**Cost-effectiveness of Breast Cancer Screening Programme for Women in Rural China**

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Keywords: cost-effectiveness, breast cancer, screening, rural, China

Abbreviation: ductal carcinoma in situ, DCIS; gross domestic product, GDP; incremental cost-effectiveness ratio, ICER; quality-adjusted life year, QALY.

Article category: cancer therapy and prevention

Novelty and Impact: Our study analysed the cost-effectiveness of breast cancer screening programme in rural China with clinical breast examination coupled with ultrasound as the primary tool. With reduction in health-related quality of life from false-positives considered, breast cancer screening does harm to health. Priority should be given to ensure that symptomatic women have proper access to diagnosis and treatment at an early stage which leads to mortality reductions but without the usual harms associated with screening. [[1]](#footnote-1)

# ABSTRACT

In low and middle-income countries mammographic breast cancer screening is prohibitively expensive and a cheaper alternative option is to use ultrasound as the primary screening test. In 2009, China launched a breast cancer screening programme for rural women aged 35-64 years with clinical breast examination coupled with ultrasound as the primary tool. This study aimed to analyse the cost-effectiveness of breast screening compared with no screening among Chinese rural women.We developed a Markov model to estimate the lifetime costs and effects for rural women aged 35 years from a societal perspective. Asymptomatic women in the intervention arm were screened every three years before age 64 years. Breast cancer in the non-screening arm can only be diagnosed on presentation of symptoms. Parameter uncertainty was explored using one-way and probabilistic sensitivity analyses. Compared to no screening, breast cancer screening cost $186.7 more and led to a loss of 0.20 quality-adjusted life years (QALYs). Breast screening was more expensive and did harm to health among rural women with an incremental cost-effectiveness ratio (ICER) of $-916/QALY. The sensitivity analysis identified utility loss from false positives as the factor that most influenced the results, but this did not affect the conclusions. In a rural setting with such low incidence, screening for asymptomatic disease is not cost-effective with current screening tools. Priority should be given to ensure that symptomatic women have proper access to diagnosis and treatment at an early stage as this will lead to mortality reductions without the usual screening harms.

# INTRODUCTION

Breast cancer is the most common cancer among women worldwide. Globally, 1.67 million new cases of breast cancer were diagnosed in 2012, contributing more than 25% of female cancer incident cases 1. Breast cancer is potentially a curable disease if diagnosed and treated early. In the US, as in other high-income countries, patients diagnosed at an early stage (Stage I/II) have a better prognosis (5-year survival rate of 85%-98%). In contrast, cases diagnosed with advanced breast cancer (Stage III/IV) have a poor 5-year survival rate of 30%-70% 2. But breast cancer disparities have been observed between urban and rural regions. Whilst the incidence of breast cancer is lower among women residing in rural areas, mortality from the disease is higher due to poorer survival 3. The poorer survival among rural women is mainly related to the rural disadvantage in access to screening, diagnosis and treatment 3. A systematic review of 41 studies reported that rural women were more likely to mention difficulties in breast cancer health service access such as a greater distance to breast cancer specialists 4. Some women tend to seek medical services only when experiencing acute illness or pain, leading to delay in diagnosis and poorer prognosis among rural patients. Late diagnosis of breast cancer also contributes to higher care costs due to the need for more intensive and expensive treatments 5.

In China, breast cancer is the most frequently diagnosed cancer and the fifth leading cause of cancer-related deaths 6. Marked urban-rural differences in breast cancer stage at diagnosis 7 and survival have been reported 8, with rural women being diagnosed at an advanced stage and thus having poorer five-year survival (51.9%–60.3%) than their urban counterparts (75.7%–79.9%) 8. Therefore, the priority for breast cancer control activities in rural China is to develop strategies to ensure that women with breast cancer are diagnosed and treated early.

The Chinese government launched a breast cancer screening programme based on clinical breast examination coupled with ultrasound as the primary screening tool for rural women aged 35-64 years in 31 provinces 9. However, the impact of this programme is still unknown and the cost-effectiveness evidence is lacking. The low incidence in rural areas may challenge the utility and cost-effectiveness of screening programmes in such settings. To date there is only very limited evidence from rural Iran and Egypt on the cost-effectiveness of breast cancer screening among rural populations in low and middle-income countries 10, 11. However, China is unique in that it is the only country to recommend ultrasound, as opposed to mammography, coupled with clinical breast examination as the primary screening test. Ultrasound permits the detection of small, otherwise occult, breast cancers in women with dense breasts 12. Ultrasound may be cheaper and logistically more viable in rural areas but its accuracy is highly dependent on the level of training and performance of the operator. Furthermore, there is no evidence that screening average-risk women with clinical breast examination or ultrasound leads to a reduction in breast cancer mortality 13.

In this study, we aimed to compare for the first time the lifetime effects, costs, and cost-effectiveness of breast cancer screening using clinical breast examination coupled with ultrasound as a primary screening test compared with no screening in rural China. We used the current policy of screening rural women aged 35-64 years in order to provide the economic evidence to policy-makers.

# METHODS

## Screening strategy

We compared the current strategy of the rural breast cancer screening programme with no screening. In the screening group, the Breast Imaging Reporting and Data System (BI-RADS) 14 was employed to report breast cancer screening results where BI-RADS I and II indicate negative results, BI-RADS III suspicious results, BI-RADS IV and V positive results, and BI-RADS 0 insufficient information. Participants in the screening programme undergo a clinical breast examination and ultrasound. Those women found to have a positive result are further tested by biopsy for diagnostic confirmation whereas those with a suspicious result, or with insufficient information, undergo mammography. If the mammography result is positive a biopsy is performed for diagnostic confirmation. If the mammography result is suspicious or provides insufficient information, doctors will use their clinical judgment to decide whether a biopsy is required to reach a final conclusion 9. The screening flow is shown in Figure 1.

In the non-screening arm, breast cancer patients can only be diagnosed on presentation of symptoms. Breast cancer patients in the screening arm can be diagnosed while they are still asymptomatic, thus at an earlier stage of the disease when prognosis is better. We assumed all breast cancer patients diagnosed by biopsy received treatment.

***Modelling strategy***

We developed a natural history Markov model for breast cancer screening in Chinese women 15 using the TreeAge software (TreeAge software Inc. Williamstown, United States of America), to inform a long-term decision model. Our model predicted the lifetime costs and quality-adjusted life years (QALYs) of screening and no screening for Chinese rural women with no previous history of breast cancer, from 35 years to death. We used a triennial screening frequency (once every three years) in the baseline analysis, and we explored the scenarios of screening every year and every five years.

## Natural history

Figure 2 illustrates the various health states and the potential transitions between them 15. Healthy women can transition to ductal carcinoma in situ (DCIS), stage I, or remain cancer-free. Women with DCIS are at a higher risk of developing invasive breast cancer (relative risk=2.02) 2. Patients at stage I can progress to stage II, stage III and stage IV in turn. All women can die from non-breast cancer causes during disease progression but only patients at stage IV can die from breast cancer. The state progression transition probabilities used in this analysis are from models described in the literature 16-18.

We estimated the probability of symptoms in an unscreened population by calibrating the model. In the non-screening arm, incident cases are only detected on presentation of symptoms; the distribution of incidence cases by stage is therefore a function of the probability of transitions and the probability of symptoms 19. We adjusted the probability of symptoms until the distribution of cases presented at each stage was similar to the distribution of reported incidence cases 17. Our estimates of transition probabilities are provided in Table 1.

## Epidemiological and clinical data

Estimates of the age-specific invasive breast cancer incidence in rural areas were extracted from the 2012 Chinese Cancer Registry Annual Report 6. DCIS incidence was not directly reported in China so we estimated the DCIS incidence based on the ratio of invasive and non-invasive breast cancer cases among 3,838 unselected Chinese breast cancer patients in a hospital setting 20. Age-specific non-breast cancer mortality figures (i.e. excluding mortality from breast cancer) in rural areas were calculated by subtracting age-specific breast cancer mortality rates 21 from the corresponding age-specific all-cause mortality rates 22.

Breast cancer incidence among Chinese women is increasing twice as fast as the global (worldwide) rate 23 but the most recent year for which data for rural areas are available is 2012. However, the incidence of this cancer in Hong Kong, and its time trends, have been shown to be similar to those for the whole of China 23. Therefore, we took the breast cancer incidence rates in Hong Kong for the year 2015 24 as a proxy for the future incidence of this cancer in rural China, and used these rates to assess the likely impact of foreseeable trends in breast cancer incidence on the robustness of the conclusions.

## Effectiveness of screening

At baseline we used the sensitivity (probability of positive diagnosis if diseased) and specificity (probability of negative diagnosis if not disease) values from 26,224 Chinese women participating in the rural breast cancer screening programme 25. The screening modality in this study was the same as the measure required for the input to our model. The biopsy test was performed for diagnostic confirmation of breast cancer. Due to limited evidence on the performance of the screening programme in rural China, we explored a 30% reduction in the screening sensitivity and specificity as the lower values in the one-way sensitivity analysis.

## Quality-adjusted life years (QALYs)

QALYs are recommended by China Guidelines for Pharmacoeconomic Evaluations 26 as the most suitable summary measure for economic evaluation of health outcomes. They adjust changes in length of life by potential alterations in quality of life, and thus reflect both mortality and health-related quality-of-life effects. QALYs equal time spent in the relevant health states multiplied by an appropriate utility score. We identified the utility scores for patients at stage I, II, III, and IV from a cross-sectional survey in which EuroQol five-dimension (EQ5D) questionnaires were used to evaluate the quality of life of breast cancer patients in 13 Chinese provinces 27. In addition, women with false-positive results experience important psychological distress 28. We estimated 25% disutility from false positives at baseline 29, 30 and explored the uncertainty by varying the utility decrement from 11% to 34% in the sensitivity analyses 29. A scenario analysis of no utility loss from false positives was also considered.

## Costs

We obtained the screening costs from the cost accounting of the rural breast cancer screening programme, including the costs of clinical breast examination ($1.4), ultrasound ($19.9), mammography ($57.0) and biopsy ($45.6) 9. The average screening cost in the rural breast cancer screening programme is reported to be $22.7 per capita 9.

We derived the direct medical costs and non-medical costs by stage from a study which enrolled 2,746 patients with invasive breast cancer from 37 hospitals across 13 provinces in China 5. We used the productivity loss days and the net income per capita of Chinese rural residents ($7.7 per day) to calculate the indirect costs. As the treatment costs of DCIS patients were not reported in the nationwide study 5, we estimated the DCIS costs from a study of 211 patients treated in the Sichuan Cancer Hospital 31. We used purchasing power parity (PPP) to convert cost values to US dollars 32. All costs in this analysis are presented at 2014 values.

## Analysis

In line with China Guidelines for Pharmacoeconomic Evaluations 26, we conducted the analysis from a societal perspective (2011), and discounted future costs and future benefits at 3%. We calculated the incremental cost-effectiveness ratios (ICER) by dividing the difference in lifetime costs by the difference in lifetime effects. The willingness-to-pay threshold was estimated to be three times the gross domestic product (GDP) per capita in China in 2014 (US$ 7683) 33. An incremental cost-effectiveness ratio of less than US$ 23 050/QALY is therefore an indication that the breast cancer screening for rural Chinese women aged 35-64 years, compared with no screening, is cost–effective.

We carried out one-way and probabilistic sensitivity analyses to explore parameter uncertainty. In the one-way sensitivity analysis, we varied the effectiveness of screening, utility parameters and cost values between the minimum and maximum estimates to assess the impact on overall results. In the probabilistic sensitivity analysis, costs were specified as having a Gamma distribution, quality of life as having a Log-normal distribution, and sensitivity and specificity of screening as having a Beta distribution – as suggested in the literature 34. All the input variables were varied simultaneously and we could obtain 1,000 estimates of incremental costs and effects by sampling from the distributions. Then a cost-effectiveness acceptability curve was plotted to show the probability of breast cancer screening being cost-effective at different willingness to pay thresholds.

Other scenarios explored included: (i) the impact of screening every year or every five years compared with no screening; (ii) screening every three years, but only 70% compliance rate of screening; (iii) age-specific breast cancer incidence in 2015 from Hong Kong; and (iv) no utility loss from false positives.

# RESULTS

Our model estimated 20 incident breast cancer cases per 1,000 women over a lifetime, with 13 detected via screening and the remaining seven on presentation with symptoms. Table 2 reports the discounted lifetime costs, QALYs and ICERs. Overall, breast cancer screening gained 0.04 life years for women attending the screening programme in the lifetime horizon, but it was more expensive ($186.7) and yielded lower QALYs (-0.20) than no screening. Breast cancer screening with clinical breast examination and ultrasound combined as the primary screening tool lowers breast cancer mortality but does harm to health among Chinese rural women and is dominated by no screening.

The one-way sensitivity analysis results (Figure 3) indicates that the most influential factor on the results was the reduction in quality of life from false positives; however, its variability did not change the conclusion that breast cancer screening is not cost-effective. The ICERs are negative (incremental costs>0; incremental effects<0) at both upper and lower limits of these variables. Probabilistic sensitivity analysis (Figure 4) shows that all simulation points fall within the north-west quadrant, indicating breast cancer screening led to higher costs and lower QALYs. The cost-effectiveness acceptability curve shows that at the threshold of US$ 23 050/QALY, the probability of breast screening doing more harm than good for Chinese rural women is 100% (Appendix 1).

In the scenario analysis (Table 2), screening every year and every 5 years achieves an ICER of US$ -704/QALY and US$ -996/QALY. A scenario of annual screening but only 70% compliance rate yields an ICER of US$ -956/QALY. If we parameterise the model using the 2015 Hong Kong data, breast screening still costs more ($257.8) and yields lower QALYs (-0.12) than no screening. In these scenarios, breast cancer screening does harm to health of Chinese rural women participating in the programme. If we were to assume no disutility from false-positive screening results, breast cancer screening in rural China would achieve an ICER of US$5,078/QALY.

# DISCUSSION

Our baseline results indicate that rural breast cancer screening in China, which is based on clinical breast examination and ultrasound as the primary tool, leads to higher costs and poorer health with a discounted ICER of $-916/QALY, thus dominated by no screening. Comparing these results to those from earlier studies, we found that whilst the economic evidence on ultrasound screening is lacking in low and middle-income countries, some studies evaluating clinical breast examination as the primary screening tool showed that it was cost-effective relative to mammographic screening in India 35 and Ghana 36, or to no screening in Vietnam 37 and Costa Rica 38. The apparent discrepancies in the conclusions between our study and the earlier studies are mainly due to the differences in quality of life decrements from false positives. If we were to assume that false-positive screening results do not affect a woman’s quality of life then breast cancer screening in rural China would achieve an ICER of US$5,078/QALY, well below the threshold of $23,050/QALY – consistent with previous cost-effectiveness studies. None of the earlier cost-effectiveness studies considered disutility from false-positives, but we used a loss of 11%-34% in health-related quality of life at baseline based on a systematic review 29. With reduction in quality of life associated with a diagnosis of breast cancer considered, even in the UK there is uncertainty about cost-effectiveness of breast cancer screening 39.

Our finding is consistent with a recent review which shows that even in a high incidence country mammographic screening is associated with considerable harm 40. Carcinoma in situ is very likely to be detected by mammographic screening, but more than half of the cases will not progress to be invasive cancer 41. Also, some tumours identified by mammography may be slow-growing that would never have been clinically apparent before a woman dies from another cause 42. Some have argued that the harm may be even higher with ultrasound screening as this modality is associated with higher false-positive rates and hence higher levels of unnecessary anxiety, biopsy tests and treatments 43. Furthermore, the accuracy of ultrasound screening may be compromised by the fact that it is labour-intensive and very operator-dependent. Health care workers report a lack of confidence in their clinical breast examination skills highlighting the need for proper training and practical recommendations to ensure screening performance is optimised 44.

In addition to the loss in quality of life from false-positive results, the low incidence in rural China may also decrease the utility and cost-effectiveness of the breast cancer screening programme. The incidence rate of breast cancer in China’s rural areas is significantly lower than that in urban areas (17.0 vs 34.3 per 100,000 person-years in 2009) 6, thus leading to a lower detection rate of screening. We investigated the impact of future increases in breast cancer incidence in rural China in the scenario analysis, but this did not affect the conclusion that the breast cancer screening programme in rural China was more expensive and less effective. Furthermore, the strategy of screening with clinical breast examination and ultrasound at the first stage may not be suitable for Chinese women residing in rural areas. Although clinical breast examination has been used in low resource settings, there is no evidence so far that it will lead to reductions in breast cancer mortality 45. Also, whilst ultrasound may be better at detecting small invasive breast cancers in women with dense breasts 12, it is usually recommended as an adjunct to mammography screening among women at higher risk for breast cancer rather than as a primary screening method for women at average risk 46-49.

In rural China, priority should be given to downstaging by ensuring symptomatic women have proper access to diagnosis and treatment at an early stage, as this will lead to reductions in mortality from the disease without the usual harms associated with screening. In China, breast cancer has become one of the leading causes of catastrophic medical expenses and can rapidly impoverish families 23. This is of particular relevance in rural areas where the disease is diagnosed at a later stage 7 and thus survival is poorer (5-year survival rates: 55.9 (51.9–60.3) in rural areas versus 77.8 (75.7–79.9) in urban areas 8). More cost-effective approaches should be implemented to reduce delays in diagnosis and treatment and thus improve the prognosis of breast cancer among rural Chinese women. Downstaging is likely to be more cost-effective than screening in rural China because the resources will be concentrated on women with breast symptoms instead of the general population. Also, in order to cope with a large number of screen-detected suspicious lesions, a cancer care system must be well-organized enough and able to deal appropriately with symptomatic disease 50. Hence, developing culturally-sensitive and cost-effective strategies to promote early diagnosis and treatment of clinically detectable women, rather than screening asymptomatic women, should be regarded as a priority.

Our study is limited by the lack of data on treatment costs for rural patients with breast cancer. The rural residents in China with severe diseases tend to seek the secondary or tertiary level of medical treatment in urban hospitals 51. Since they usually need to travel further to reach the hospitals, the direct non-medical costs including transport costs might be underestimated in the study. In addition, the rural-urban differences have been observed in the choice of neo-adjuvant chemotherapy and surgical procedures 52. Rural patients with breast cancer also tend to have worse adherence to adjuvant treatment, which is strongly associated with recurrence 53. These factors could result in differences in the direct medical costs between urban and rural patients. Although our sensitivity analysis proves that the results are quite robust when the costs are varied up and down by 30%, the impact of cost variations on the overall results could be further explored if more evidence on the treatment costs of rural patients is available. Another limitation of this study is the assumption of progression rates between stages and the relative risk of invasive cancer from ductal carcinoma in situ. We used the estimated data from other countries and assumed the parameters were applicable to China. These factors require careful consideration. In addition, due to a limited number of studies on false-positives, there is still uncertainty about the utility loss from false-positive screening results. In this analysis, we used the estimate from the UK studies at baseline which might bias the cost-effectiveness results of the screening programme in China. Ideally, individual women should be allowed to specify their own utility loss associated with a false-positive screening result as risk averseness would conceivably be highly personalized. Further research is required to reduce uncertainty.

This is a modelling study based on the natural history of breast cancer. However, the biology of breast cancer may be heterogeneous. Some tumours are detected late because they are aggressive and fast-growing. Others may spread before screen-detection is possible, in which case early detection may not improve disease prognosis. There is so far no evidence on the benefits of breast ultrasound screening 13. Similarly, data from two large randomised clinical trials (RCTs) do not suggest a beneficial effect of screening by breast examination 45. Ideally, RCTs should be conducted to evaluate the benefits and harms of the breast cancer screening programme in rural China, and their time horizon should be long enough to capture differences in long-term health outcomes including breast cancer mortality - the ultimate outcome of interest. To our knowledge no such RCTs have been conducted or are on-going in rural China. Therefore, in the absence of evidence from RCTs, we have adopted a Markov natural history model in this study to evaluate the cost-effectiveness of the breast cancer screening programme in rural China.

In conclusion, our finding shows that in a rural setting with such low breast cancer incidence, screening for asymptomatic disease is not cost-effective with the current screening tools. Instead, priority should be given to ensure that symptomatic women are diagnosed and treated appropriately at an early stage as this will lead to reductions in mortality from the disease without the usual harms associated with screening.

# DECLARATION OF INTERESTS

The authors declare that there is no conflict of interest.

**FUNDING**

This study has been funded by National Natural Science Foundation of China (71273016 and 71673004).

# ACKNOWLEDGEMENTS

We thank the China Medical Board for providing a scholarship for Li Sun’s Ph.D. research work at London School of Hygiene & Tropical Medicine. The content is solely the responsibility of the authors and does not necessarily represent the official views of the China Medical Board.

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# FIGURE CAPTIONS

**Fig.1** Screening flow in the breast cancer programme in rural China

**Fig.2** The Markov model for breast cancer progression

**Fig.3** Tornado diagram

**Fig.4** Incremental discounted lifetime costs and effects of rural screening compared with no screening

**Table 1: Parameter values in the Markov model**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Variables** | **Baseline** | **Minimum** | **Maximum** | **Distribution** | **Reference** |
| **Transition probabilities** |  |  |  |  |  |
| Age-specific incidence in rural areas |
| 35-39 | 0.0002306 | - | - | - | Chinese Cancer Registry |
| 40-44  | 0.0003645 | - | - | - | Annual Report 6 |
| 45-49  | 0.0004659 | - | - | - |  |
| 50-54  | 0.0006039 | - | - | - |  |
| 55-59  | 0.0005969 | - | - | - |  |
| 60-64  | 0.0005292 | - | - | - |  |
| 65-69  | 0.0003608 | - | - | - |  |
| 70-74  | 0.0003277 | - | - | - |  |
| 75-79  | 0.0003248 | - | - | - |  |
| 80-84  | 0.0002748 | - | - | - |  |
| 85+  | 0.0001620 | - | - | - |  |
| Ratio of DCIS incidence compared to invasive breast cancer incidence |  |
|  | 0.12 | - | - | - | Lu et al., 2011 20 |
| Relative risk of invasive cancer in DICS |  |  |  |
|  | 2.02 | - | - | - | SEER Program, 2002 2 |
| Progression rate |  |  |  |  |  |
| Stage I–Stage II | 0.06 | - | - | - | C.P.Tsokos, 1987 18 |
| Stage II-Stage III | 0.11 | - | - | - |  |
| Stage III-Stage IV | 0.15 | - | - | - |  |
| Stage IV-death | 0.23 | - | - | - | Wong et al., 2007 16 |
| Stage-specific probability of symptoms |  |  |  |  |
| Stage I | 0.004 | - | - | - | Model Calibration |
| Stage II | 0.014 | - | - | - |  |
| Stage III | 0.380 | - | - | - |  |
| Stage IV | 0.980 | - | - | - |  |
| Annual fatality rate after treatment |  |  |  |
| Stage I | 0.006 | - | - | - | Ginsberg et al., 2012 17 |
| Stage II | 0.042 | - | - | - |  |
| Stage III | 0.093 | - | - | - |  |
| Stage IV | 0.275 | - | - | - |  |
| **Effectiveness of screening** |  |  |  |  |
| Sensitivity | 0.833 | 0.583 | 0.936 | β | Chu, 2014 25 |
| Specificity | 0.857 | 0.600 | 0.913 | β |  |
| **Utility scores** |  |  |  |  |  |
| Stage I | 0.79 | 0.77 | 0.80 | Log-normal | Shi et al., 2016 27 |
| Stage II | 0.79  | 0.78 | 0.80 | Log-normal |  |
| Stage III | 0.77  | 0.76 | 0.79 | Log-normal |  |
| Stage IV | 0.69 | 0.65 | 0.72 | Log-normal |  |
| Disutility – false positives  | 0.25  | 0.11 | 0.34 | Log-normal | Peasgood et al., 2010 29 |
| **Costs** |  |  |  |  |  |
| Screening costs | 22.7 | 15.9 | 29.5 | γ | Cost accounting 9 |
| Treatment costs |  |  |  |  |  |
| DCIS | 2189 | 1532 | 2845 | γ | Li et al., 2013 31 |
| Stage I | 9219 | 6453 | 11984 | γ | Liao et al., 2017 5 |
| Stage II | 10118 | 7083 | 13153 | γ |  |
| Stage III | 11895 | 8326 | 15463 | γ |  |
| Stage IV | 16156 | 11309 | 21003 | γ |  |

**Table 2: Lifetime costs, QALYs, and incremental cost-effectiveness ratios**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Lifetime costs per case (US$) | Life years | QALY | Incremental comparisons |
|  | costs | Life years | QALY | ICER ($/QALY)(95% CI) |
| **Baseline analysis** |  |  |  |  |  |  |
| No screening | 43.3 | 23.75 | 23.71 | - | - | - | - |
| Screening every 3 years | 230.0 | 23.79 | 23.51 | 186.7 | 0.04 | -0.20 | -916 (-1651, -562) |
| **Scenario analysis** |  |  |  |  |  |  |
| Screening every year | 525.7 | 23.80 | 23.03 | 482.4 | 0.05 | -0.68 | -704 (-1644, -345) |
| Screening every 5 years | 167.1 | 23.78 | 23.59 | 123.8 | 0.03 | -0.12 | -996 (-2950, -461) |
| Screening every 3 years, 70% compliance rate  | 180.4 | 23.78 | 23.57 | 137.1 | 0.03 | -0.14 | -956 (-2783, -435) |
| Breast cancer incidence in 2015 from Hong Kong  | 401.7 | 23.86 | 23.47 | 257.8 | 0.14 | -0.12 | - 2111 (-19020, -633) |
| No utility loss from false positives | 230.0 | 23.79 | 23.75 | 186.7 | 0.05 | 0.04 | 5078 (3845, 6534) |

CI: confidence interval; ICER: incremental cost-effectiveness ratio; QALY: quality-adjusted life year; US$ United States dollars.

a Discounted at 3%.

Note: some inconsistency arose in some values due to rounding.

# APPENDIX

Appendix 1 Cost-effectiveness acceptability curve



1. This study has been funded by National Natural Science Foundation of China (71273016 and 71673004). The authors declare that there is no conflict of interest. [↑](#footnote-ref-1)