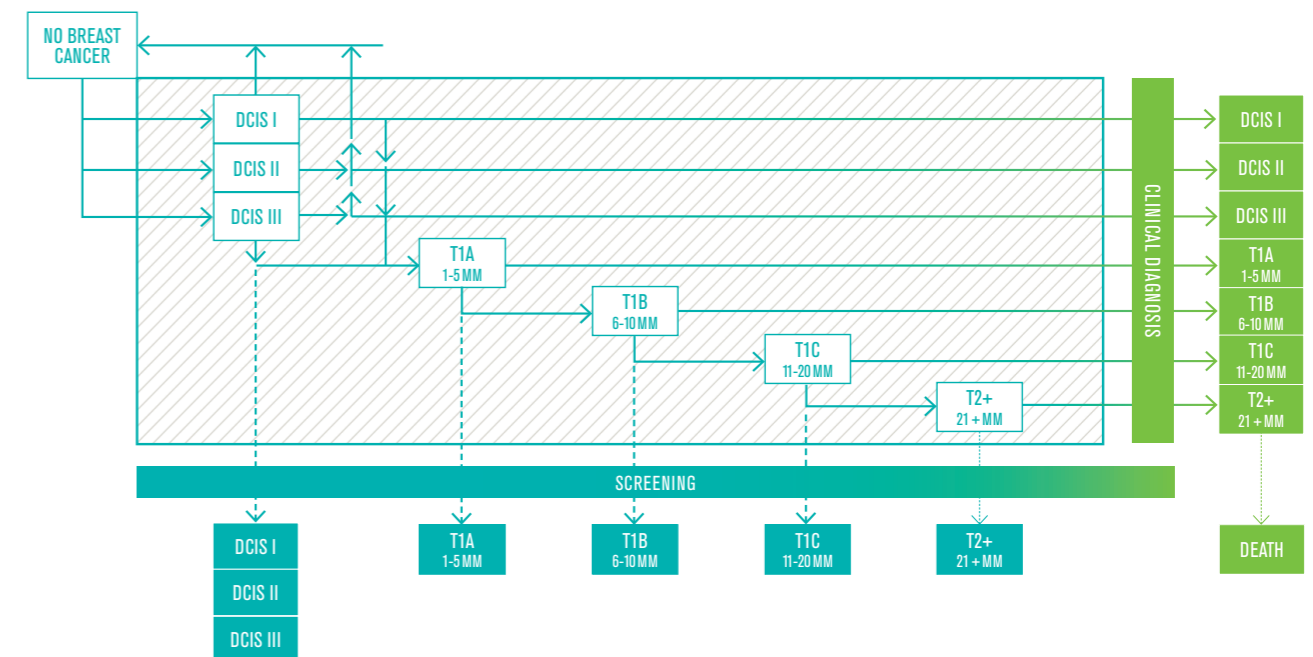


FIGURE 4 Graphic depiction of the progression through different stages in the MISCAN model. DCIS= ductal carcinoma in situ, DCIS I= less aggressive, DCIS II= intermediate, DCIS III=aggressive, T1a= an invasive breast cancer >0.1cm and <0.5cm, T1b= an invasive breast cancer >0.5cm and <1.0cm, T1c= an invasive breast cancer >1.0cm and <2.0cm, T2+= an invasive breast cancer >2.0cm.

RESULTS

The model is calibrated regularly using data from the Dutch screening programme. For this study we calibrated the model using data until 2010 **FIGURE 5**.

We modelled different scenarios with different screening sensitivities, different attendance rates and different introduction years.

The different scenarios resulted in different breast cancer incidence. For example we compared the average breast cancer incidence in women aged 50-60, from 2005 to 2010, between scenarios. Breast cancer incidence was 24% higher with Dutch screening than without screening. This difference is mostly explained by an increased number of DCIS. Lowering the sensitivity by 10% decreased incidence by 2.0% overall, DCIS decreased by 14.3%. On the other hand increasing sensitivity by 25% increased incidence by 0.7%. If we lowered attendance to 40% (instead of 80%, which is the attendance rate in the Dutch screening programme) incidence decreased by 0.2% in women aged 50-60 but increased by 1.9% in women aged 70-80 **FIGURE 6**. The same analysis was performed for the scenarios in which screening starts in 2013 with comparable results.

We intend to publish our results in an international peer-reviewed medical journal in the near future.

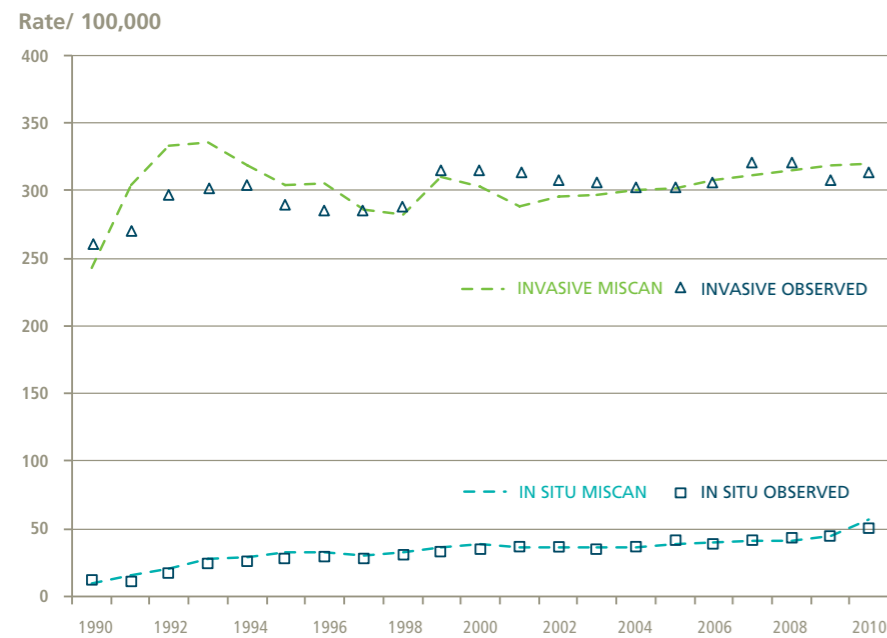


FIGURE 5 Comparing observed breast cancer incidence to predicted incidence. Calibration of the MISCAN model of invasive breast cancer and DCIS.

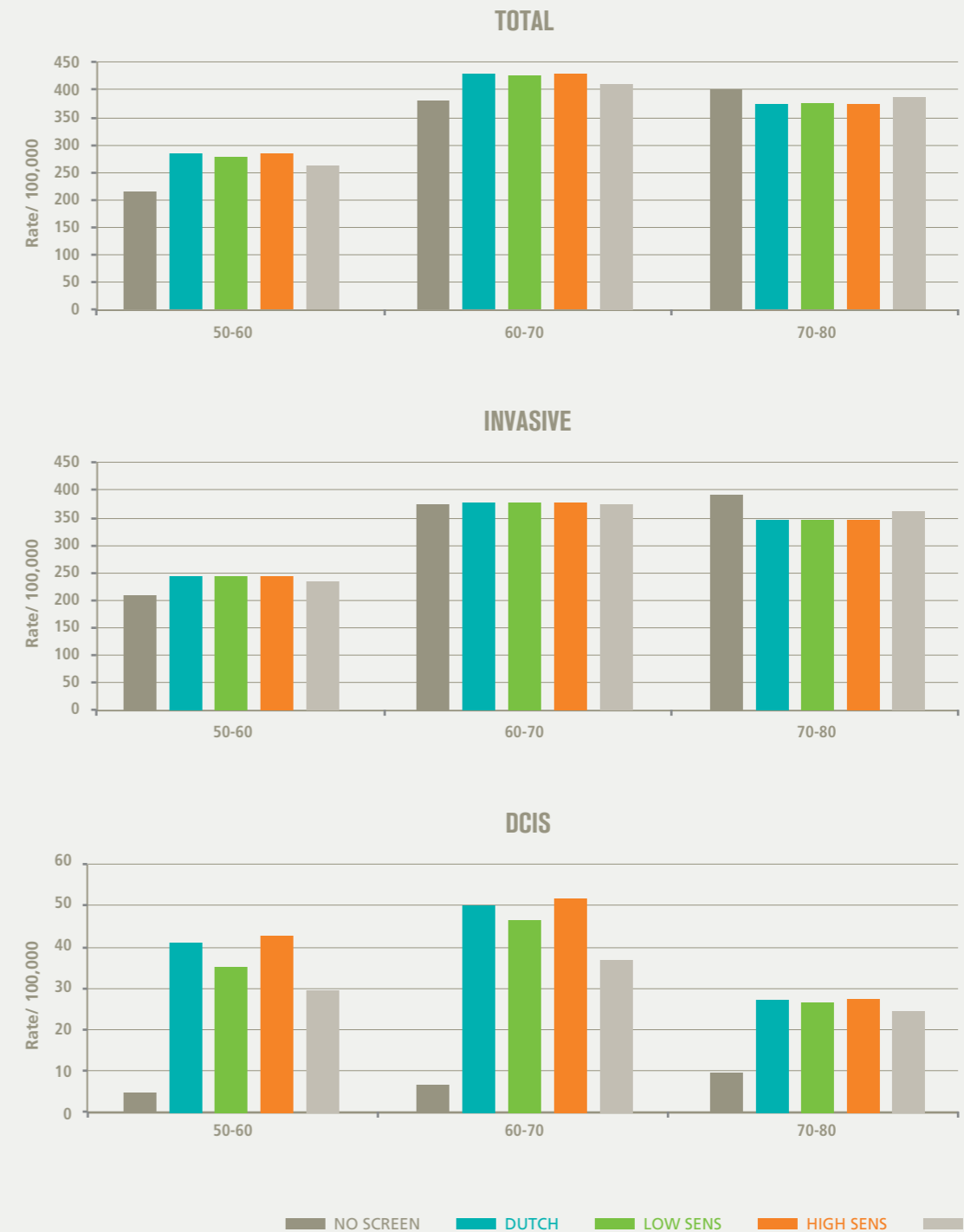


FIGURE 6 Comparing the different scenarios in overall incidence rate, DCIS incidence rate and invasive breast cancer incidence rate, by age band and all per 100,000.

Illustration of impact of screening introduction over time

(by Stefan König from SCOR Global Life)

As (re-)insurers we are interested in the effect over time which we decided to demonstrate on only three of the many scenarios derived from the MISCAN model by the Department of Public Health of the Erasmus MC. The first two scenarios ("No Screen" and "Dutch") correspond to the figures in the previous chapter. "No Screen" simulates a situation in the Netherlands where screening was never introduced. "Dutch" is the scenario calibrated to the observed data in the Netherlands and projected into the future based on the most recent best practice of screening. As a third scenario ("Introduction") we present the most extreme and most abrupt screening introduction effect, namely a simulation in which the situation in the Netherlands before any screening is transferred into the current situation with digital screening (high sensitivity), high attendance rate and biannual invitation from age 50. The biannual invitation means the introduction wave will be restricted to two succeeding years without the normally expected smoothing effect created by the more natural roll out to the population at the invited age bands.

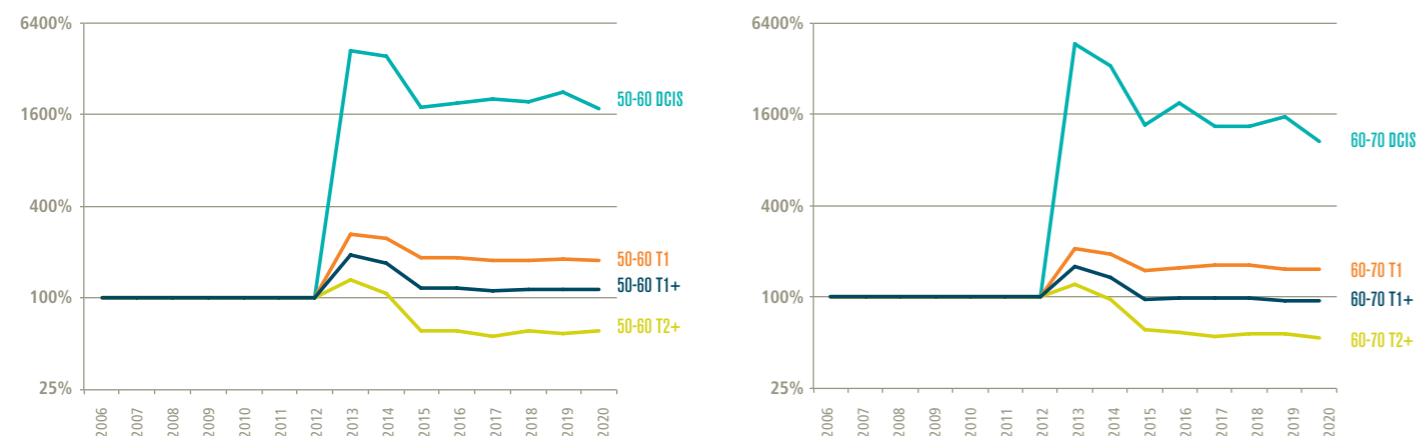


FIGURE 7 Relative increase of tumour detection after screening introduction by size of tumour (logarithmic scale with basis 4) DCIS= ductal carcinoma in situ, T1= an invasive breast cancer >0.1cm and <2.0cm, T2+= an invasive breast cancer >2.0cm and T1+ all invasive breast cancer (T1 and T2+).

RELATIVE IMPACT OF SCREENING INTRODUCTION

In the first four graphs **FIGURE 7+8** we show the effect of the "Introduction" scenario. The graphs show the increase in cancer detection by taking the simulated number of cancers detected under the "Introduction" scenario over a situation where screening was never introduced. As expected in both age bands and at all cancer stages we can see a steep increase of detected cases during the introduction years. Also as expected the increase is higher in the earlier cancer stages than it is in the more advanced cancers stages. This is not surprising as higher stages of breast cancer have a higher likelihood of being detected in the absence of screening, either by

the patient himself or during standard check-ups. After the two year introduction the effect by stage and age becomes more differentiated. For DCIS the relative increase is the highest with rates stabilising at up to 20 times that of the pre-screening situation, even if the total number is still lower than that of invasive cancer. Similar but to a much lighter extent T1 stabilises at 175% for age band 50-60 and 150% for age band 60-70 of the situation without screening.

At the advanced stages of cancer we finally see the hoped for positive effect of screening, with T2+ dropping to 50% of the cases compared to a situation without screening. For most cancer and CI products however we are interested in the aggregate invasive breast cancer rate (T1+). Here we see that after the two year introduction wave of 180% / 150% the detection stabilises for the age band 50-60 at 110% of the situation without screening and for the older ages it goes back to nearly the same level as without screening.

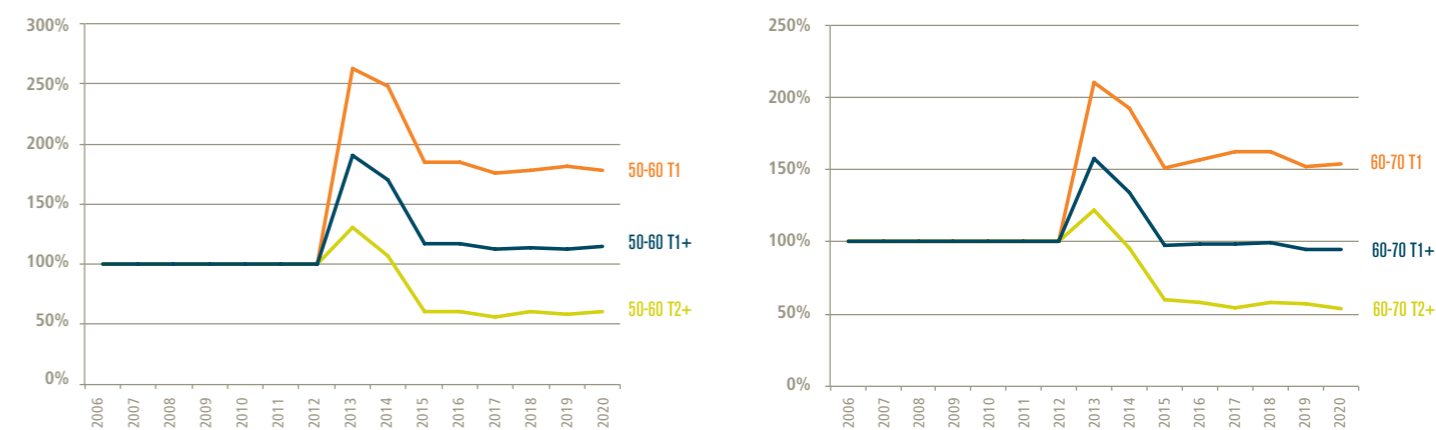


FIGURE 8 Relative increase of tumour detection after screening introduction by size of tumour (invasive only, linear scale)

ABSOLUTE IMPACT OF DIFFERENT SCREENING SCENARIOS

In the next two graphs **FIGURE 9** we show the absolute impact on incidence rates. In this situation it is most interesting to compare the model runs for the "Introduction" scenario (with screening introduction in 2013) with the "Dutch" scenario reflecting the real development of screening and morbidity in the Netherlands.

As in the previous graphs the introduction wave can be seen. In comparison to the situation with longer in force screening the T1 incidence before screening is much lower while T2+ is much higher. As expected after the wave the curves converge to the situation with screening.

In addition the projections show the underlying trend of onset of cancer which can be seen by the steady increase at the periods before and after the screening introduction effect, where no other external effects (screening or other risk factors like smoking behaviour) were changed.

On the next page we combine all invasive tumours and compare all three scenarios "No Screen", "Dutch" and "Introduction" **FIGURE 10**. We see again the introduction wave and after that we see the age band 50-60 showing an increase of invasive incidence rates of 10% and the age band 60-70 stabilising on approximately the same level. This is consistent with the age band comparisons in **FIGURE 6** from the previous chapter.

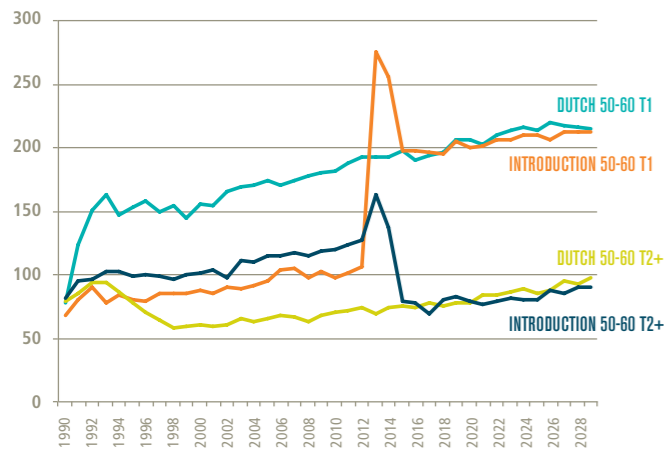
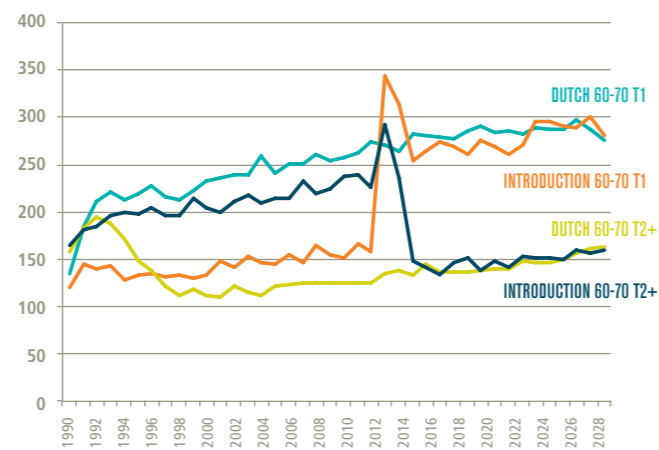


FIGURE 9 Morbidity over time for invasive breast cancer (separated into T1 and T2+) in two scenarios ("Dutch" and "Introduction"), all per 100,000.



Another interesting fact should be pointed out. As mentioned the modelled curve for the scenario "Dutch" was fitted on the actual observed data. Therefore we can also see the end of the actual observed screening wave in the Netherlands during the years 1990 till 1997.

For the DCIS the absolute figures also show the increase during the simulated introduction of a screening program **FIGURE 11**. Please note that the incidence before screening introduction is basically zero, as without screening DCIS is too small and usually without symptoms and is therefore rarely detected other than

by chance. In addition we can see in the graph of the "Dutch" scenario the increase in the 90's where screening was introduced and an additional small wave starting 2010 where digital screening was introduced in the Netherlands.

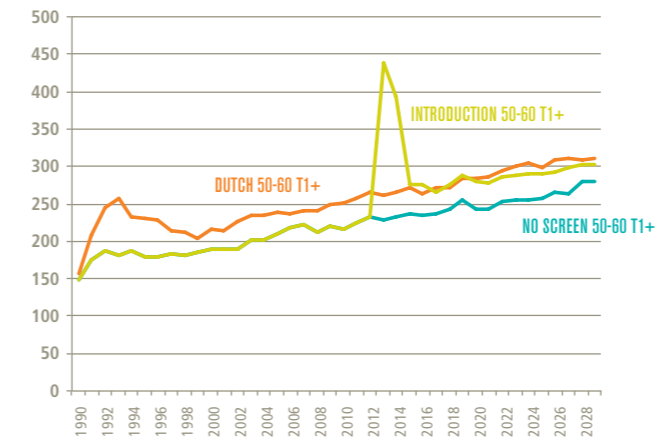


FIGURE 10 Morbidity over time for invasive breast cancer in three scenarios ("No Screen", "Dutch" and "Introduction"), all per 100,000.

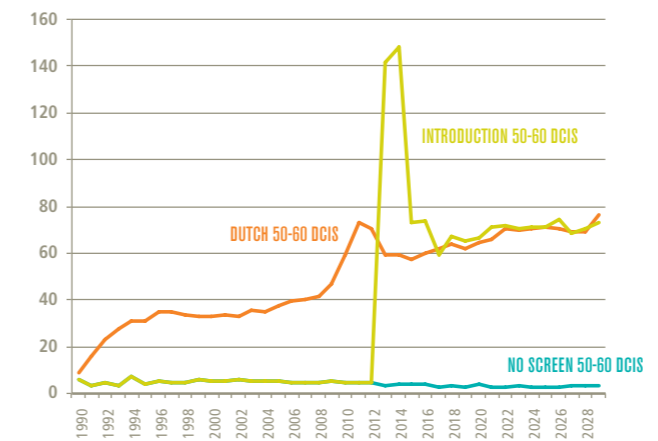
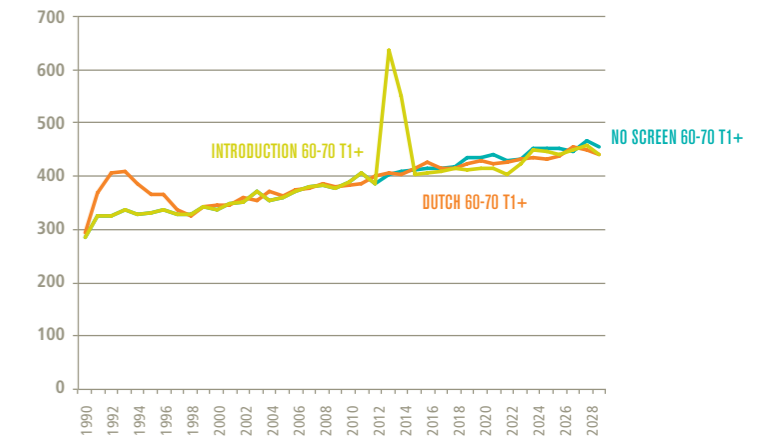


FIGURE 11 Morbidity over time for DCIS breast cancer in three scenarios ("No Screen", "Dutch" and "Introduction"), all per 100,000.

Effect on different sample insurance products

(by Stefan König from SCOR Global Life)

For the insurance industry the demonstration of the impact of screening by age band is usually not enough and we used the MISCAN data to build a model to project a portfolio with age dependent incidences over time, based on the different screening scenarios and on different product designs. For this publication we decided to use only the most interesting model point showing nearly all of the effects, namely the 45 year old women. This age is interesting, because screening programs usually start with age 50 and this gives us the opportunity to place the screening effect and the shock of the screening introduction in the middle of the first observed period of 10 years. The 20 year projection then demonstrates the effect including the improvement in more advanced breast cancer after screening is in place. Three example product designs have been selected and using the example model point and the two durations we have projected results under all three screening scenarios from the previous chapter.

The three product designs used are:

1. A product with single lump sum of 100% of sum insured after an invasive breast cancer. This represents a typical first generation (female) cancer product and also corresponds to the original critical illness cancer definition. ("100% T1+")
2. A product paying the full benefit also for carcinoma in situ of the breast. This would be the widest possible definition for breast cancer cover, if you ignore products with multiple benefits. ("100% DCIS+")
3. A scaled product, paying a different benefit by severity of breast cancer. Illustratively we show a product with 25% payment for DCIS, 100% of the lump sum benefit for T1 breast cancer and double benefit for breast cancer starting from T2. ("25%/100%/200%")

Please note that the third, scaled product is only an illustrative product design to keep the model reasonable simple. Other triggers might be more appropriated to insured interest, for example a carcinoma in situ benefit based on severity of treatment, or a double indemnity based on stage or just for metastatic breast cancer.

On top of the MISCAN scenarios on incidence we also include some basic actuarial assumptions, namely a mortality

of 60% of GBV 2000-2005 [24] (to represent that cancer products usually are only simplified and cancer specific underwritten) and an actuarial interest rate of 1% p.a. to calculate the Present Value (PV) of expected claims. In contrary to normal best practice we did not use lapse or selection/anti-selection discounts/loadings. In the table below **TABLE 1** we present the results, which were used to calculate all further comparisons.

PV CLAIMS OVER 10 YEARS	100% T1+	100% DCIS+	25%/100%/200%
Dutch	26,279	30,590	34,198
No screening	23,017	23,315	35,086
Screening introduced in year five	28,819	34,554	39,820

PV CLAIMS OVER 20 YEARS	100% T1+	100% DCIS+	25%/100%/200%
Dutch	55,892	64,795	74,413
No screening	51,331	51,904	79,305
Screening introduced in year five	58,793	69,631	80,304

TABLE 1 Present Value of claims of one thousand 45 year old women each with 1000 sum insured for 100% benefit.

DIFFERENCE OF PRODUCT DESIGN BY SCREENING SITUATION

Some of the results are not surprising. The two products with a wider cover also have a higher PV claims in each scenario. However the increase is different by product. As DCIS in an environment without screening is usually only detected by chance, the additional cost for the DCIS benefit is barely measurable. On the other hand the additional claims and therefore the additional costs for the scaled product is the highest with an increase in cost of more than 150%, driven by the double benefit of T2+ cancer.

Please note that nowadays also in countries without organised screening women with good health insurance might have other means for getting a (digital) mammography which would produce additional claims not displayed by this model. This should always be kept in mind when adding benefits for early stage cancer.

COMPARISON TO 100% T1	100% DCIS+		25%/100%/200%	
	10 years	20 years	10 years	20 years
Dutch	+16%	+16%	+30%	+33%
No screening	+1%	+1%	+52%	+54%
Screening introduced in year five	+20%	+18%	+38%	+37%

TABLE 2 Relative increase of PV claims compared to the product with 100% benefit for invasive cancer.

DIFFERENCES BY SCREENING SITUATION FOR EACH PRODUCT DESIGN

If we compare the scenario of a situation without screening and the current situation in the Netherlands, we see similar results in the cash flow comparison as by age band. We have seen that the aggregated (invasive) cancer incidences are higher in the situation with screening in the age bands relevant for our model point. Therefore the PV of the product only covering invasive cancer is lower in the situation without screening. The gap widens in the product which offers the full benefit for DCIS also because the additional claims are mostly only detectable by screening.

Only for the scaled product are the PV's reduced, as here the preventative effect of screening on the T2+ breast cancer with the highest benefit shows effect. So the desired effect of earlier detection is also preventing the most expensive claims in the scaled product, compensating for the additional claims at lower severity and lower benefit.

COMPARISON BETWEEN DUTCH SCENARIO AND NO SCREENING SCENARIO					
100% T1		100% DCIS+		25%/100%/200%	
10 years	20 years	10 years	20 years	10 years	20 years
+14%	+9%	+31%	+25%	-3%	-6%

TABLE 3 Relative increase of PV claims in an environment with screening compared to one without.

EFFECT OF SCREENING INTRODUCTION BY PRODUCT DESIGN

To see the effect of screening introduction we compare the scenario with screening introduction with the situation without screening. Not surprisingly the shock has a higher effect on the shorter duration of 10 years and also the biggest effect on the product with 100% DCIS cover. We can see an increase of nearly 50% in this product, which could be translated to an ultimate loss ratio of nearly 150% of the full underwriting year. The smallest shock can be seen on the scaled product.

Assuming the actuary used a similar best estimate trend assumption as in our simulations the loss ratio would be only 113% on the short duration and on the long duration the original price would be nearly sufficient, as at the longer duration the positive effects of screening on higher severity takes effect.

If we look back to all comparisons this means that while the scaled product (with this design including 200% benefits) is in general more expensive than a "first generation" invasive breast cancer product it is also the product that is the most stable and the least sensitive product to the introduction or change of screening programs. It is also the only one benefiting from the intended positive effects of screening to reduce advanced breast cancer, at least at the ages relevant for the cash flow of our model point.

EFFECT OF SCREENING INTRODUCTION					
100% T1		100% DCIS+		25%/100%/200%	
10 years	20 years	10 years	20 years	10 years	20 years
+25%	+15%	+48%	+34%	+13%	+1%

TABLE 4 Relative increase of PV claims if screening is introduced.

The Research & Development Centre for Disability and Critical Illness is one of the actuarial R&D centres of SCOR Global Life. Created in 2007, the Centre is dedicated to the international analysis of disability and critical illness risks and reinsurance solutions.

Disability and critical illness coverage needs to be tailored to a given country's social welfare system, demographical trends, medical technical changes and private insurance market. The Centre conducts research in order to assess the major trends affecting risk in each country and offers personalised advice on products and portfolios.

CONCLUSION AND OUTLOOK

It was demonstrated that the development of cancer incidences and the effect on the insurance products not only depends on the observed underlying trend but also on external factors like organized screening programs. The latter not only has an effect on number of breast cancer cases, but also on the distribution between stages of breast cancer. The results from the model showed that more cancers will be found at earlier stages and at younger ages in an environment with organised screening. Conversely more severe cases especially at older ages are reduced. We have also shown how the introduction of screening would change the pattern of cancer detection by severity over time and the shock this might have on incidences. Also the effect on different insurance products was demonstrated and we have shown that scaled products might be (depending on exact design) more expensive than first generation cancer or CI products but also more stable regarding changes in screening developments.

While the insurable interest is still a major driving factor behind product development the effect of screening and possible introduction or improvement of screening needs to be taken into account and the models developed can help in fine-tuning the expected effect on cash flows and cost of capital. The models can help to develop products less sensitive to trend and shock scenarios with a more stable price which also benefits the insured. In addition the better understanding of the possible developments helps in reducing the risk for the insurance industry and therefore can help reduce security margins which again will make products more affordable to the insured. This results can also help us to understand situations in other countries better and the models used in producing this paper can be adopted to markets all over the world.

We will continue investigating this and the Department of Public Health of the Erasmus MC and SCOR Global Life have already agreed to extend the cooperation to a target market in Asia.

- [1] World Health Organisation. Cancer Fact sheet. 2013 Jan; [Online] <http://www.who.int/mediacentre/factsheets/fs297/en/index.html> (visited on 12/25/2013).
- [2] Stewart BW, Wild CP, eds (2014). World Cancer Report 2014. Lyon, France: International Agency for Research on Cancer. 2014. ISBN 978-92-832-0432-9; p. 516
- [3] Institute and Faculty of Actuaries (IFoA). CMI Working Paper 52 : Cause-specific CMI critical illness diagnosis rates for accelerated business, 2003-2006. 2011 Jun; <http://www.actuaries.org.uk/research-and-resources/pages/cmi-working-paper-52> ISSN 2044-3145
- [4] Stewart BW, Wild CP, eds (2014). World Cancer Report 2014. Lyon, France: International Agency for Research on Cancer. ISBN 978-92-832-0432-9; p. 15
- [5] Office of National Statistics. Breast cancer incidence, mortality and survival, England, 1971–2011 (Part of Cancer Statistics Registrations, England (Series MB1) , No. 42, 2011 Release) [Online] <http://www.ons.gov.uk/ons/rel/vsob1/cancer-statistics-registrations--england--series-mb1--no--42--2011/sty-breast-cancer-survival.html> (visited on 12/15/2014).
- [6] Canadian Partnership Against Cancer. Organized Breast Cancer Screening Programs in Canada: Report on Program Performance in 2007 and 2008. Toronto: Canadian Partnership Against Cancer; 2013 Feb.
- [7] Moutel et al.: Women's participation in breast cancer screening in France – an ethical approach. BMC Medical Ethics 2014 15:64. doi:10.1186/1472-6939-15-64
- [8] NETB. National evaluation of breast cancer screening in the Netherlands 1990-2007. Twelfth evaluation report.; 2009.
- [9] NETB. Interim report 2011. Main results 2008-2009 breast cancer screening programme in the Netherlands. Report. Rotterdam/ Nijmegen: Erasmus MC/ UMC St Radboud; 2011.
- [10] de Gelder R, Bulliard JL, de Wolf C, Fracheboud J, Draisma G, Schopper D, et al. Cost-effectiveness of opportunistic versus organised mammography screening in Switzerland. Eur J Cancer. 2009 Jan;45(1):127-38.
- [11] de Gelder R, Fracheboud J, Heijnsdijk EA, den Heeten G, Verbeek AL, Broeders MJ, et al. Digital mammography screening: Weighing reduced mortality against increased overdiagnosis. Prev Med. 2011 Jun 21.
- [12] de Gelder R, Heijnsdijk EA, van Ravesteyn NT, Fracheboud J, Draisma G, de Koning HJ. Interpreting overdiagnosis estimates in population-based mammography screening. Epidemiol Rev. 2011 Jul;33(1):111-21.
- [13] Sorum R, Hofvind S, Skaane P, Haldorsen T. Trends in incidence of ductal carcinoma in situ: the effect of a population-based screening programme. Breast. 2010 Dec;19(6):499-505.
- [14] Yen MF, Tabar L, Vitak B, Smith RA, Chen HH, Duffy SW. Quantifying the potential problem of overdiagnosis of ductal carcinoma in situ in breast cancer screening. Eur J Cancer. 2003 Aug;39(12):1746-54.
- [15] Kessar P, Perry N, Vinnicombe SJ, Hussain HK, Carpenter R, Wells CA. How significant is detection of ductal carcinoma in situ in a breast screening programme? Clin Radiol. 2002 Sep;57(9):807-14.
- [16] Jorgensen KJ, Gotzsche PC. Overdiagnosis in publicly organised mammography screening programmes: systematic review of incidence trends. BMJ. 2009;339:b2587.
- [17] Duffy SW, Agbaje O, Tabar L, Vitak B, Bjurstam N, Bjorneld L, et al. Overdiagnosis and overtreatment of breast cancer: estimates of overdiagnosis from two trials of mammographic screening for breast cancer. Breast Cancer Res. 2005;7(6):258-65.
- [18] Zackrisson S, Andersson I, Janzon L, Manjer J, Garne JP. Rate of over-diagnosis of breast cancer 15 years after end of Malmö mammographic screening trial: follow-up study. BMJ. 2006 Mar 25;332(7543):689-92.
- [19] Morrell S, Barratt A, Irwig L, Howard K, Biesheuvel C, Armstrong B. Estimates of overdiagnosis of invasive breast cancer associated with screening mammography. Cancer Causes Control. 2010 Feb;21(2):275-82.
- [20] Biesheuvel C, Barratt A, Howard K, Houssami N, Irwig L. Effects of study methods and biases on estimates of invasive breast cancer overdiagnosis with mammography screening: a systematic review. Lancet Oncol. 2007 Dec;8(12):1129-38.
- [21] de Koning HJ, Draisma G, Fracheboud J, de Bruijn A. Overdiagnosis and overtreatment of breast cancer: microsimulation modelling estimates based on observed screen and clinical data. Breast Cancer Res. 2006;8(1):202.
- [22] Casparie M, Tiebosch AT, Burger G, Blauwgeers H, van de Pol A, van Krieken JH, et al. Pathology databanking and biobanking in The Netherlands, a central role for PALGA, the nationwide histopathology and cytopathology data network and archive. Cell Oncol. 2007;29(1):19-24.
- [23] Tsikitis VL, Chung MA. Biology of ductal carcinoma in situ classification based on biologic potential. Am J Clin Oncol. 2006 Jun;29(3):305-10.
- [24] Dutch Actuarial Association (Actuarieel Genootschap). Sterftequotienten Gehele Bevolking Vrouwen (GBV) 2000-2005, in AG report 'Over sterfte en Overleven'. 2007 Apr. ISBN 978-90-804-1774-8

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