INTERNATIONAL CANCER SCREENING CONFERENCE

June 3-5, 2019 | Rotterdam | The Netherlands

ICSN

Screening in balance

ABSTRACT BOOK

Erasmus MC University Medical Center Rotterdam Public Health

NIH NATIONAL CANCER INSTITUTE

ACADEMIC CENTER SCREENING&PREVENTION

Center for Global Health

Novel strategies in screening & BIG DATA

26 - Poster Presentation

Early Health Technology Assessment of Digital Breast Tomosynthesis in a National Breast Cancer Screening program

J Wang[1], Phi[1], Greuter[1], Daszczuk[1], Feenstra[1], Pijnappel[2], Vermeulen[1], Buls[3], Houssami[4], Lu[5], De Bock[1]
[1]Univerisity medical center Groningen, GRONINGEN, The Netherlands
[2]University Medical Center Utrecht, UTRECHT, The Netherlands
[3]Vrije Universiteit Brussel, Universitair Ziekenhuis Brussel, BRUSSEL, Belgium
[4]Sydney School of Public Health, Faculty of Medicine and Health, University of Sy, SYDNEY, Australia
[5]Tianjin Medical University, TIANJIN, China

Introduction
Because of the increased sensitivity of digital breast tomosynthesis (DBT) compared to digital mammography (DM), we aimed to evaluate whether DBT could be a cost-effective alternative technology in a population breast cancer screening program.
Materials and Methods
A validated micro-simulation model (SiMRiSc) was used to assess the cost-effectiveness of biennial screening with DBT for women aged 50-75. Three scenarios were simulated: DBT for women with dense breasts only (scenario 1), DBT for the whole population (scenario 2), or maintaining DM screening (reference). The sensitivity of DBT varied between 65% and 100% and the discounted incremental cost-effectiveness ratio (ICER) was compared to a threshold of €20 000 per life year gained (LYG). Discounting was applied according to international guidelines.
Results
Compared with the reference DM screening, scenario 1 yielded 1.0%-7.4% more screen-detected cancers and 1.1%-9.2% more LYGs when the sensitivity of DBT was >75%. When scenario 2 was applied these values were 0.5%-15.0% and 0%-17.1%, respectively, when the sensitivity of DBT was >80%. Scenario 1had an ICER of €17,276/ LYG when DBT sensitivity was 95%, whereas scenario 2 had an ICER of € 21,245/ LYG even at a DBT sensitivity of 100%(Figure 1). Compared to scenario 1, scenario 2 was more effective, however, had a less favourable ICER when DBT sensitivity was >85%(Figure 1).
Conclusion
DBT is unlikely to be cost-effective compared to DM for population screening, but may be cost-effective for screening women with dense breasts. Strategies assessing feasibility of density-directed DBT population screening merit research effort.

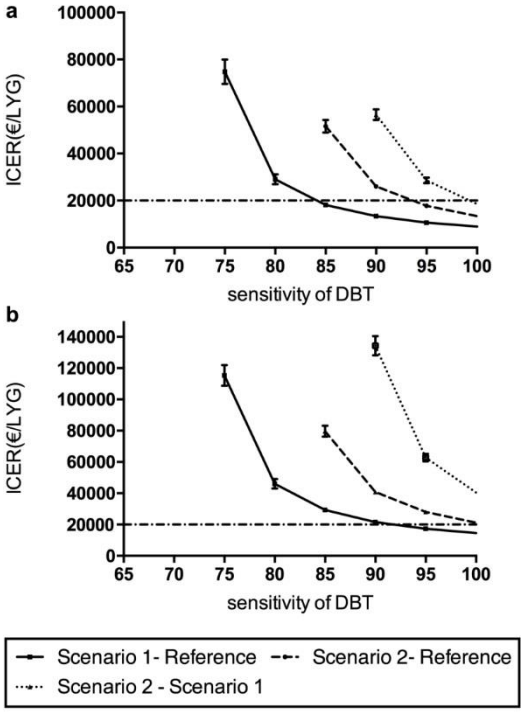


Figure 1 The incremental cost effectiveness ratio (ICER) as a function of the sensitivity of digital breast tomosynthesis (DBT), where costs and life years gained (LYG) were not discounted (a), where both discounted by 3% (b).

Picture 1:

Caption 1: Figure 1 The incremental cost effectiveness ratio (ICER) as a function of the sensitivity of digital breast tomosynthesis (DBT)

Novel strategies in screening & BIG DATA

40 - Poster Presentation

Risk of Recurrence for Women Treated for CIN 3/AIS of the Cervix as Determined by Subsequent Pap Smear Results

Kupets[1], Jembere[2], Wang[2], L. Rabeneck[2]
[1]Toronto-Sunnybrook Regional Cancer Center, Cancer Care Ontario, TORONTO, Canada
[2]Cancer Care Ontario, TORONTO, Canada

Background:
To determine risk of recurrent cervical dysplasia after local ablative treatment (LEEP, LASER, CONE) for CIN 3/AIS predicted by subsequent Pap smear results performed in the first 3 years post treatment.
Methods:
Utilizing administrative data from cancer and cervical cytology registries as well as physician billing data for procedures in Ontario, Canada, we identified all women with a diagnosis of CIN 3 or AIS from 2006-2010 and determined their recurrence rate 1- 5 years post treatment defined as a biopsy finding of CIN 3/ AIS or retreatment (LEEP, Laser, Cone, Hysterectomy).
Results:
19,453 women underwent treatment for CIN 3/AIS. Overall, 8.92% recurred. Mean time to recurrence was 927 days. Post treatment risk of recurrence with 1, 2, or 3+ normal Pap results is 7.8%, 6.1% and 6% respectively; recurrence with 1, 2 or 3+ low grade Paps (LSIL, ASCUS) is 12%, 22% and 33% respectively. Logistic regression was carried out to determine odds of recurrence post treatment. Factors associated with increased risk include age decile above 21-29, subsequent Pap abnormality, low grade or high grade as compared to a normal Pap result. Two normal Pap smear results have the same protective effect as 3 or more normal Pap results. Treatment modality did not impact recurrence rates.
Conclusions:
Post treatment Pap smears provide information on risk for recurrence and can inform subsequent screening frequency as well as discharge planning from colposcopy. Addition of HPV testing post treatment can help determine risk of recurrence further.

Novel strategies in screening & BIG DATA

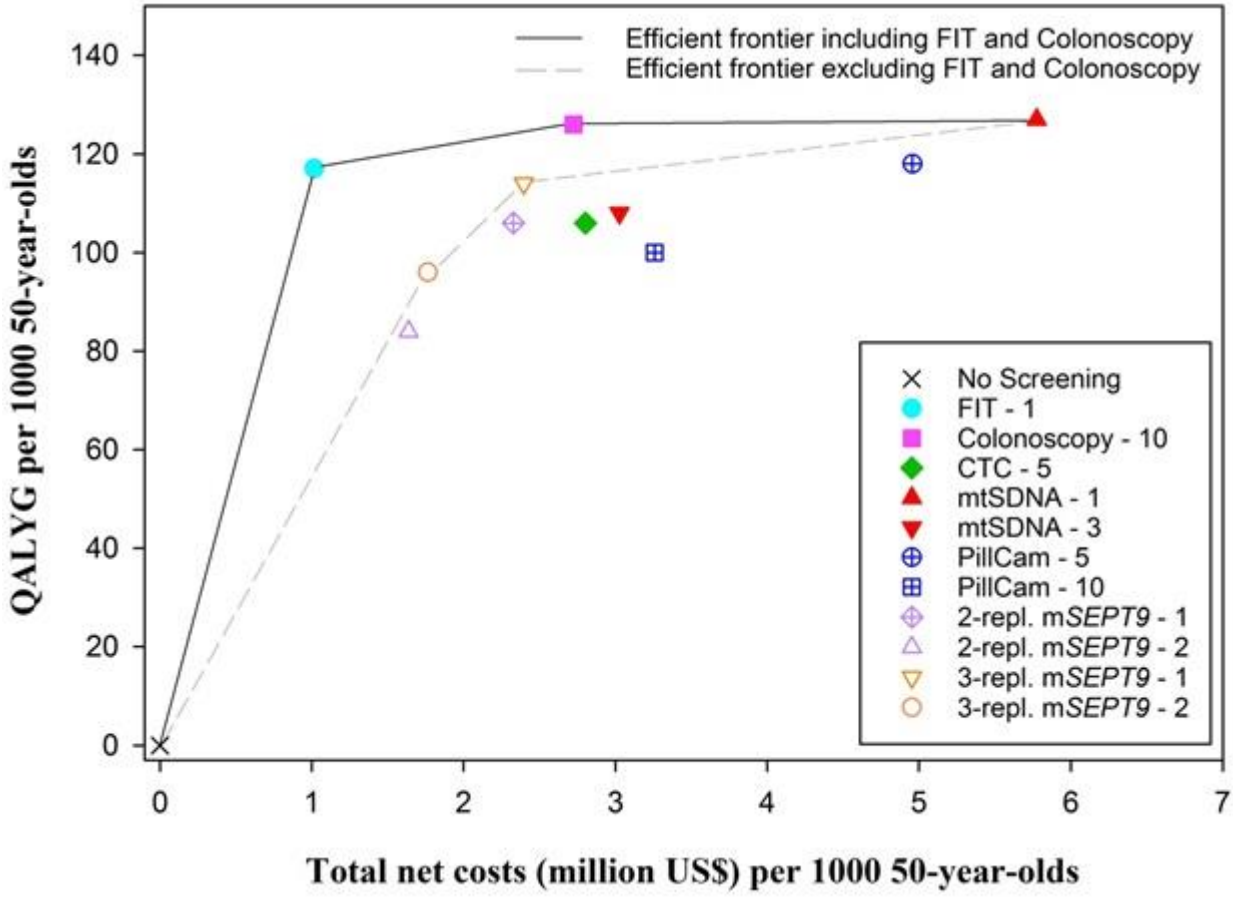
45 - Poster Presentation

Comparing the cost-effectiveness of innovative colorectal cancer screening tests

E.F.P. Peterse[1], R.G.S. Meester[2], L. de Jonge[1], A.H. Omidvari[1], F. Alarid-Escudero[3], A.G. Zauber[4], I. Lansdorp-Vogelaar[1]
[1]Erasmus MC University Medical Center, ROTTERDAM, The Netherlands
[2]Department of Medicine, Stanford University, STANFORD, United States of America
[3]Center for Research and Teaching in Economics (CIDE) - CONACyT, AGUASCALIENTES, Mexico
[4]Memorial Sloan Kettering Cancer Center, NEW YORK, United States of America

Background: Colorectal cancer screening with colonoscopy and the fecal immunochemical test (FIT) is underutilized. Innovative alternative screening tests could increase screening acceptance. This study determined which of the currently available alternative tests is most promising in terms of its cost-effectiveness.
Methods: The well-established MISCAN-Colon model was used to evaluate the cost-effectiveness of screening with the PillCam COLON 2 every 5 or 10 years, computed tomographic colonography every 5 years, the multitarget stool DNA (mtSDNA) test every 1 or 3 years, and the 2-replicate or 3-replicate methylated *SEPT9* DNA plasma assay (m*SEPT9*) every 1 or 2 years. Quality-adjusted life-years gained (QALYG), number of colonoscopies, total costs from a societal perspective, and incremental cost-effectiveness ratios (ICERs) were projected for the different strategies, and compared to annual FIT screening and colonoscopy screening every 10 years.
Results: m*SEPT*9 strategies had the lowest costs among the alternative screening tests. If performed annually, the benefits of m*SEPT9* screening were comparable to annual FIT screening, but resulted in 51% more colonoscopies and 33% higher costs. Among the alternative tests, the 3-repl. m*SEPT9* was the most cost-effective option, having ICERs of $18,407 and $35,423 per QALYG for biennial and annual screening, respectively (Figure 1). Yearly mtSDNA was the only other efficient alternative strategy, with an ICER of $259,326. None of the evaluated alternative tests were cost-effective compared to FIT and colonoscopy screening.
Conclusion: This study suggests that if an individual is not willing to participate in FIT or colonoscopy screening, the 3-replicate m*SEPT9* is the most cost-effective alternative.

Picture 1:



Caption 1: Figure 1. Lifetime costs and quality-adjusted life-years of the evaluated screening strategies.

Novel strategies in screening & BIG DATA

87 - Poster Presentation

Measuring quality of cervical cancer screening in the context of multiple screening strategies in the United States

EF Beaber[1], A Kamineni[2], JS Haas[3], CS Skinner[4], JA Tiro[4]
[1]Fred Hutchinson Cancer Research Center, SEATTLE, United States of America
[2]Kaiser Permanente Washington Health Research Institute, SEATTLE, United States of America
[3]Massachusetts General Hospital, BOSTON, United States of America
[4]University of Texas Southwestern Medical Center, DALLAS, United States of America

Background: Cervical cancer screening is changing rapidly in the United States (U.S.) and now includes human papillomavirus (HPV) primary screening as an option. Comprehensive screening process metrics are needed to measure quality of care amid changing screening strategies.
Methods: We refined a conceptual model of the cervical cancer screening process for average-risk women by integrating HPV primary screening (clinician-performed or self-collected). Guided by the model, we defined detailed quality metrics for this newly-introduced screening modality and illustrated how its addition impacts delivery of screening and diagnostic evaluation for cervical cancer prevention and control.
Results: Our conceptual model depicts multiple steps and transitions required for women to successfully navigate the cervical cancer screening process. The model underscores the complexity of determining screening episodes and managing positive screens with the addition of HPV primary screening. Identifying average-risk women via electronic health records is challenging, as it requires knowledge of prior cervical abnormalities, prior surgeries, and other risk factors. Important quality metrics for measuring screening uptake and completion include: proportion of women tested, screened, with low-grade cervical lesions and follow-up, with high-grade cervical lesions and follow-up, not-up-to-date with screening, and with cervical cancer diagnosed. Measuring de-implementation of low-value cervical cancer screening (e.g., screening women >65 years of age with adequate prior screening or women <21 years) is also needed to improve quality of care.
Conclusions: Our conceptual model defines important quality metrics, and as a timely example, illustrates the added complexity that HPV primary screening brings for monitoring U.S. women through the cervical cancer screening process. Health systems in the U.S. and internationally can apply our proposed metrics to measure quality of cervical cancer screening delivery. As screening and management guidelines evolve, our model and metrics can be modified to incorporate new screening strategies and other populations, such as low-risk, HPV-vaccinated women.

Novel strategies in screening & BIG DATA

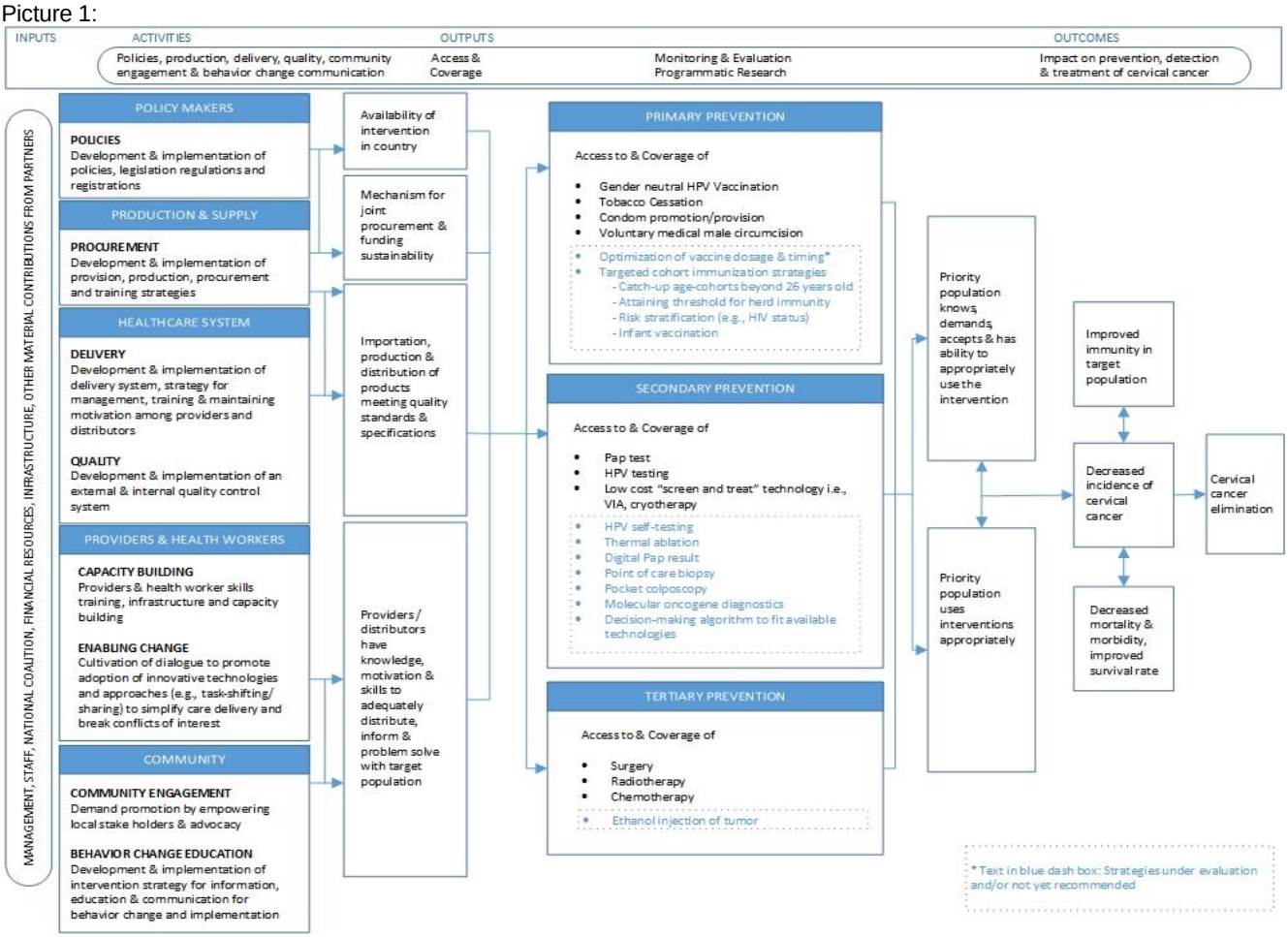
88 - Poster Presentation

A Framework for Cervical Cancer Elimination in LMIC: Gaps in Evidence and Next Steps

MS Shin[1], GL Liu[1], NM Mugo[1], PG García[2], DR Rao[1], JW Wasserheit[1], RB Barnabas[1]
[1]University of Washington, SEATTLE, United States of America
[2]Universidad Peruana Cayetano Heredia, LIMA, Peru

Background
There is a global call for cervical cancer (CC) elimination. With existing prevention and treatment modalities, CC elimination is now attainable in well-resourced settings. However, in low-and-middle-income countries (LMIC), limited financing and capacity constrain prevention and control efforts. We conducted this landscape analysis to produce a roadmap toward CC elimination in LMIC and highlight evidence gaps to increase impact of CC prevention and care.
Methods
We reviewed and synthesized literature from 2010-2018 on primary, secondary, and tertiary CC prevention strategies. We additionally conducted expert interviews with gynecologic and infectious disease providers, researchers, and LMIC health officials. Using these data, we developed a logic model and identified evidence gaps.
Results
The logic model for CC elimination maps multi-sectorial collaboration among policy makers, production and supply, healthcare systems, providers, health workers, and communities. The model articulates responsibilities for stakeholders and visualizes processes to increase access to and coverage of prevention methods. We discuss the challenges of contextual factors, and highlight innovation needs. Effective prevention methods include HPV vaccination, screening using visual inspection and HPV testing, and thermocoagulation. However, vaccine coverage remains low in LMIC. New strategies, including single-dose, gender-neutral, and multi-age cohort vaccination could enhance impact. Loss to follow-up and treatment delays could be addressed by improved same-day screen-and-treat technologies. Limited access to chemotherapy/radiotherapy for treating CC necessitates new approaches (e.g., ethanol injection).
Conclusion
The logic model provides a practical framework to guide CC elimination in LMICs. The model highlights existing and innovative strategies, unmet needs, and collaborations required to achieve elimination across implementation contexts.

Picture 1:



Caption 1: Cervical Cancer Elimination Logic Model for LMIC

Novel strategies in screening & BIG DATA

92 - Oral Presentation

First-void urine: an option for non-invasive one-step screen and triage in cervical cancer prevention

Van Keer[1], Pattyn[1], Tjalma[2], Van Ostade[1], Ieven[1], Van Damme[1], Steenbergen[3], Vorsters[1]
[1]University of Antwerp, WILRIJK, Belgium
[2]University Hospital Antwerp, EDEGEM, Belgium
[3]Amsterdam UMC, AMSTERDAM, The Netherlands

Background
Research has been primarily confined to identify high-risk Human Papillomavirus DNA (HR-HPV) and biomarkers for cervical cancer (CC)-screening in cervicovaginal samples. The use of first-void urine (FVU) to detect the principal cause of CC (HR-HPV), has been demonstrated by good HR-HPV-agreements with cervical samples (CS). Although highly sensitive, a triage test is needed to identify HR-HPV-positive women with a high risk of precancerous disease/cancer. Eight studies (2003-2017) have investigated the use of FVU to detect CC-biomarkers, all restricted to exploratory/clinical assay development phases of biomarker development.
Due to its high preference and non-invasive character, this one-step triage approach might increase participation and compliance to follow-up among screening non-participants. We therefore investigated HR-HPV and biomarker presence in FVU compared to CS and histology.

Methods
FVU and CS were collected from a referral population (25-64y women) with a colposcopy guided biopsy if indicated (NCT02714127). Cytology and histology results were available. HPV DNA type-specific qPCR (AML) was performed on FVU and CS. FVU DNA-extracts were analysed for host cell methylation markers (HCMM) by methylation-specific qPCR (Amsterdam UMC).
Results
A similar HR-HPV prevalence was observed in FVU (n=76/110) and CS (n=73/110). Good (Kappa=0.688; 95%CI:0.542–0.835) and excellent agreements (Kappa=0.902; 95%CI:0.807–0.996) were observed between paired samples for HR-HPV and HPV16/18, respectively. Significant elevated HCMM-levels were observed for 2/6 markers in FVU from women (n=38) with high-grade histological outcomes (CIN2+/CIN3) compared to women without cervical disease, yielding AUC's between 0.720-0.792.
The clinical accuracy of the proposed markers in FVU will be validated in a diagnostic accuracy study (NCT03064087).
Conclusion
FVU is a potential liquid biopsy to test primary HR-HPV and optionally biomarkers in the same sample. This approach creates opportunities to increase both adequate referrals for follow-up and number of screening participants. The presented approach needs to be validated in a population-based pilot study.

Novel strategies in screening & BIG DATA

98 - Poster Presentation

Implementation of a National Cancer Screening Register in Australia

Morrish[1], Gertig[2]
[1]Australian Government, CANBERRA, Australia
[2]National Cancer Screening Register, MELBOURNE, Australia

Background

The National Cancer Screening Register was implemented by the Australia Government in partnership with the state and territory governments to support two of the national cancer screening programs in operation in Australia: the National Cervical Screening Program (NCSP) and the National Bowel Cancer Screening Program (NBCSP). When the NCSP started in 1991 two yearly screening via the Papanicolaou (Pap) test was recommended for eligible persons aged 18–20 years until age 69. On the 1 December 2017, primary HPV testing with reflex cytology replaced the Pap test in the NCSP, with eligible persons recommended to screen every 5 years starting at the age of 25 years until age 74.

To support this significant change to the NCSP, a national register was also implemented to consolidate eight state and territory cervical screening registers. The implementation of a single Register to support the changes to the NCSP is working towards achieving multiple benefits including: 1) Introduction of one national record for each individual in the National Cervical Screening Program, 2) consistency of screening pathways nationally to align with new clinical guidelines, and 3) a single master source of eligible participants based on Australia's publically funded universal health care system.

In May 2018 the eight Australian and State and Territory government NCSP registers were migrated into a single National Cancer Screening Register. This presentation will describe Australia's new National Cancer Screening Register, and discuss the process of implementation, the challenges, benefits and status to date.

Novel strategies in screening & BIG DATA

103 - Oral Presentation

Development of a Model for Identifying Individuals at Risk for Severe Dysplasia or Esophageal Cancer for Chinese Population

Li, Chen
National Cancer center/Cancer Hospital, BEIJING, China

Background: China accounts nearly 50% esophageal cancer cases in the world, with low early diagnosis rate and poor prognosis. It has been reported that endoscopy with biopsies for histologic confirmation is the gold standard method of detecting esophageal cancer. However, inaccurate positioning of high-risk individuals who are suggested to attend endoscopic screening is one of pressing issues among esophageal cancer screening in china. Therefore, we aimed to develop a population-based model to identify individuals at high risk for severe dysplasia and above (SDA) for Chinese Population.
Methods: We collected epidemiology and clinical screening data from 120,811 individuals (40-69years old) of 13 counties in Provinces of Jiangsu, Anhui, Shandong and Henan in China, who underwent endoscopic screening from January 2007 to through December 2016. Using logistic regression analysis, we identified several factors, measured at baseline, are associated with SDA and then developed a high-risk evaluation model. Besides, we incorporated these factors into points-based model to develop a scoring system to identify a point cut off of high-risk individuals. The receiver operating characteristic curve (AUROC), sensitivity, and specificity were used to assess the model performance.
Results: In our models, age, sex, smoking, body mass index, family history of cancer and clinical manifestations (Dysphagia or Odynophagia or posterior sternal pain) identified individuals who developed SDA (AUROC:0.737, 95% confidence interval, 0.721–0.753). The scoring system, using points-based model, identified individuals who developed SDA with 66.9% sensitivity and 66.9% specificity.
Conclusions: A low-cost, easy-to-use model for identifying individuals at risk for SDA for Chinese population was developed by using several well-established risk factors that are related to esophageal cancer. A further study needed to be conducted to evaluate the utility of these factors in screening programs, so that this model could be used to select individuals who are suggested to undergo endoscopy for esophageal cancer screening.

Novel strategies in screening & BIG DATA

118 - Oral Presentation

Why colorectal screening fails to achieve the uptake rates of breast and cervical cancer screening: understanding determinants to inform policies and strategies

KA Robb[1], M Kotzur[1], R Papworth[1], P McSkimming[1], C Campbell[2], S Wyke[1], S Macdonald[1], D Weller[2], RJ Steele[3], E Crighton[4], C McCowan[1]
[1]University of Glasgow, GLASGOW, United Kingdom
[2]University of Edinburgh, EDINBURGH, United Kingdom
[3]University of Dundee, DUNDEE, United Kingdom
[4]NHS Greater Glasgow and Clyde, GLASGOW, United Kingdom

Background: Population-based cancer screening is available, free-of-charge, in the UK. In contrast to uptake of clinic-based breast (72%) and cervical (73%) cancer screening, uptake of home-based faecal occult blood test is around 60%. To inform new approaches to increase uptake of stool-based colorectal screening, we compared women with different screening histories demographic and health characteristics and perceptions' of colorectal screening.
Methods: Phase 1- data on breast, cervical and colorectal screening invitations and completion for women aged 20-74 (n=430,591) in Glasgow during 2009-2013 were linked to GP data. Data were analysed using logistic-regression. Phase 2- we purposively sampled women from Phase 1 with three different screening histories to be mailed invitations to qualitative interviews: i) participated in all programmes ('screening-participants'); ii) participated in breast and cervical but not colorectal programmes ('colorectal-specific non-participants'); and iii) did not participate in any programme ('non-participants'). Framework analysis was used.
Results: Phase 1- During 2009-2013 uptake was 72.6% for breast, 80.7% for cervical and 61.7% for colorectal screening. Older and more affluent women were more likely to complete all screening programmes. Multi-morbid women were less likely to complete breast and colorectal but not cervical screening. Phase 2- The accounts (n=59) of the three groups differed, with the colorectal-specific non-participants expressing that: i) treatment for colorectal cancer treatment is more severe; ii) colorectal symptoms are easier to detect oneself than breast or cervical symptoms; iii) they felt worried about incorrectly completing the test; and iv) the colorectal test could be more easily delayed/forgotten than breast or cervical screening.
Conclusion: Our novel, comparative approach provided insight into targets to increase uptake of colorectal screening including: i) reducing fear of colorectal cancer treatments; ii) increasing awareness that screening is for the asymptomatic; iii) increasing confidence to self-complete the test; and iv) providing a suggested deadline and/or additional reminders.

Novel strategies in screening & BIG DATA

124 - Oral Presentation

Prevalence of Human Papillomavirus in young screened women

LHT Thamsborg[1], BA Andersen[2], LGL Larsen[3], JC Christensen[4], TJ Johansen[2], JH Hariri[5], SC Christiansen[6], EL Lynge[7]
[1]University of Copenhagen, COPENHAGEN, Denmark
[2]Randers Regional Hospital, RANDERS, Denmark
[3]Naestved Hospital, NAESTVED, Denmark
[4]Aalborg University Hospital, AALBORG, Denmark
[5]Soenderjylland Hospital, SOENDERBORG, Denmark
[6]Sydvestjysk Hospital, ESBJERG, Denmark
[7]Nykoebing Falster Hospital, NYKOEBING FALSTER, Denmark

Background
For many years, cytology has been the primary screening method in cervical screening. Now more countries are transitioning to primary test for Human Papillomavirus (HPV). Because of a high prevalence, HPV-testing in young women could result in overdiagnosis. However, during the past few years, HPV-vaccinated women have come of age for cervical screening. Although some studies have shown significant reductions in vaccine HPV-types in the post-vaccination era, studies on HPV-prevalence in populations of young screened women are warranted.

Methods
As part of a Danish method study (Trial23) on the use of primary HPV-testing in young vaccinated women, HPV-tests were performed on screening samples from women born in 1994. These women were offered HPV-vaccination at the age of 14 years and according to national statistics 83% are vaccinated. Samples were analyzed from February 2017 to April 2018 in participating labs in four out of five Danish regions. Cobas4800 HPV-DNA test covering 14 high-risk (HR) HPV types was used. There are four possible outcomes of the test; HPV-negative, HPV-16, HPV-18 or HPV-other type. Trial23 is undertaken as a method study with no direct involvement in the cervical screening program.

Results
Here we report on preliminary results of HPV-testing from the baseline screening round of Trial23. Out of 5380 cervical screening samples tested for HPV, 61% tested negative for HR-HPV, 38% of samples were positive for HPV-other and only 1% of samples were positive for HPV-16 or 18 with the majority being HPV-16 positive.
Conclusions
This study reports on HPV-prevalence in screening samples from a cohort of women offered HPV-vaccination as girls. In this population, HPV-16 and 18 infections are almost non-existing while HR HPV-other types still seem to be prevalent. These results can help inform on whether primary HPV-testing is feasible for screening of young vaccinated women.

Novel strategies in screening & BIG DATA

127 - Poster Presentation

Receiver Operating Characteristic Curve (ROC) Corrected with Mean Sojourn Time for Prostate Specific Antigen (PSA) Test in Population-based Prostate Cancer Screening

Chu[1], Chen[2], Yen[2], Auvinen[3], Chen[1]
[1]National Taiwan University, TAIPEI, Taiwan
[2]Taipei Medical University, TAIPEI, Taiwan
[3]University of Tampere, TAMPERE, Finland

BACKGROUND
While receiver operating characteristics (ROC) curve of serum prostate-specific antigen (PSA) test has been widely used to evaluate the performance of diagnostic tool but it is not straightforward to use in population-based prostate cancer screening because asymptomatic cancer staying in pre-clinical screen-detectable phase is often faced with incomplete ascertainment.
METHODS
Total of 20,796 men with PSA test at the first screening round from population-based Finnish prostate cancer screening trial during 1996-1999 were enrolled. Cancers detected at the first screen, together with interval cancers ascertained during 4-year follow-up, were expediently used to estimate sensitivity and specificity. A sojourn-time-adjusted model was applied to estimating the possible false negative cases for those with PSA<4 ng/ml for correcting receiver operating characteristic curve.
RESULTS
Of the 20687 men included for analysis, 584 prostate cancers were detected by screen and 129 ICs were noted in 4 years. Of the 17890 men with PSA<3 ng/ml, only 40 men with ICs were considered as subjects with disease. By the proposed method, we could estimate 414 detectable cancers if biopsy for men with PSA<4 ng/ml. The corrected sensitivity decreased compared with the uncorrected analysis (68.8% vs. 94.4% for PSA≥3.0 ng/ml; 55.4% vs. 86.3% for PSA≥4.0 ng/ml). The corrected area under curve (AUC) of the PSA test was 79.8% (77.7~81.8%), which was significantly lower compared to uncorrected AUC as 95.9% (95.3~96.6%). The optimal cut-off based on ROC curves with correction was different at PSA≥2.5 ng/ml.
CONCLUSIONS
Based on the new quantitative method, the corrected sensitivity, specificity, and AUC of PSA tests are able to estimate the asymptomatic cancer arising from screen-negative subjects in population-based PSA screening. It is helpful in determination of cut-off value of PSA tests for population-based screening.

Novel strategies in screening & BIG DATA

129 - Oral Presentation

Breast Cancer Screening with comparing Tomosynthesis to Mammography: A Systematic Review

Wang, Jen, Peng, Chen
National Taiwan University, TAIPEI, Taiwan

Breast Cancer Screening with comparing Tomosynthesis to Mammography: A Systematic Review

Background
While mammography is widely used for early detection of breast cancer in mass screening program alternative imaging technics of film-based screening tools are proposed. We aimed to compare the performance of tomosynthesis with that of the conventional screening tool mammography.
Methods
A systematic review was conducted to compare sensitivity and specificity between tomosynthesis and mammography. We applied the Bayesian method with non-informative prior to sequentially update the sensitivity and specificity of two film-based breast cancer screening techniques. We also performed meta-analysis to elicit information from literatures to estimate median sojourn time (MedST) in preclinical detectable phase (PCDP) of breast cancer for both tomosynthesis and mammography. The Wilcoxon signed-rank test was used to compare the difference of MedST.
Results
In the screen-detected group, tomosynthesis showed higher posterior sensitivity than mammography (0.89 for tomosynthesis vs 0.83 for mammography) , and posterior specificity (0.89 for tomosynthesis vs 0.86 for mammography). The similar findings were observed for clinically-detected group. The MedST of tomosynthesis is significantly longer than that of mammography in screen-detected group (Wilcoxon signed-rank test (WSRT)=10.5, P=0.031) by 0.48 years gain for early detection (median; lower quartile (Q1)=0.29 and upper quartile (Q3)=0.55); however, it only 0.14 years (median; Q1=0 and Q3=0.41; WSRT=15, P=0.039) gained in the clinically-detected group.
Conclusion
Tomosynthesis performed better than mammography both in sensitivity and specificity, leading to detect preclinical breast cancer earlier than mammography around half a year in screening population.

Novel strategies in screening & BIG DATA

131 - Poster Presentation

Drift of Fecal Hemoglobin on Multistate Progression of Colorectal Cancer: Implication for Population-wide Approach

Peng[1], Hsu[1], Yen[2], Chen[1]
[1]National Taiwan University, TAIPEI CITY, Taiwan
[2]Taipei Medical University, TAIPEI CITY, Taiwan

ABSTRACT
Background
The recently proposed fecal hemoglobin (f-Hb) is an emerging quantitative biomarker for predicting the risk of colorectal neoplasia. With the advent of life-style modification for non-communicable disease using a population-wide approach to the shifting distribution of f-Hb, it is of great interest to first quantitatively assess how drift of f-Hb and velocity of dynamic f-Hb affect multi-stage disease progression of CRC and then to estimate the reduction in incident CRC due to the shifted distribution of f-Hb.
Methods
We applied diffusion process to model drift and velocity of dynamic f-Hb and also applied Markov process to model disease progression of CRC from normal, pre-clinical detectable phase (PCDP) and finally to clinical phase (CP) with the marriage of two proposed models into the proposed meta-stochastic model. Data used here were derived from nationwide biennial screening program for CRC screening with fecal immunological test from 2004-2014.
Results
The estimated parameters show the drift of f-Hb was -0.475 (95%CI: -0.478~-0.473) for normal state but increased from 0.416 (95%CI: 0.382~0.455) for non-advanced adenoma, 0.553 (95%CI: 0.490~0.609) for advanced adenoma, and to 0.646 (95%CI: 0.612~0.683) for CRC. The time (days) required increased from 211 (95%CI: 205~216) for non-advanced adenoma, 257 (95%CI: 248~267) for advanced adenoma and to 486 (95%CI: 475~496) for CRC. The similar findings using the Wiener process were noted. The drift of f-Hb made more contribution to increasing the incidence of PCDP than to accelerating the transition rate from PCDP to CP. When the drift was changed from 0.33 (the current estimate) to 0.1 due to the shifted f-Hb distribution as a result of population-wide approach, the incidence of CRC could be reduced by 32%.
Conclusions
A novel meta-stochastic model was proposed for evaluation of the effectiveness of population-wide approach to shifting f-Hb resulting from life-style modification.

Novel strategies in screening & BIG DATA

147 - Oral Presentation

Acceptability and clinical accuracy of HPV testing on self-collected samples for women attending routine cervical screening

j. Berkhof[1], N. Polman[2], L. Massuger[3], F.J. van Kemenade[4]
[1]Study PI Amsterdam UMC, Vrije Universiteit, AMSTERDAM, The Netherlands
[2]Amsterdam UMC, Vrije Universiteit, AMSTERDAM, The Netherlands
[3]Study PI RadoudMC, NIJMEGEN, The Netherlands
[4]Study PI ErasmusMC, ROTTERDAM, The Netherlands

Background: Several countries have implemented HPV self-sampling for screening non-attendees, but its clinical accuracy in the regular screening population remains to be assessed. The IMPROVE-study is a randomised non-inferiority trial designed to evaluate the acceptability and clinical accuracy of primary HPV testing on self-collected samples in routine screening.
Methods: 187,473 women (aged 29-61) were invited to participate in the study as part of their regular screening invitation. Participating women (16,410) were randomised (1:1) to self-collection or clinician-collection and tested using a PCR-based HPV test. HPV-positive women were retested using the other collection method and triaged by cytology in accordance with current Dutch screening guidelines. Primary endpoint was cervical intraepithelial neoplasia grade 3 or worse (CIN3+). Among a subset of 4,955 participating women, a questionnaire was sent out to ask about their experiences with self-sampling and/or clinician-based sampling.
Results: HPV prevalence was 7·4% in self-collected and 7·2% in clinician-collected samples. Relative sensitivity for endpoint CIN3+ was 0·99 (95%CI: 0·91-1·08) and relative specificity was 1·00 (95%CI: 0·99-1·01). HPV-negative women in the self-sampling group reported significantly lower levels of shame, nervosity, discomfort and pain during sampling than HPV-negative women in the clinician-based sampling group (p-values <.001). However, trust in correct sampling was significantly higher in the clinician-based sampling group than in the self-sampling group (p-value <.001). The majority of women that received both HPV tests (76.5%) preferred self-sampling to clinician-based sampling in future screening.
Conclusion: In the regular screening population, HPV testing on self-collected and clinician-collected sample had similar accuracy. Women have a positive attitude towards self-sampling but express some concerns with respect to accuracy. Our study supports a screening approach where women can choose for either self-sampling or clinician-based sampling.

Novel strategies in screening & BIG DATA

148 - Oral Presentation

Cost-effectiveness of tomosynthesis in population-based breast cancer screening: a probabilistic sensitivity analysis

V.D.V. Sankatsing[1], N.T. van Ravesteyn[1], K. Juraniec[1], S.E. Grimm[2], H.J. de Koning[1]
[1]Erasmus MC, ROTTERDAM, The Netherlands
[2]School for Public Health and Primary Care, MAASTRICHT, The Netherlands

Background: Recent studies show that digital breast tomosynthesis may be a promising screening test. There is, however, uncertainty around the test characteristics and costs of tomosynthesis. The purpose of this study was to determine if tomosynthesis screening is cost-effective in a population-based screening setting, using literature and expert opinion to estimate tomosynthesis-specific model parameters.
Methods: Using the MIcrosimulation SCreening ANalysis (MISCAN) model, a cost-effectiveness analysis including a probabilistic sensitivity analysis was conducted, performing 10,000 model runs with 1,000,000 women simulated per run. Two cohorts were biennially screened between age 50-74 years; one with digital mammography and the other with tomosynthesis. Tomosynthesis-specific test sensitivity, specificity and unit costs were based on literature and expert opinion. We considered two willingness-to-pay-thresholds of €20,000 per life-year gained (LYG) and €35,000 per LYG. Effects and costs were discounted at 3.5% per year. We also determined which parameters caused most of the decision uncertainty.
Results: In the base case, digital mammography screening led to 180 LYG per 1000 women, followed over their lifetimes, whereas tomosynthesis gained 193 life-years per 1000 women. In the probabilistic sensitivity analysis, the mean incremental cost-effectiveness ratio (ICER) of tomosynthesis compared to digital mammography was €26,836 per LYG. The probability that tomosynthesis is more cost-effective than digital mammography was 0.36 at a threshold of €20,000 per LYG and 0.66 at €35,000 per LYG. The range in plausible unit costs of tomosynthesis caused most of the uncertainty in the results.
Conclusion: At a willingness-to-pay-threshold of €35,000 per LYG, biennial tomosynthesis is cost-effective and is likely to be more cost-effective than digital mammography. Tomosynthesis leads to higher benefit than digital mammography. However, the uncertainty surrounding the costs of tomosynthesis affects the ICER. A value of information analysis could provide more insight in this matter and in the costs of additional research to reduce uncertainty.

Novel strategies in screening & BIG DATA

156 - Poster Presentation

Using WHO data and a simple statistical model to disaggregate breast cancer mortality reductions produced by national cancer screening programs

Hanley[1], Njor[2]
[1]McGill University, MONTREAL, Canada
[2]Randers Regional Hospital, RANDERS, Denmark

Background
In Eur.J.Epi.2017 we applied a new statistical model (Liu et al. IntStatRev2015) linking Lexis-cell-specific (incidence-based) breast cancer mortality data to the number and timing of invitations received by subcohorts of women in a region that implemented screening before most of Denmark did. The aim was todisaggregate the mortality reductions into the minimal ones in the first years and in (older) women invited fewer times, larger ones after some years in those invited several times, and waning ones in the years after the last invitation. The fitted parameters yield fitted hazard ratio (% reduction) curves that are (bathtub-shaped) functions of follow-up-time, specific to the invitation histories of the various sub-cohorts. The conditional (Lexis-cell-matched) fitting allows pooling of log-likelihood functions from different jurisdictions.
Results to date are limited by the small sizes of the compared experiences, the small number of programmes where we have mortality data from same-country similar-in-time non-screening areas, the one-dataholder-at-a-time permissions/agreements required to assemble/share (incidence-based) data, and the limited follow-up windows (as screening is introduced to previously non-screening areas)that make it difficult to fit the portion of the hazard function extending wellbeyond the last invitation for each subcohort.
Methods and Results
We extend the model to handle the limitations of the (not- incidence-based, but extensive) age-and-year-specific breast cancer mortality data in the WHO database, data which heretofore have not been analyzed in a principled way. The proposed approach exploits the publicly available data from the many countries that have – asynchronously -- introduced national breast cancer screening programs, while recognizing the reductions in mortality due to factors other than screening. The age-and-year-matched contrasts involve countries that have had screening program for various numbers of years, vs. those that have not yet/only partially begun. They provide more refined estimates of mortality reductions than approaches heretofore.

Novel strategies in screening & BIG DATA

166 - Poster Presentation

Quality assurance reports on cervical samples analysed in Flemish pathology laboratories to improve cervical smear analysis

Haelens[1], Denolf[1], De Brabander[1], Vermeylen[1], Androgé[1], Asselman[1], Truyen[1], Gielen[2], Kellen[3], Van Eycken[1]
[1]Belgian Cancer Registry, BRUSSEL, Belgium
[2]Intermutualistisch Agentschap - Agence Intermutualiste, BRUSSEL, Belgium
[3]For Cancer Detection, University Hospital Leuven, Campus St. Rafael, LEUVEN, Belgium

Background
The Belgian Cancer Registry (BCR) collects all cervical test results from the laboratories for pathological anatomy in a cyto-histopathology registry (CHP). Hence, this CHP contains screening results of all smears and HPV tests and plays a crucial role in the organization and evaluation of the Flemish cervical cancer screening program organized by the Centre for Cancer Detection and funded by the Flemish government. To monitor the quality of the CHP, individual feedback reports with benchmarking are send by BCR to all Flemish laboratories.
Methods
Analyses were performed on the eligible screening population of women aged 25 to 64 years. To evaluate completeness of data and to subdivide all smears and HPV tests into screening, follow-up and not-reimbursed tests (= overconsumption), CHP data are linked with reimbursement data from health insurance companies using a unique patient identifier in accordance with privacy regulations. Reimbursement data further add information on follow-up such as colposcopy, biopsy, conisation and hysterectomy. Each laboratory received an individual feedback report containing figures which comprise the anonymized data of all laboratories. They also received their own identification code in order to position themselves relative to the others.
Results
Between June 2015 and January 2018, all Flemish laboratories received 4 feedback reports on samples taken between 2013 and 2017.
Quality indicators included are:
Timeliness and completeness of data delivery
Quality of coding the test results
Quality of smear analysis:
Distribution in percentages for different lesions
ASC/SIL ratio (= number of atypical lesions / number of low grade and high grade lesions)
HPV-triage and HPV positivity for the different lesions
Correlation between ASC/SIL ratio and HPV positivity
Conclusions
Individual evaluations with benchmarking already resulted in quality improvement. Although laboratories provide high quality data, the large interlaboratory variability regarding the quality of smear analysis, suggests there is still room for amelioration.

Novel strategies in screening & BIG DATA

168 - Poster Presentation

Tailoring Facebook ads to increase intention to get screened for breast cancer among Ontarian women

Bravo, Walker, Chiarelli, Kane, Banaszewska, Karapetyan, Verhaaff, L. Rabeneck
Cancer Care Ontario, TORONTO, Canada

Background: Cancer Care Ontario, a provincial agency in Canada responsible for cancer services, uses Facebook ads to disseminate messages about breast cancer screening. Tailoring may be an effective strategy to enhance the personal relevance of such ads and increase intention to get screened for breast cancer. The goal of this study was to assess the comparative effectiveness of tailored and non-tailored Facebook ads on social media engagement and intention to get screened among women aged 50-59 years.

Methods: A randomized controlled trial was conducted in three targeted areas in Ontario: Sudbury, Ottawa, and Hamilton. Postal regions in each of the three sites were randomly assigned a tailored or non-tailored ad. Social values datasets informed the content of ads. Landing pages were developed to collect data on women's intention to screen after viewing the Facebook ad. Six ads ran for a month on Facebook in January 2018. Chi-squared tests were performed to analyze Facebook data and Fisher's exact tests were used to analyze screening intentions.
Results: Facebook ads reached 59, 478 women across all three sites (Hamilton: 18, 556; Ottawa: 31, 629; Sudbury: 9, 293). Tailored ads in all three sites had significantly more link clicks per reach (i.e., clicks on the ad to the landing page per person) and engagements per reach (i.e., shares, comments, likes per person) than non-tailored ads ($p<0.001$). More women in the tailored ad group reported intention to screen than women in the non-tailored group in Hamilton and Ottawa (Hamilton: $p= 0.0013$; Ottawa: $p = 0.009$).
Conclusion: Tailoring Facebook ads can be an effective strategy for promoting social media engagements and intentions to screen for breast cancer among targeted audiences. Measuring intentions is an innovative way to measure the impact of ads and engage with audiences on social media regarding decision-making about important health issues.

Novel strategies in screening & BIG DATA

215 - Poster Presentation

Utilizing social media for colorectal cancer screening: a cluster randomized controlled trial protocol

Ruco[1], Tinmouth[2], Rabeneck[3], Dube[4], Chiarelli[3], Llovet[3], Baxter[5]
[1]University of Toronto and St. Michael's Hospital, TORONTO, Canada
[2]Sunnybrook Research Institute and University of Toronto, TORONTO, Canada
[3]Cancer Care Ontario, TORONTO, Canada
[4]University of Ottawa, OTTAWA, Canada
[5]St. Michael's Hospital, TORONTO, Canada

Background: Utilizing social media for health promotion is an emerging and cost-effective approach in targeting health behaviour but remains relatively underexplored for cancer screening. The objective of our study is to outline the protocol of a pragmatic cluster randomized controlled trial (RCT) evaluating the impact of Facebook ads promoting colorectal cancer (CRC) screening.
Methods: We will conduct focus groups with persons in our target population (age 50-74 at average risk for CRC) to develop three messages for inclusion in the trial. We will also conduct “split testing” on Facebook to identify a photo to accompany the ads. A pragmatic cluster RCT will be conducted in Ontario, Canada with randomization at the Forward Sortation Area (FSA). We will target all FSAs and randomly allocate each to one of four study arms (message 1, 2, 3 or control group with no ad campaign). The campaign will be launched for three months.
Results: The primary outcomes will be intention to screen and screening participation. Intention to screen will be captured through Facebook pixel while screening participation will be captured through administrative databases. Secondary outcomes will include click through rates, number of likes, impressions and comments of each ad as measured through Facebook Ad Manager. Adjusted chi-square analysis accounting for clustering will be used to compare proportions for primary outcomes. Significant differences between the ads in regards to social media engagement will also be explored.
Conclusion: Our study will inform the feasibility of using social media for CRC screening and also has the potential to reach a large number of people in a relatively short amount of time with the ability to limit cost. Our study results are likely to be taken up by screening programs looking for innovative ways to increase screening participation and can easily be translatable to other cancer disease sites.

Novel strategies in screening & BIG DATA

217 - Poster Presentation

Examining Patient Characteristics and Digital Breast Tomosynthesis Choice

MW Marsh, TS Benefield, MA Pritchard, LM Henderson
University of North Carolina at Chapel Hill, CHAPEL HILL, United States of America

Background

Screening with digital breast tomosynthesis (DBT) is reported to reduce recall rates and increase cancer detection rates. In an effort to reduce monetary barriers to prevention, many insurance providers in the United States now cover screening DBT. We sought to determine the characteristics of women who, when given the choice between 2D digital mammography (DM) and DBT, choose screening DBT, and to evaluate recall rates on DM versus DBT.

Methods

We utilized data from mammography facilities that offer DBT and DM based on woman's preference and that participate in a North Carolina population-based breast imaging registry. We included 20,822 women ages 40-79 years who underwent screening DBT or DM between 1/2/2015 and 4/4/2018. We explored whether patient differences exist in screening DBT use by implementing multilevel random effects logistic regression models and adjusting for pairwise comparisons and type 1 error rates. Given the large sample size, we also calculated Cohen's H values to evaluate clinical significance. Finally, we compared recall rates for DBT and DM.

Results

Approximately half of screening exams were performed with DBT (49.4% n=12,646) and half with DM (50.6%, n=12,944). Patient characteristics associated with screening DBT use included white race ($p<0.0001$), increasing age ($p<0.0001$), public insurance (p-value<0.0001), dense breasts ($p=0.0033$), personal history of breast cancer ($p=0.0033$), family history of breast cancer ($p<0.0001$), and a prior breast biopsy ($p<0.0001$). Cohen's H values ranged from 0.042 for the breast density comparison to 0.446 for the comparison of public versus other insurance. Adjusted recall rates were significantly lower for DBT versus DM (3.8% vs. 4.7% respectively, $p=0.0004$).

Conclusions

Despite financial coverage for screening DBT, women with known risk factors were more likely to request and undergo screening DBT than DM. Efforts to educate women on emerging breast imaging modalities will allow women the opportunity to make informed choices.

Novel strategies in screening & BIG DATA

253 - Poster Presentation

Estimated Benefits and Harms of Breast Cancer Screening Based on Polygenic Risk and Family History

J. van den Broek[1], H. J. de Koning[2], M. Wolfson[3], C.B. Schechter[4], N.T. van Ravesteyn[2], J. Simard[5], D. Easton[6], P. Kraft[7], Mandelblatt[8], A.C.J.W. Janssens[9], A. Trentham-Dietz[10]
[1]Erasmus MC, ROTTERDAM, The Netherlands
[2]Erasmus University Medical Center, ROTTERDAM, The Netherlands
[3]School of Epidemiology and Public Health and Faculty of Law, OTTAWA, ONTARIO, Canada
[4]Albert Einstein College of Medicine, Bronx, United States of America
[5]Québec-Université Laval, Québec, Canada
[6]University of Cambridge, Centre for Cancer Genetic Epidemiology, Cambridge, United Kingdom
[7]Harvard T.H. Chan School of Public Health, Boston MA, United States of America
[8]Georgetown University, Lombardi Cancer Center, WASHINGTON DC, United States of America
[9]Emory University, Atlanta, United States of America
[10]University of Wisconsin-Madison, Wisconsin, United States of America

Background:
Current breast cancer screening guidelines are age-based. However, at any given age there is variability in breast cancer risk. This study assessed risk-based screening approaches using first-degree family history (FH) and polygenic risk (PGR) to identify women for risk-based screening.
Method:
Two established breast cancer models estimated the impact of risk-based screening on breast cancer deaths, life years, false-positive mammograms, and overdiagnoses for the 1985 U.S. female birth cohort. Digital mammography screening strategies varying in initiation age (30, 35, 40, 45, 50) and interval (annual, hybrid, biennial, triennial) were evaluated for women differing in risk due to their FH and European-ancestry PGR score. The benefits and harms of risk-based screening were compared to current age-based guidelines for biennial screening from 50-74.
Results:
The estimated gain in life years and reduction in breast cancer mortality due to personalized screening were 8% and 4% (FH), 19% and 11% (PGR), and 25% and 15% (PGR+FH). These benefits followed from risk stratification and increased screening examinations, but were associated with increased rates of false-positives and overdiagnoses from 917 and 14.5 per 1.000 women screened over a lifetime for age-based screening to 1024 and 15.0 (FH), 1154 and 15.9 (PGR), 1186 and 16.4 (PGR+FH).
Conclusion:
European-ancestry women at increased risk due to FH or PGR could consider risk-based screening strategies starting before age 50 depending on their attitude towards breast cancer risk, and the potential harms and benefits of screening.

Novel strategies in screening & BIG DATA

257 - Oral Presentation

Anticipating precision screening

Patrick M Bossuyt
Amsterdam University Medical Centers, AMSTERDAM, The Netherlands

In an era where precision medicine has become the new buzzword, population screening should not be exempted for this movement to make medicine and health care less of a one-size-fits-all program. All healthcare interventions should take into account – and in principle be tailored to – the specific characteristics of the individual citizen.
This movement towards precision screening poses a challenge for most ongoing population screening programs. First, they often lack the evidence to move to an evidence-based differentiation in screening schedules. Second, the individualized nature of precision screening challenges key values such as equity and solidarity, which provide the foundation of mots health care systems.
This manuscript reviews the evidence-base for current attempts to precision screening, and highlights how individualization is already an element in some population-based screening programs. It additionally reviews central values in population-based screening programs and discusses how some of these are challenged by individual-centric approaches towards precision screening.

We rely on systenmatic reviews of the biomedical literature and present a case study on colorectal cancer screening, contrasting a number of Western countries.

Novel strategies in screening & BIG DATA

261 - Oral Presentation

Balance of mammography in conjunction with ultrasonography for breast cancer screening according to breast density: Japan Strategic Anti-cancer Randomized Trial, J-START

Prof OHUCHI[1], Prof SUZUKI[2], Dr HARADA[1], Dr ZHENG[1], Prof ISHIDA[1]
[1]Tohoku University Graduate School of Medicine, SENDAI, Japan
[2]Tohoku Medical and Pharmaceuitical University, SENDAI, Japan

Background
Due to limitations of mammography, studies have investigated performance of supplementary screening tools including ultrasonography, tomosynthesis and MRI Radiography is unlikely to be optimum solution and MRI is expensive. Ultrasonography is attractive because it is not impaired by breast density, with technical developments rising sharper. Now, question is raised whether adjunctive ultrasonography improve balance of breast cancer screening in case of different breast densities.
Methods
This is a sub-study of J-START (Lancet 387, 2016). Briefly, women aged 40-49 were randomized in 1:1 ratio to undergo screening by mammography plus ultrasonography (intervention) or mammography (control). Participants were enrolled from Miyagi Cancer Society. Sensitivity, specificity, recall rates, biopsy rates, characteristics of screen-detected and interval cancers were evaluated between both groups, and each modality were evaluated according to breast density.
Results
The sensitivity in intervention was higher than that in control group (93.5% vs 72.7% p=0.02). In intervention group, the sensitivity of mammography was only 65% in non-dense breasts and 73.1% in dense breasts, whereas the sensitivity of mammography plus ultrasonography was 90.0% in non-dense breasts and 96.2% in dense breasts. Screen-detected cancers were more frequently clinical stage 0/I in intervention compared with control (90.7% vs 58.3% p=0.003). The number of invasive cancers detected by ultrasonography was statistically higher than that by mammography (81.8% vs 35.3% p=.0046), not only in dense (83.3% vs 40.0% p=0.046) but also in non-dense breast (80% vs 28.6%; p=0.038), and all invasive cancers were node negative. In contrast, specificity was significantly lower in intervention group (86.6% vs 90.6% p<0.001).
Conclusion
Adjunctive ultrasonography has good screening balance with mammography regardless of breast density, detecting early stage and invasive malignancy for asymptomatic women, in dense as well as non-dense breasts. Thus, ultrasonography should be considered as an optimal solution in young women with averaged risk regardless of breast density.

Novel strategies in screening & BIG DATA

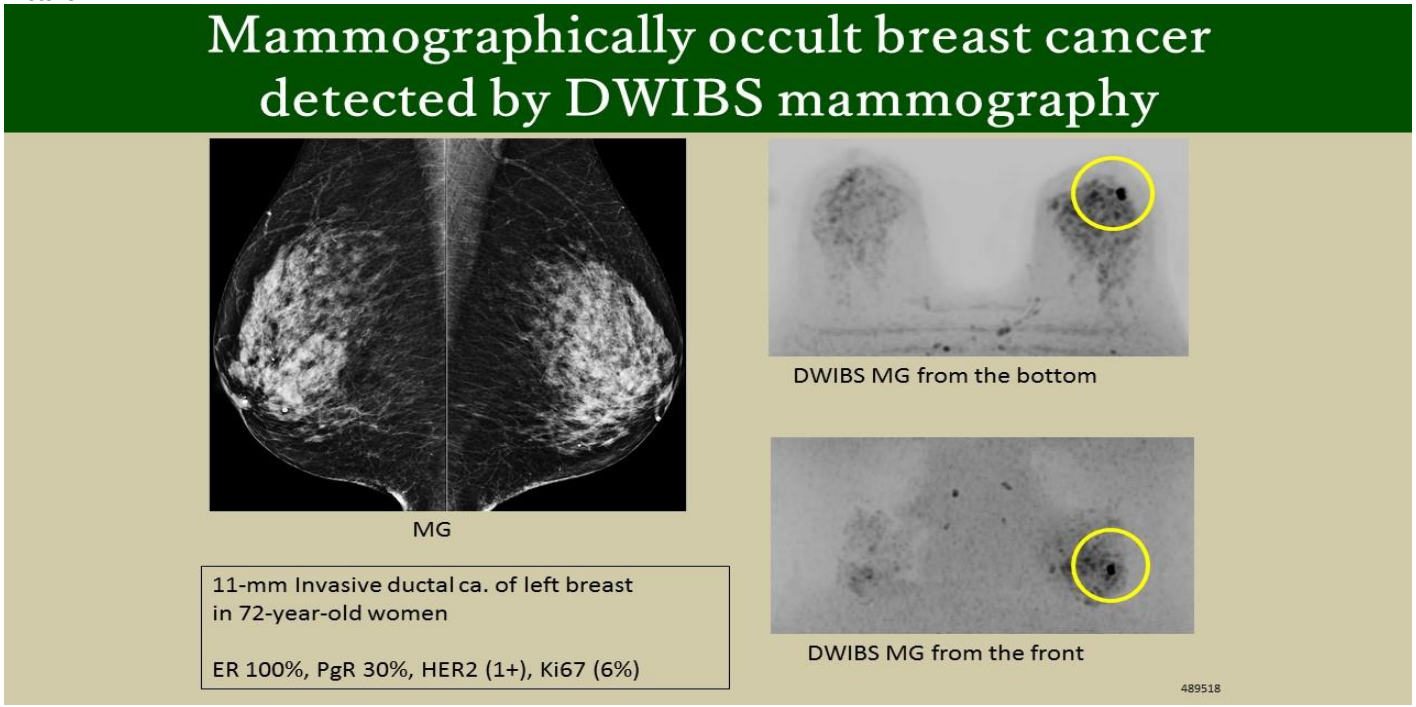
263 - Poster Presentation

Non-contrast-enhanced Breast MRI (DWIBS Mammography) for Breast Cancer Screening Women with Dense Breasts: A Feasibility Study

Uematsu
Shizuoka Cancer Center Hospital, SHIZUOKA, Japan

Background: The sensitivity of dense breast mammograms could be about one-third or half the near 100% sensitivity of fatty breast mammograms. The current reports show that contrast-enhanced breast MRI (CE MRI) outperforms mammography and ultrasound in all women with any breast cancer risk. Nowadays, abbreviated breast MRI protocols are developed, that is shorter and less costly than CE MRI. However, it still needs an intravenous contrast agent. It is costly, painful, and time-consuming. Thus, we are now researching about non-contrast-enhanced breast MRI (DWIBS mammography) for women with dense breasts. We evaluate clinical feasibility of diffusion-weighted whole-body imaging with background body signal suppression (DWIBS) mammography for detecting mammographically occult breast cancers in women with dense breasts.
Methods: Using 3T MRI at b values of 0 and 1,000 s/mm^2, 400 lesions including 40 mammographically occult breast cancers were examined with DWIBS and STIR. Lesion visibility on DWIBS mammography was evaluated. The reading time was measured, then the signal and morphology on STIR were compared breast cancers with benign lesions to make the diagnostic criteria. DWIBS mammography was displayed as an inverted grey scale MIP. A lesion detected on DWIBS mammography was considered as positive if it showed low signal intensity relative to the background breast tissue.
Results: DWIBS mammography sensitivity for mammographically occult breast cancer was 94% and the average reading time was only 10 seconds. Low/iso intensity on STIR ($p<0.0001$), non-mass lesion type ($p<0.026$), and ill-defined margin ($p<0.0001$) were significantly associated with breast cancer.
Conclusions: Non-contrast-enhanced DWIBS mammography has high sensitivity for mammographically occult breast cancers with the shorter scanning and faster reading time; these results suggest that this novel technique might be useful as a supplemental screening modality for women with dense breasts.

Picture 1:



Caption 1: Here you can see mammograms show dense breasts and no abnormality. But, the DWIBS mammograms clearly show the 11-mm invasive ductal carcinoma.

Novel strategies in screening & BIG DATA

274 - Oral Presentation

Impact of mailed home-based HPV self-sampling kits on screening uptake and cervical pre-cancer detection in underscreened women: results from a US-based pragmatic randomized trial

DSM Buist[1], Tiro[2], Gao[1], DL Miglioretti[3], Thayer[1], Beatty[1], Lin[4], Kimbel[1], Winer[4]
[1]Kaiser Permanente Washington, SEATTLE, United States of America
[2]University of Texas Southwestern Medical Center, DALLAS, United States of America
[3]University of California at Davis, DAVIS, United States of America
[4]University of Washington School of Public Health, SEATTLE, United States of America

Background: One in four U.S. women are not up-to-date with cervical cancer screening; 50% of cervical cancers diagnosed annually in the U.S. occur in underscreened women. We evaluated whether a programmatic strategy of mailed HPV kits increased detection and treatment of cervical pre-cancers (CIN2+) and screening uptake.
Methods: From 2014-2016, we randomized 19,851 women, aged 30-64 years, overdue for Pap screening into a pragmatic trial within Kaiser Permanente Washington. Follow-up intervals were 6-, 12-, and 18-months for screening uptake, CIN2+, and treatment. Control arm (n=9,891) included usual care (annual patient reminders, ad-hoc clinic outreach); intervention arm (n=9,960) included usual care plus a mailed HPV kit, allowing women to select in-home or in-clinic testing. Kaiser Washington's lab communicated kit results to primary care providers responsible for follow-up. Primary outcomes were CIN2+ detection and treatment. A secondary outcome was screening uptake (kit with reflex in-clinic screen if indicated, or no kit but in-clinic screen). We conducted intention-to-treat log-binomial regression to estimate relative risks (RR) and 95% confidence intervals (CI).
Results: Four additional CIN2+ cases were detected (12 versus 8;RR=1.49,95%CI:0.61-3.64) and 5 additional cases treated (12 versus 7;RR=1.70,95%CI:0.67-4.32) in the intervention versus control arm. Screening uptake was higher in the intervention arm (2,646 [26.6%] versus 1,719 [17.4%];RR=1.53,95%CI:1.45-1.61). In the intervention arm, 1178 (11.8%) returned the home-test and completed screening; 28 (0.3%) returned the HPV kit but did not complete necessary diagnostic follow-up; and 1440 (14.5%) came in for an in-clinic screen.
Conclusions: Mailing HPV kits to overdue women increased screening uptake compared to usual care alone; those offered kits were equally likely to select self-sampling versus in-clinic screening. While there was no significant increase in pre-cancer detection and treatment, there is suggestion that a hybrid strategy holds promise. These results can be used to guide home-testing cervical cancer screening implementation in different settings.

Novel strategies in screening & BIG DATA

278 - Poster Presentation

Impact of community-based integrated screening program on life expectancy and specific-cause mortality

Chen[1], Chen[2], Hsu[2], Yen[2]
[1]College of Public Health, National Taiwan University, TAIPEI, Taiwan
[2]Taipei Medical University, TAIPEI, Taiwan

Background
Most of studies on long-term effectiveness of disease prevention program in reducing mortality have targeted single disease rather than multiple diseases. There is an opportunity to evaluate the impact of the prevention program of multiple diseases using the proposed community-based Integrated Screening (CIS) model combining five major neoplastic and three chronic diseases. The aim of this study is to evaluate the impact of CIS on all-cause and diseases-specific mortality and the improvement of life-expectancy.
Methods
The CIS, embracing a series of prevention program, had been initiated since 1999. It has been also continued in Keelung, the northernmost city of Taiwan, and has been extended to Changhua (central), Tainan, (south) and Taitung (east) until 2012. All the four cohorts were composed of participants aged 30-79 years. The quasi-experimental design was adopted to compare mortality and average life expectancy between the screened and unscreened group. We also estimated adjusted non-compliance relative rate in relation to the effectiveness of the CIS.
Results
Total of 331, 684 eligible residents participated in the CIS program. The relative rate with non-compliance bias adjustment for the screened versus the unscreened was 0.50 (95% CI: 0.49-0.51) for subjects aged 30-79 years. The effectiveness of reducing cause-specific mortality was not only demonstrated in cancers and chronic diseases. The average LE in the CIS cohort was longer than the non-screened cohort by 8 years in the Keelung, 10.6 years in Changhua. 11.7 years in Tainan, and 9.4 years in Taidung.
Conclusion
We demonstrated half of 50% significant mortality reduction contributed from a bundle of prevention programs from the CIS. Such mortality reduction also led to the gain of 10 years of average LE. However, the disparity of gaining average LE across geographic areas suggests there are other factors accounting for accessibility to and availability of intervention programs.

Cancer screening in low- and middle income countries

8 - Poster Presentation

Comparative Community based uptake of self sampling for HPV DNA testing for cervical cancer screening in Ethiopia: a cluster randomized trial

Muluken Gizaw[1], Friederike Ruddies[2], Adamu Addissie[1], Alemayehu Worku[1], Tamrat Abebe[1], Brhanu Teka[1], Andreas M. Kaufmann[3], Eva Kantelhardt[2]
[1]Addis Ababa University, ADDIS ABABA, Ethiopia
[2]Martin-Luther-University, HALLE(SAALE), Germany
[3]Charité-Universitätmedizin, BERLIN, Germany

Background: In Ethiopia, although the standard method of cervical cancer screening is using Visual Inspection with Acetic Acid (VIA), service accessibility is limited and the uptake of eligible women is very low. Self-collection based Human Papilomma Virus (HPV) DNA testing might improve the uptake of targeted women for cervical cancer screening especially for hard to reach populations in Ethiopia. We investigated whether self-collection of cervical samples for HPV tests would be associated with increased uptake of screening.
Methods: A community based randomized controlled trial has been conducted in Butajira, one of the Health and Demographic Surveillance Sites (HDSS) of Ethiopia. A total of 22 clusters comprising 2356 women aged 30-49 were randomized in two arms. Community based sensitization was conducted using the local community workers at their vicinity. Following the community mobilization women's were invited to go to the local health post for self collection based HPV testing (arm A) and Hospital for VIA screening (arm B). We compared the uptake of screening between two arms.
Results: In the HPV arm, of the total 1213 women sensitized, 1020 (84.1%)($P<0.0001$) accessed the health post for HPV screening. In the VIA arm, 575 of 1143 (50.5%) visited the hospital. Among the women accessed the health post for HPV testing 892 of 1020 (87.5%) provided samples, while 466 of 575 (81%) underwent VIA screening. 144(20%) of women were positive for HrHPV of whom 122(85%) attended VIA as a follow up test.
Conclusion: The trial demonstrated better community acceptability and uptake of self-collection-based cervical cancer screening at the health post compared to VIA at the hospital. Women were more receptive for VIA after the HPV testing result is positive. Self-collection-based cervical cancer screening can be done at the local health facility and may significantly improve the uptake of cervical cancer screening in Ethiopia.

Cancer screening in low- and middle income countries

39 - Poster Presentation

Breast cancer screening program implementation in Lithuania

Steponaviciene, Vincerzevskiene, Smailyte
National Cancer Institute, VILNIUS, Lithuania

Background
It is proved that mammography screening program (MSP) can reduce mortality from breast cancer (BC). Besides program's execution it is essential to monitor the performance of the national MSP. The aim of this study was to evaluate Lithuanian MSP.
Methods
Data from National Health Insurance Fund about participants in MSP were linked with data from Lithuanian Cancer Registry and the Deaths registry. Performance and impact indicators were evaluated.
Results
Mammography screening in Lithuania began in 2005. Women aged 50-69 years are sent by general practitioner (no centralized invitation) to the screening center every two years. The attendance rate is low, less than 44 % of target population is screened. Only 25 % of all BCs in target population were diagnosed during screening, and only 49 % were identified in I stage. In target population incidence rates of I stage BC increased significantly during study period, however, no effect of introduction of MSP on this trend was seen – the increase was bigger before implementation and the similar trend was seen in other two age groups not affected by MSP. Incidence rates of advanced BC were stable in target population as well as in other age groups. The age-standardized mortality decreased in all ages from 25.1 to 18.6 per 100,000 women. The biggest decrease was seen in the age group under 50 and no impact of MSP was detected. The overall program's sensitivity amounted to 75.1% during all study period.
Conclusions
Many of the performance and impact indicators do not met the requirements of EU. The participation rate was low, only 49% of cancers were detected in I stage. The implementation of MSP in Lithuania was not associated with an increase of I stage or decrease of advanced cancer incidence and the decrease in mortality.

Cancer screening in low- and middle income countries

94 - Poster Presentation

Organized integrated cancer screening program - Feasibility and implementation challenges of cervix HPV screening in rural low resource setting

J SUBRAMANIAN, RAJARAMAN
CANCER INSTUTUTE(WIA), CHENNAI, India

Aim To study the challenges and generate information in implementing an organized HPV based cervix cancer screening program in a low-resource setting.

Study Area

South Indian Rural community - Villupuram Sub- district with target population of 104000 women aged 30-59 years, over 5 years

Method

Cervical cancer screening is combined with awareness creation and primary screening with clinical breast examination for breast, cessation counseling and oral examination for tobacco users. The team of doctors and health-workers recruited and trained from local community, arrives in an ambulance with materials required to set up a temporary clinic in remote rural areas. Over a period of 5-7 days, the team attempts to screen all eligible women in the village, for cervical, breast and oral cancers. HPV samples collected, analysed and reported by health workers in the rural center. Cytology triaging for positive women is done and referred for colposcopy to the higher center. Women are also taught breast self-examination and counseled if a tobacco user. Centralized data collection and linkage to cancer registry in place.

Results

The program is ongoing. Between Nov 2014 and Sep 2018, 98298 households surveyed, 71859 eligible households identified, 42493 women contacted, 37341 consented and 30535 underwent cervix screening. Net coverage rate is 42%, HPV positivity rate (1921) 6.3%, CIN2+ detection rate (151) 4.9/1000 with treatment completion rate (86) 57 %, at this point of time.

Conclusion

The programmatic experience of the first ever population-based HPV based organized screening program has demonstrated that such a program in a low resource setting is feasible, sustainable and scalable. Challenges are low coverage and treatment completion rates. Continuous awareness creation, robust follow up mechanisms, screen and treat methods are being tried and tested. The same model has been scaled to two other sub districts targeting an eligible population of 125000 women.

Cancer screening in low- and middle income countries

95 - Oral Presentation

Trends in cervical and breast cancer mortality rates in rural Vellore, south India, from a pilot program of population-based cancer screening.

Oommen[1], [2], Jeyapaul[1], Cherian[1], Marcus[1], Malini[1], Prasad[1], George[1]
[1]Christian Medical College, Vellore, India, VELLORE, India
, India

Background: Although randomised trials have reported the effectiveness of population-based screening on reduction of cervical and breast cancer mortality, this is seldom reported from programs in developing countries.
Methods: A population-based education-cum-screening program was started for women aged 25-60 years, in one rural block (population: 1, 16, 085) in Vellore, south India, by the community health department of a not-for-profit hospital, in November 2014, which also collects mortality statistics. This report analyses mortality between 2010-2017, in 46 program villages compared to 36 without the program.
Results: The attendance at screening camps was 10.2% (1891) in three years, with six cases of cervical pre-cancer/cancer. There was a 44% reduction in average cervical cancer mortality rates in program villages after the program started (14.3 per 100,000 in 2010-2014, 8.0 per 100,000 in 2015-2017), compared to little change in other villages (12.9 per 100,000, 12.3 per 100,000), although it was not statistically significant (Poisson regression test p value: 0.662), with no change in breast cancer deaths.
Conclusions:
Cervical cancer mortality rates appear to be reducing in rural Tamil Nadu, possibly reflecting better treatment access and early detection. This evaluation showed slighly higher reduction in program villages, indicating the added benefits of introducing population based screening. Population-based strategies can augment opportunistic screening at primary health centres, for greater mortality reduction.
Trends of cervical cancer mortality in study block

[$]Program started in November 2014

Year	Cervical cancer mortality rates per 100,000 (95% Poisson Confidence Intervals)	
	Program villages	Other villages
2010	5/21569 23.2 (15.4-34.5)	1/11704 8.5 (4.1-15.8)
2011	3/22187 13.5 (7.7-22.2)	1/12066 8.3 (4.1-15.8)
2012	4/22644 17.7 (10.7-27.2)	3/12353 24.3 (16.2-35.7)
2013	1/23207 4.3 (1.6-10.2)	2/12667 15.8 (9.1-24.7)
2014[$]	3/23500 12.8 (6.9-20.9)	1/12967 7.7 (3.5-14.4)
2015	1/24156 4.2 (1.6-10.2)	2/13480 14.8 (8.4-23.5)
2016	1/24857 4.0 (1.6-10.2)	1/13490 7.4 (3.5-14.4)
2017	4/25173 15.9 (9.1-24.7)	2/13711 14.6 (8.4-23.5)

Picture 1:
Caption 1: Trends of cervical cancer mortality in study block

Cancer screening in low- and middle income countries

109 - Poster Presentation

Addressing challenges to implementing cervical cancer screening in Rwanda

Jean-Paul[1], Francois[1], Cyprien[2], Tharcisse[3], Marc[1], Lydia[4], Origene[2], Jean Marie Vianey[2], Vestine[3], Illuminee[3]
[1]Rwanda Biomedical Center, KIGALI, Rwanda
[2]PIH/IBM, BUTARO, Rwanda
[3]Butaro Hospital, BUTARO, Rwanda
[4]Brigham and Women's Hospital, HARVARD, United States of America

Abstract background: Rwanda has one of the highest cervical cancer incidence rates in the world, however national population-based screening has not yet been implemented. Despite training of nurses in about 50% of rural health facilities, screening rates remain very low. Barriers include challenges with provider training, staff turnover and inadequate referral pathways. We describe a novel training and implementation program launched in 2 Rwandan districts in August 2018 by Rwanda's Ministry of Health in partnership with the organization Partners In Health.
Methods: We conducted on-site trainings targeting all health care providers in two districts. 64% and 84% of the districts' providers were trained, 4 times the number of those trained in the previous four years with comparable resourcesWe conduct regular mentorship to strengthen capacity of providers with focus at district hospital which will be mentoring health centers. To reduce loss-to-followup of screen-positive cases needing further management, a patient navigation model has been established.
Results: Over three months after training, 2686 women presented for cervical cancer screening in Rwamagana and Rubavu districts versus 1155 received from April 2017 to March 2018 in both districts. 22 women were Visual Inspection with Acetic Acid positive (VIA+) and treated with cryotherapy. Every health facility has established a women's cancer clinic and trained providers are rotating to run the clinic for program integration and continuity of service provision. We are measuring rates of loss to follow up to assess the impact of patient navigation.

Conclusion: Data from this new program will inform design of national cervical cancer programs, improve referral systems, and develop indicators and tools to promote better integration of cervical cancer program within all health facilities in Rwanda.

Cancer screening in low- and middle income countries

123 - Poster Presentation

Using Informed and Shared Decision-making in a Cervical Cancer Screening Programme

R Isaac
Christian Medical School Vellore, VELLORE, India

Using Informed and Shared Decision-making in a Cervical Cancer Screening ProgrammeRita Isaac[a], MD, MPH, Madelon Finkel[b], Ph.D.,David Weller[c], MBBS MPH a Christian Medical College, Vellore, India
b Weill Cornell Medical College, US
c University of Edinburgh

Background: Cervical cancer (CC) remains the most common cause of cancer deaths for women in India. While low-tech VIA screening followed by cryotherapy is an effective means of increasing survival rates, educating and engaging women in the importance of screening, especially rural poor women, is often challenging. Our patient-centered 'Educate, Screen and Treat' programme in a rural, under-screened population in Tamil Nadu focuses on informed and shared decision-making.
Methods: We present a novel communication strategy designed to create an informed community through group and one-to-one education using multiple media and tools (eg, puppets, stories, visual aids. mHealth messages) with special attention to developing a non-stigmatizing, non-threatening educational programme. Qualitative analysis was used to assess the acceptability and impact of the programme.
Results: Over ten years, we found an incremental increase in the number screened, and compliance among the test-positive cases with follow-up to confirmatory biopsy and treatment rose from almost zero in 2008 to near 100% in 2017. A one-page 'Option Grid' delineating responses to frequently asked questions was disseminated to local providers to facilitate informed participation in screening. A 6 months phase II trial of voice-site via mobile phones significantly empowered women to make informed choices independently. Based on our experience, 7 local organizations trained are using our methods for their CC screening programme.
Conclusion: Women in the study initially had very low levels of informed participation in cervical cancer screening. After introduction of our informed decision-making pilot, knowledge and compliance increased. Culturally acceptable, non-stigmatizing and non-threatening educational messages significantly improved the uptake of screening over the past 10 years.

Cancer screening in low- and middle income countries

142 - Poster Presentation

Evaluation of cervical cancer screening performance in Ayder and Mekelle hospitals: Tigray, Ethiopia, 2018

Reda Berhe, Reda Berhe
Mekelle University, MEKELLE, Ethiopia

Background: Globally, cervical cancer is a leading cause of morbidity and mortality among women. In Ethiopia cervical cancer is the 2nd leading cause of morbidity and mortality following breast cancer. About 7,095 new cervical cancers are diagnosed annually and 4732 age-standardized mortality rate is estimated. It is unknown to what extent the clinics have the capacity to screen for cervical cancer. The purpose of the study is to evaluate cervical cancer screening performance and facility readiness of two government hospitals using standardized toolkit.
Method: Cross sectional study was conducted in Ayder specialty hospital and Mekelle general hospital in August 2018. Using a standardized toolkit developed by CDC and WHO, the assessment was performed by observation and asking the facility staff about provider skill performance, facility readiness, data quality and client involvement. We also collected 2 years data from registration book to evaluate the number of women screened.
Result: Over the 2 year period a total of 1127 women received cervical cancer screening using VIA and 259 (23%) were VIA positive. Seventy three percent (n=821) of women screened were in the target age group of 30-49 years. Out of 259 VIA positive screening result 194(75%) were eligible for cryotherapy, 18(7%) were eligible of loop electrosurgical excision procedure. Out of 1124 with complete screening results, almost all (99.8%) were first time screens. Treatment was provided on the same day of screening visit. The provider skill performance of the facilities was good; the overall performance score and facility readiness score was satisfactory but client and community assessment scores were poor.
Conclusion: Almost one in four women in these hospitals has a positive screening result and almost all were treated on the same day. The overall performance score and facility readiness of the hospitals is satisfactory. Data analysis and interpretation should be strengthened.

Cancer screening in low- and middle income countries

144 - Poster Presentation

Organization of the Breast Cancer Screening Program in the Republic of Belarus: First Results.

O.V. Trusova[1], E.N. Horevich[2], O.N. Romanovich[2], V.Z. Rusovich[3], V.V. Osharin[2], V.E. Smelov[4]
[1]N.N.Alexandrov National Cancer Centre of Belarus, Radiology Department, LESNOY, Belarus
[2]N.N.Alexandrov National Cancer Centre of Belarus, LESNOY, 2, Belarus
[3]World Health Organization Belarus Country office, MINSK, Belarus
[4]International Agency for Research on Cancer, LYON, France

Background. Breast cancer is the leading malignancy in women in the Republic of Belarus (incidence: 50.4/100,000, mortality: 12.9/100,000). In 2012 an organized digital mammography-based breast cancer screening (BCS) programme in Belarus was initiated. The pilot projects originally started in a Minsk's central outpatient clinic. In 2016, the state-financed BCS became a part of the National Health Program.
Methods. The joint project BELMED of the European Union and several specialized agencies of the United Nations (UNDP, UNFPA, UNICEF, WHO, and IARC) was launched for 2015-2019, with the implementation of BCS as one of its tasks. Originally established at N.N.Alexandrov National Cancer Centre, the Project Management Team (PMT) on BCS closely worked with BELMED international partners, to employ the international expertise for implementation of the Belarus BCS programme (using digital mammography, a screening interval of two years, the target group women aged 50-69).
Results. Currently, the PMT tasks includes the organization, coordination, analysis of the results and quality control of BCS at the national scale (population of Belarus: 9.5 million, women aged 50-69: 1,4 million; number of screening centres: 26, radiographers trained in mammography: 69, radiologists trained to read mammograms: 64).
In 2016/2017, 40,369/48,894 women were screened, 9,142/8,126 (22.6%/16.6%) women required additional assessment and 246/276 (2.7%/3.4%) cancers were detected (early stages in 40.5%/46.5%), respectively.
Training of Belarus specialists involved in implementation of the BCS program has been carried out in (inter)national locations. Due to the international cooperation, transition from the local to the BIRADS system, developments of the quality control procedures, information materials and the screening registry have been made or in progress.
Conclusions. The Belarus experience shows how beneficial even for a developed national health care system with a strong governmental support can be international collaboration and exposure of the expertise for the proper implementation of a cancer screening programme.

Cancer screening in low- and middle income countries

151 - Poster Presentation

Survival rates and prognostic factors of esophageal cancer patients among residents of Oromia region, Ethiopia: 2013-2015

G.G. Bulcha[1], Maria E. Leon[2], Isabelle Deltour[2], Gwen A. Murphy[3], Aseffa Sime[4], Valarie McCormak[2], Joachim Schuz[2], Sanford M Dawsey[3]
[1]Oromia Regional Health Bureau, ADDIS ABABA, Ethiopia
[2]International Research on Cancer Control, World Health Organization, LYON, France
[3]Nation Cancer Institute, UNITED STATES, United States of America
[4]Addis Ababa University, ADDIS ABABA, Ethiopia

Background: Esophageal Cancer (EC) has long been considered one of the deadliest malignancies, with overall 5-year survival of <5% in developing countries. There is no study on the survival rate of patients acquiring EC in Ethiopia. In this study, we analyzed EC patient's data, estimate the overall median survival (OMS) and assess the independent effects of clinico-demographic variables on OMS.
Methods: We did a retrospective review of 526 EC patient charts diagnosed during 2013 to 2015 in three tertiary hospitals, among residents of Oromia region. The study includes only invasive image of EC. The final follow-up was on 31 December, 2016, a median follow-up time of 30 months. We conducted comparative descriptive analyses of major variables between high versus low risk districts. Survival analyses by Kaplan–Meier and Cox proportional hazards. All analysis was made by using STATA version 14 software.
Results: Of the 526 cases included, 83% were residents from high risk districts of the region, with equal male to female ratio. Patients resides in the EC high risk districts were more likely receiving treatment in Tikur Anbessa Teaching Hospital and mostly consume very hot meal/drink than low risk districts (P=<0.01). The OMS was 5 months. After adjustment for different variables in multivariate analyses, higher risk of death in patients resides in low risk districts (hazard ratio (HR) 1.6, 95% confidence interval (CI) (1.03-2.5), Aged >55 years old HR of 1.5 (95%CI: 1.1-2.1) and with non-specified histology HR of 2.2 (95%CI: 1.5-3.3) as reference to Esophageal Sqoumous Cell Carcinoma (ESCC).
Conclusions: High number of EC patents diagnosed, with poor OMS. We found that patients with ESCC and aged <55years old had a better OMS. Significant survival difference in areas of residence was due to survival difference by histology. Our findings support further hospital based study on prospectively followed patients.

Cancer screening in low- and middle income countries

159 - Poster Presentation

Patient-level data linkage for evaluating organized cancer screening programs - Example of estimating net cost of cancer patients' care in Hungary

Csanádi[1], Pitter[1], Széles[1], Fadgyas-Freyler[2], Korponai[2], Kenessey[3], Lansdorp-Vogelaar[4], de Köning[4], Vokó[1]
[1]Syreon Research Institute, BUDAPEST, Hungary
[2]National Health Insurance Fund, BUDAPEST, Hungary
[3]National Cancer Registry, BUDAPEST, Hungary
[4]Erasmus MC University Medical Center, ROTTERDAM, The Netherlands

Background
Continuous evaluation is a key principle of organized cancer screening programs. A particular challenge is to estimate the cost of care related to screening. In countries without established systematic monitoring, data linkage between institutions could be helpful.
Methods
We estimated the healthcare costs for breast, cervical and colorectal cancer in Hungary by linking patient-level data of the National Cancer Registry with the National Health Insurance Fund. We distinguished three treatment periods: initial 6 months after diagnosis, 6 months before death, and "continuing" period between these. Cost of care was estimated as the incremental cost of patients diagnosed with cancer compared to a random sample of individuals free of the investigated cancer, matched for age-group, place of living and sex.
Results
Our sample included 1356 cervical (diagnosed between 2010 and 2014), 6732 breast and 4365 colorectal (diagnosed between 2012 and 2014) cancer patients. Highest costs for initial and continuing phase were observed in breast, while the highest terminal costs were observed in colorectal cancer patients. Initial costs were highest for all cancers. There was a trend towards larger net costs for patients with higher stage at diagnosis in the initial and continuing phases for some cancers, but not in the terminal phase.
Conclusions
Our study demonstrates that patient-level data linkage between different institutions is a viable option to estimate parameters not available directly from screening programs. The cost of cancer care is substantial and varies by cancer site. Our cost estimates can be used to evaluate the cost-effectiveness of screening.

Table: Average net cost of care calculated in Hungarian Forints (HUF)

Picture 1:

Table: Average net cost of care calculated in Hungarian Forints (HUF)

	Average net cost in HUF (95% Confidence interval)		
	Initial 6 months	Continuing phase (annual)	Last 6 months
Breast	1,390,095 (1,357,614-1,422,576)	870,693 (830,756-910,629)	672,415 (556,447-788,382)
Cervical	790,452 (754,590-826,314)	381,691 (325,005-438,376)	398,523 (256,163-540,884)
Colorectal	1,177,228 (1,152,278-1,202,178)	766,873 (716,481-817,266)	835,104 (686,381-983,828)

Cancer screening in low- and middle income countries

169 - Poster Presentation

How far are Albanian women from a culture of cancer prevention? A survey on their attitudes and behavior towards breast and cervical cancer early detection in the framework of an Euro Mediterranean collaborating network - the INCA project.

Jaramillo[1], Filipi[2], Ylli[2], Shundi[2], Dotti[1], Casella[1], Tomatis[1], Segnan[1], Ponti[1], Bisanti[1], Giordano[1]
[1]Azienda Ospedaliero Universitaria Città della Salute e della Scienza di Torino, TURIN, Italy
[2]Albanian Institute of Public Health, TIRANA, Albania

Background Breast and cervical cancer incidence, and incidence mortality ratio, represents for Albanian women a major health problem. Due to limited infrastructure and resources, the National Cancer Control Plan 2011-2020 does not foresee mass screening programs but education/sensibilization of the population and medical personnel. In 2017 a survey was conducted to assess the effects of awareness campaigns on women's attitudes/behaviors towards breast and cervical cancer early detection; secondary objective was identifying barriers/facilitators to early detection.
Methods A cross-sectional survey was administered to a sample of 1000 women aged 30-50 in 18 urban and rural areas (Fieri prefecture). Univariate and bivariable analyses are performed to determine factors associated with attitudes and behaviors towards early detection.

Results Out of 1000 women, 899 were interviewed (half in urban, half in rural areas). 809 (89.9%) and 863 (96.0%) have heard of cervical and breast cancer prevention respectively; awareness is independent of setting, age, education level, marital status and health insurance. 46.5% (376/809) did a Pap Smear and 49.1% (424/863) a mammography, mainly advised by a healthcare professional (cervical: 80.0%, breast: 84.0%). Nearly half did it once in a lifetime (cervical: 51.3%, breast: 43.4%). The most influencing barriers for not being tested are lack of healthcare professionals advise and cost affordability.
Conclusion Data suggest awareness-raising measures had an effect on women's behaviors. Surprisingly no differences emerged between subgroups we would have expected (e.g. urban vs rural). Despite the absence of an organized program, half of interviewees were tested for cervical cancer. Similar numbers for breast cancer within a young population could highlight some inappropriateness. Information from both tested and non-tested women, highlight the key role of healthcare providers in promoting a culture of prevention. Above study's outcomes, creating for this country a framework build upon high quality public health methodologies is an added value.

Cancer screening in low- and middle income countries

171 - Poster Presentation

Predictors of breast disorders detected by clinical breast examination during pregnancy and postpartum in Ibadan, Nigeria

S.O. Odedina[1], I.O. Ajayi[2], I.O. Morhason-Bello[3], B. Adedokun[2], D. Huo[4], O.I. Olopade[4], O.A. Ojengbede[3]
[1]West African Breast Cancer Study Unit, IKEJA, Nigeria
[2]University of Ibadan, IBADAN, Nigeria
[3]College of Medicine, IBADAN, Nigeria
[4]University of Chicago, ILLINOIS, United States of America

Background: Predictors of breast disorders (BD) detected during pregnancy and six months postpartum were identified to improve interventions for prevention and control of pregnancy-associated breast disorders.
Methods: A longitudinal study of pregnant women attending selected antenatal clinics representing the three levels of health care system was conducted in Ibadan, Nigeria. The women were followed up during their third trimester, 6-weeks and 6-months postpartum. A pretested interviewer-administered questionnaire was used to collect information on personal characteristics and potential risk factors at recruitment. Clinical breast examination was performed at recruitment and follow-ups using MammaCare® method. Breast disorders were classified as palpable lumps, inflammation, persistent pain or abnormal nipple discharge. Physical Activity (P.A.) was measured using Metabolic Equivalents of Task (min/week). Generalized linear marginal model was used to determine factors associated with BD in pregnancy and 6-months postpartum, and cox proportional hazard model was used to determine predictors of time to first BD detection at $p<0.05$.
Results: A total of 1248 pregnant women was recruited. Two hundred and twenty three (17.9%) women were found to have BD, and 94.6% of these had breast lumps. Women with history of benign breast diseases were likely to have BD in pregnancy and 6-months postpartum (aOR = 2.18, 95% CI = 1.21 – 3.92). Factors associated with a higher hazard of BD among 1099 women without BD at recruitment were history of breast trauma (aHR = 3.74, 95% CI = 1.45 – 9.67), ≥3 abortions compared to none (aHR = 2.25, 95% CI = 1.04 – 4.83) and women with lowest quartile of P.A. compared to women found with lower middle quartile of P.A. (aHR = 2.72, 95% CI = 1.24 – 5.98).
Conclusion: We found moderate physical activity, avoiding breast trauma and reducing abortions to be protective of breast disorders in pregnancy and six months postpartum.

Cancer screening in low- and middle income countries

187 - Oral Presentation

Global elimination of cervical cancer: estimates from mathematical models

J Kim[1], M Brisson[2], K Canfell[3], E Burger[1], D Martin[2], E Benard[2], K Simms[3], M Drolet[2], S Sy[1], C Regan[1], A Keane[3], M Smith[3], MC Boily[4], N Broutet[5], R Hutubessy[5]
[1]Harvard TH Chan School of Public Health, BOSTON, United States of America
[2]Laval University, QUEBEC, Canada
[3]Cancer Council New South Wales, SYDNEY, Australia
[4]Imperial College, LONDON, United Kingdom
[5]World Health Organization, GENEVA, Switzerland

Background. In May 2018, the World Health Organization Director-General issued a call to eliminate cervical cancer (CC) as a public health problem. We evaluated potential scenarios of vaccination against human papillomavirus (HPV) and CC screening in low and lower-middle income countries (LMIC) to examine feasibility and timing of elimination at different elimination thresholds of cancer incidence.
Methods. Three independent modeling groups projected reductions in CC incidence over time in 78 LMIC under standardized assumptions of HPV vaccination, CC screening and treatment. HPV vaccination of 9-year-old girls only (with single-year catch-up to 14-year-olds) was assumed to reach high and rapid uptake (80-90%) and conferred 100% protection against HPV16/18/31/33/45/52/58 over the lifetime; screening involved HPV testing once or twice per lifetime at ages 35-45 with gradual uptake ranging from 45-90% and loss-to-follow up of 10%.
Results. All three models predicted that girls-only HPV vaccination can result in CC incidence of <10 per 100,000 women-years in most LMIC except in sub-Saharan Africa. In order to meet a lower threshold of <4 per 100,000 women-years, screening at least twice per lifetime is necessary. With screening, the timeframe for CC elimination at either threshold ranged from 25-40 years in LMIC. Results were most sensitive to the starting incidence rates in each country. Male vaccination and increasing screening frequency contributed to faster and greater reductions in CC incidence; vaccinating older age cohorts resulted in faster decreases in incidence, but did not change the steady-state level of incidence reduction.
Conclusions. In this collaborative global modeling analysis, we found robustly across three independent models that HPV vaccination will play a vital role in CC elimination, but CC screening will expedite cancer reductions and will be necessary for elimination in countries with higher starting incidence rates. Future work will examine the cost-effectiveness of different strategies to achieve CC elimination.

Cancer screening in low- and middle income countries

230 - Oral Presentation

Use of thermo-coagulation within a ‘screen and treat' cervical cancer screening programme in Malawi -outcomes at one year, professional perspectives, and client experience

Campbell[1], Kabota[2], Chirwa[2], Morton[2], Ter Haar[2], A Cubie[1]
[1]Uinversity of Edinburgh, EDINBURGH, United Kingdom
[2]Nkhoma Hospital, NKHOMA, Malawi

Background: Thermo-coagulation is an alternative treatment to cryotherapy within ‘screen and treat’ cervical screening services using visual inspection with acetic acid (VIA) in resource-constrained settings. This ablative treatment is suitable for low-grade squamous epithelial lesions.
Aim: To evaluate the effectiveness of thermo-coagulation in the treatment of VIA-positive lesions within a ‘screen and treat’ programme in Malawi, and its acceptability to clients and providers.
Methods: Over the last four years, the Nkhoma Cervical Cancer Screening Programme has implemented a ‘screen and treat’ approach using VIA and treatment using thermo-coagulation in a rural district general hospital and associated health centres. Women with VIA-positive lesions are offered treatment with thermo-coagulation; treated women are requested to return for review at one year. Semi-structured qualitative face-to-face interviews were carried out in English with nineteen providers in nine health centres associated with Nkhoma Hospital. A patient experience questionnaire using validated facial pain scales was developed and translated into Chichewa.
Results: Between October 2013 and July 2017, over 1,650 women have received treatment with thermo-coagulation. Of a cohort of 446 treated women who had returned for a 1-year review visit by July 2017, only 20 (4.48%) were VIA-positive, i.e. a treatment failure rate of < 5%, comparable with the international literature. Relationships between HIV status, initial VIA positivity, age, and treatment outcomes, will be presented. Staff reported professional satisfaction in being able to offer treatment consistently to VIA-positive clients, closer to their communities. Over 120 women have completed pain scales questionnaires following treatment with the traditional machine, or with one of the two new hand-held models.
Conclusions: In many low-resource settings, VIA-based screening with robust treatment protocols will remain central to cervical cancer control until the promise of HPV vaccination is fully realised. Thermo-coagulation is an effective treatment modality, acceptable to clients and patients.

Cancer screening in low- and middle income countries

232 - Oral Presentation

Cost-effectiveness of colorectal cancer screening in a low incidence country: The example of Saudi-Arabia

S.K. Naber[1], M.A. Almadi[2], G. Guyatt[3], F. Xie[3], I. Lansdorp-Vogelaar[1]
[1]Erasmus MC, University Medical Center Rotterdam, ROTTERDAM, The Netherlands
[2]King Saud University, RIYADH, Saudi Arabia
[3]McMaster University, HAMILTON, Canada

Background
Although colorectal cancer (CRC) is the most common cancer among males in Saudi Arabia, the incidence is low compared to European countries and the US, where screening has been widely implemented. This study evaluates the potential cost-effectiveness of CRC screening in Saudi-Arabia.
Methods
We used the well-established MISCAN microsimulation model for CRC to evaluate different screening programs for a hypothetical cohort of 1000 45-year-old Saudi-Arabian males. First, the model was adjusted to the life-expectancy, age-specific CRC incidence, CRC stage distribution, and stage-specific mortality rates observed in Saudi-Arabian males. Second, we simulated four different screening strategies; once-only colonoscopy at age 45, 10-yearly colonoscopy at ages 45-75, annual fecal immunochemical testing (FIT) at ages 45-75, and biennial FIT at ages 45-75. Costs and quality-adjusted life years (QALYs) were obtained from the local context, both discounted at an annual rate of 3%.
Results
In the absence of screening, the model predicted 14 CRC cases and 9 CRC deaths at a total cost of $446,000. Biennial FIT prevented 5 of these cases and **5** of these deaths, thereby resulting in **16** QALYs gained at an incremental cost of $318,000. Annual FIT prevented two more cases and one more death, yielding **7** more QALYs gained at an incremental cost of **$254,000**. In summary, biennial FIT had an incremental cost-effectiveness ratio (ICER) of $20,000 compared to no screening, and annual FIT of **$36,000** compared to biennial FIT.
Conclusion
Despite its low CRC incidence, a country like Saudi-Arabia might benefit from an organized CRC screening program. The optimal strategy will depend on the willingness-to-pay threshold, which is yet to be determined for the Saudi-Arabian context. Final results, including those for Saudi-Arabian females, will be presented at ICSN.

Cancer screening in low- and middle income countries

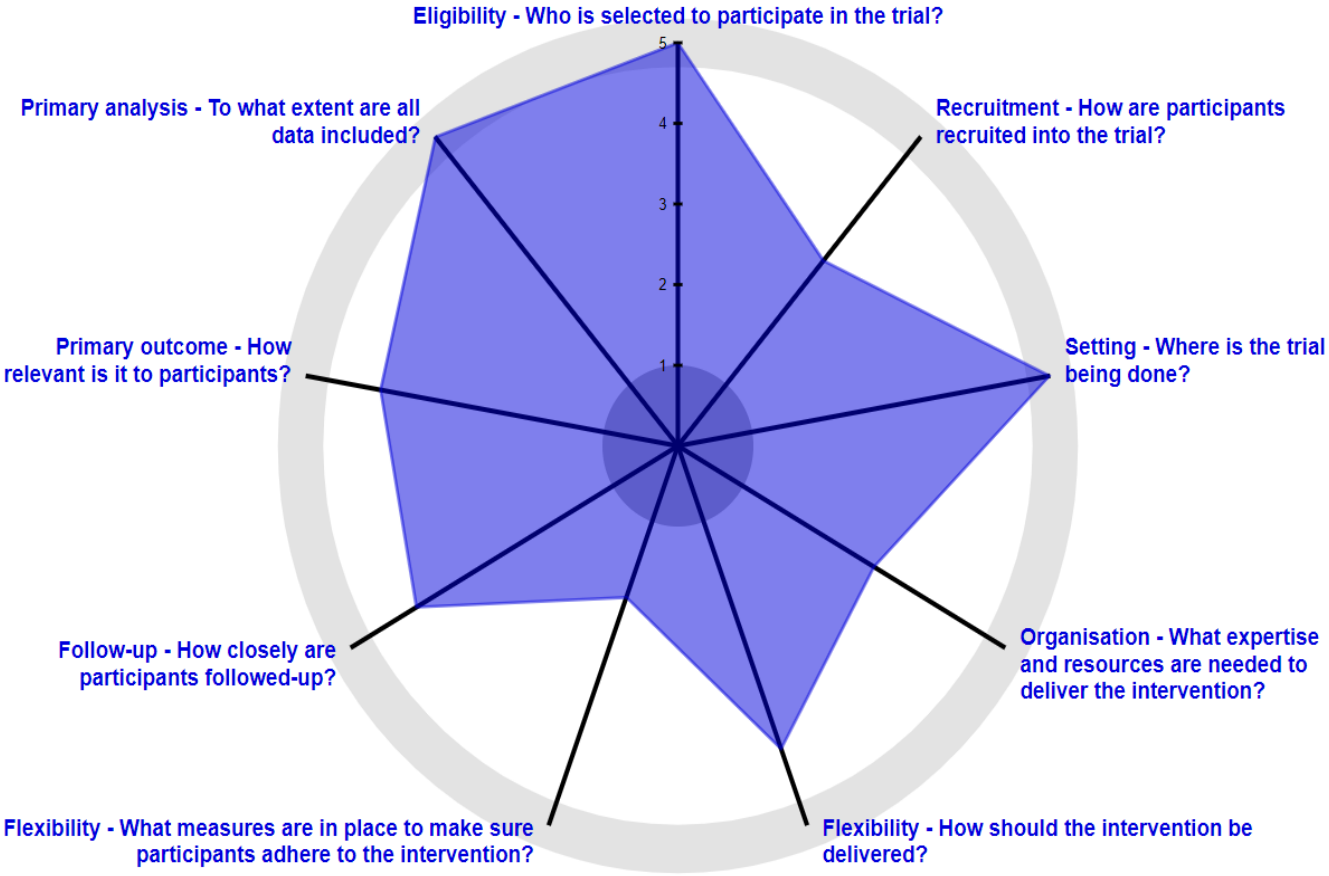
246 - Poster Presentation

Using PRECIS-2 to assess the pragmatic aspects of the ESTAMPA study for HPV cervical cancer screening and triage process.

Prajakta Adsul[1], Rol[2], Baena[2], Barbier[2], Almonte[2]
[1]National Cancer Institute, ROCKVILLE, United States of America
[2]International Agency for Research on Cancer, LYON, France

Background: Cervical cancer is the fourth most common cancer in women worldwide and low- and middle-income countries (LMICs) share the largest burden. Cervical cancer screening requires the completion of a series of steps (diagnosis and treatment) beyond initial testing. However, evidence supporting the acceptability and feasibility of primary HPV screening processes is still missing. ESTAMPA is a multi-centric screening and triage study recruiting 50,000 women ages 30-64 years, in 12 sites from 9 Latin American countries. ESTAMPA aims to evaluate different triage methods for HPV positive women and the location-specific implementation aspects. Currently, HPV-based screening is not usual care at any of the sites.
Methods: Tools such as the Pragmatic Explanatory Continuum Indicator (PRECIS-2) allows a formal approach to assess the pragmatic aspects of a study and distinguish it from an explanatory study, which helps inform its applicability and impact. The PRECIS-2 tool was applied by the ESTAMPA leading investigators to score and evaluate the study in 9 domains. Usual care was considered as a variable and dependent on the country's resources and capacity.
Results: Although ESTAMPA was not designed as a pragmatic trial, we found that it lies mostly in the pragmatic end of the continuum. Participant eligibility, study setting and primary analysis scored most highly on the pragmatic scale while flexibility in adherence scored least highly. (Fig 1)
Conclusion: Key aspects of the study can translate well to real-world settings and provide decision making guidance for future implementation of effective HPV cervical cancer screening programs.

Picture 1:



Caption 1: Fig 1. PRECIS-2 wheel for ESTAMPA

Cancer screening in low- and middle income countries

247 - Poster Presentation

Providers and community health workers perceptions on scaling-up cervical cancer screening programs in the public health sector in India

Prajakta Adsul[1], Srinivas[2], Madhivanan[3]
[1]National Cancer Institute, ROCKVILLE, United States of America
[2]Public Health Research Institute of India, MYSORE, India
[3]Florida International University, MIAMI, United States of America

Cervical cancer is the second most frequent cancer diagnosed among women in India and accounts to nearly 1/3rd of the global cervical cancer deaths. Screening using visual inspection methods presents an evidence-based intervention for reducing cancer related mortality. Consequently, India has recently launched a national program for cervical cancer prevention in the public-sector led primary health care settings. The goal of this study was to conduct a qualitative assessment of health system stakeholders that could influence the scale-up of cervical cancer screening programs in the public health system.
A total of 15 primary care providers were interviewed and 6 focus groups discussions were conducted with 35 community health workers; all working in the public health system in the Mysore district, India. All interviews were transcribed, and transcripts were analyzed with Atlas.ti, informed by a grounded theory approach, to identify emerging themes.
Study participants perceived a strong need for cervical cancer screening services in their community however, neither group members reported being familiar with the screening tests for cervical cancer. Providers reported that the existing public health care delivery system is setup for maternal and child care and cancer screening services have different objectives and functions which can be challenging for point of care providers and community health care workers. These challenges were mainly associated with promoting a culture of cancer prevention, motivating asymptomatic women, and providing financial support for screen positive women for diagnosis and treatment.
Provider-, patient-, and system-level perspectives need to be incorporated to generate an effective scale-up strategy. Future efforts need to incorporate implementation strategies that (1) focus on improving facility and provider level readiness for delivering cancer prevention services, (2) increasing the acceptability and uptake of cancer screening tests among asymptomatic women in the community, and (3) reducing the cost of follow-up for diagnosis and treatment.

Cancer screening in low- and middle income countries

276 - Poster Presentation

Downstaging in opportunistic breast cancer screening in Brazil: a temporal trend analysis

DB Vale[1], C Cardoso-Filho[1], JY Shinzato[1], FS Spreafico[1], P Basu[2], LC Zeferino[1]
[1]Unicamp, CAMPINAS, Brazil
[2]IARC, LYON, France

Background
Breast cancer is the most common female cancer in Brazil with an estimate of 60 thousand new cases per year. A widespread use of mammography opportunistic screening has been observed in the last 20 years. The present study aimed to analyze the trends in breast cancer stage distribution at diagnosis as a function of age in the period.
Methods
This was a study of temporal trends of stage distribution of the women with breast cancer diagnosed between 2000 and 2015 in São Paulo state, Brazil. Data were accessed by the Hospital Cancer Registry. The sample was described according to age, stage and date of diagnosis by absolute frequency and proportions (%). For trends, the Cochran-Armitage test was used with 5% level of significance (P-value<0.05).
Results
A total of 93,674 women were included in the analysis, with a median age of 56 years old. One third (34.4%) of the women were younger than 50 years old, and stage II was the most frequent one (36.4%), even when analyzed by age groups. Stage 0 corresponded to 7,7% (7,247 women) of cases. In the period there was significant trend towards an increase on Stages 0, I and IV (P<0.01) and a trend towards a decrease on Stages IIA, IIB and IIIB (P<0.001). Stage IIA was the more prevalent until 2009, and stage I was the more prevalent afterwards. The trend to increase the proportion of stages 0 and I and to decrease the proportion of stages IIA, IIB and IIIB were significant in all age-groups.
Conclusions
Breast cancer cases were diagnosed mainly at early stages, and about one third of cases were younger than 50 years old. Downstaging has been shown. Opportunistic screening may have supported these results. Further studies are needed to show whether these results will impact the prognosis.

Cancer screening in low- and middle income countries

279 - Poster Presentation

Performance of the breast cancer screening program in Campinas, Brazil

DB Vale, JO Fernandes, AC Marcelino, B Gozzi, N Moraes, C Cardoso-Filho
Unicamp, CAMPINAS, Brazil

Background
Breast cancer screening programs in low- and middle-income countries are poorly studied. In Brazil screening is recommended by mammography for women 50-69 years old every two years. This study evaluates the performance of breast cancer screening in the city of Campinas, Brazil, according to the age of the women, through the analysis of program quality indicators.
Methods
This was a cross section study that used secondary aggregated data from 2010-2014 of the public health system of Campinas, an urban city in São Paulo, Brazil. The variables were absolute number of mammograms performed, coverage, results and ratio of benign/malignant biopsies, as a function of age. Figures were showed as proportions.
Results
In the period 127,794 mammograms were performed, and out of them 47% were in women 50-69 years old and 36% in women 40-49 years old. The annual coverage of the population that uses the public health system was 29% in women 50-59 years old and 24% in women 60-69 years old. BI-RADS 0 results corresponded to 10% of the total in women 40-49 years old. Of the 1,176 biopsies, the benign/malignant ratio for the groups 40-49 years, 50-59 years, 60-69 years and >69 years were 1.3, 1.0, 0.9 and 0.5, respectively.
Conclusion
The annual coverage of the population that uses the public health system in the period was lower than the desirable. About 1/3 of mammograms were performed in women 40-49 years old, group with the highest rates of inconclusive mammograms and benign biopsies. The breast cancer opportunistic screening program in the city could be improved.

Cancer screening in low- and middle income countries

281 - Poster Presentation

HPV BASED SCREENING MAY BE THE BEST SUITED SCREENING ALGORITHM - EVIDENCE FROM A POPULATION BASED CERVIX CANCER SCREENING PROGRAM FROM RURAL INDIA

J SUBRAMANIAN
CANCER INSTUTUTE(WIA), CHENNAI, India

Worldwide 570000 women were diagnosed with cervical cancer in 2018 and approximately 90% of 311000 cervix cancer related deaths occurred in low- and middle-income countries (WHO). In India where the incidence is 25/100000 there is no policy for cervical cancer control.

Background

Three randomised control studies for cervix cancer screening conducted in India show variable results for mortality impact with a follow up of nearly 10-15 years. The present study is an implementation of low-cost HPV DNA based cervix cancer screening program in rural India that has one of the highest incidences of cervical cancer.

Methodology

In an organised screening program, point of care low cost HPV DNA testing is done at the door step by trained health nursing assistants who do the sampling, analysis, reporting and follow up of the positive women. Visual tests are done after HPV sample collection and results recorded. HPV positive women are recalled and offered colposcopy and biopsy and treated accordingly.

Results

Between June 2018 and 31st Jan 2019 7241 women of age 30-59 years have been screened. 34 cases of CIN2+ diagnosed and 21/34(61.7%) received treatment. The median age of screened women 39 years positivity rate is 6.7% and VIA positivity rate is 16%. Cost per screened woman is 20.14 and 14.32 USD respectively for HPV and visual tests, pending a detailed cost-effectiveness analyse

Conclusions

With 50% of screened population around 40years high positivity rate for visual tests and a with more cost-effective point of care HPV testing, developing an HPV DNA based screening and treatment algorithm maybe the best suited screening policy for a LMIC like India.

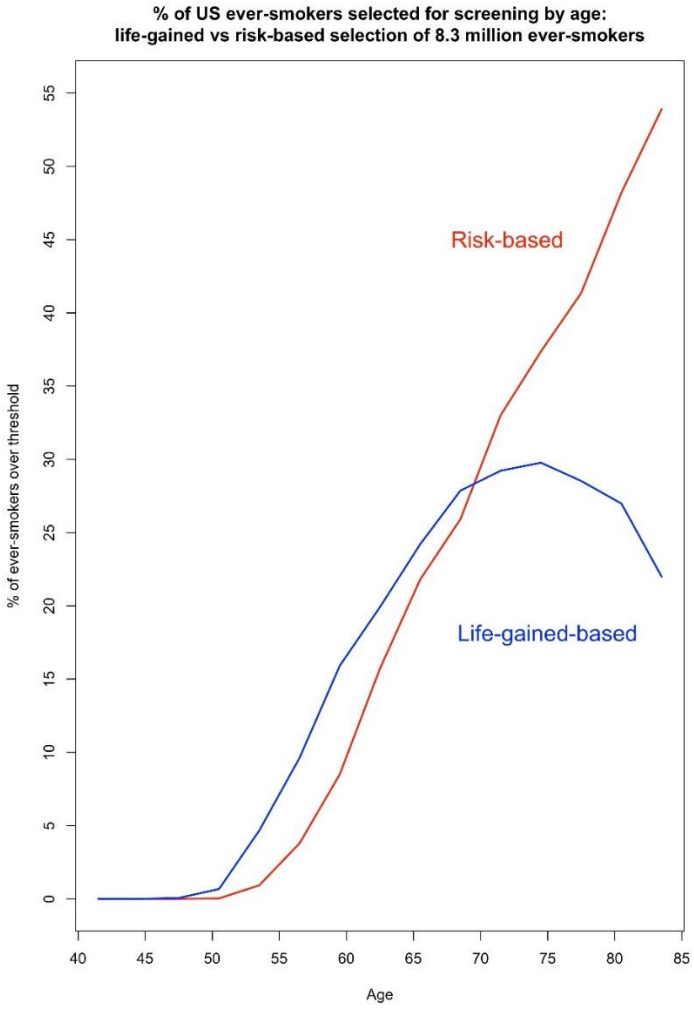
Lung cancer screening

34 - Oral Presentation

Life-gained-based versus risk-based selection of smokers for lung-cancer screening

L. C. Cheung[1], C. D. Berg[1], P. E. Castle[2], H. A. Katki[1], A. K. Chaturvedi[1]
[1]National Cancer Institute, BETHESDA, United States of America
[2]Albert Einstein School of Medicine, BRONX, NY, United States of America

Background: Individualized risk-based selection of ever-smokers for lung-cancer screening could improve efficiency over US Preventive Services Task Force (USPSTF) guidelines. However, such selection would include older ever-smokers with co-morbidities, and lower life-expectancy. Instead, we propose selecting ever-smokers for screening based on individualized gain in life-expectancy.
Methods: Using the US-representative National Health Interview Survey data, we developed and validated an overall mortality model for ever-smokers; estimated life-expectancy in the presence and absence of CT-screening; and projected outcomes of a National Lung Screening Trial (NLST)-like screening program under life-gained-based vs. risk-based selections.
Results: The mortality model had good calibration (Expected/Observed=1.00;95%CI=0.98-1.02) and discrimination (Area-Under-Curve=0.847;95%CI=0.841-0.853) in US ever-smokers aged 40-84 years. Selecting the same number of ever-smokers as USPSTF-guidelines in 2013-2015 (8.3 million), we estimate that life-gained-based vs. risk-based selection would significantly increase life-expectancy from CT-screening overall (633,400 vs. 607,800 years,p<0.001), per lung-cancer detected (1.45 vs. 1.35 years,p<0.001), and per lung-cancer death-averted (12.05 vs. 11.05 years,p<0.001), while targeting a similar number of preventable lung-cancer deaths (52,600 vs 55,000,p<0.001) in the US population. The 1.56 million individuals included in life-gained-based but not risk-based selection have lower risk (5-year lung-cancer-death-risk=1.16% vs. 1.93%,p<0.001) but substantially higher life-years gained per averted death (21.7 vs. 8.9,p<0.001). These gains would arise from preferential inclusion of younger ever-smokers (mean=59 vs. 75 years) with fewer comorbidities (mean=0.75 vs 3.7) in life-gained-based vs. risk-based selection.
Conclusions: Life-gained-based selection could maximize the benefits of lung-cancer screening in the US population by including ever-smokers who have not only high lung-cancer risk but also high life-expectancy.



Caption 1: Life-gained selection >= 16.2 days of life expectancy gained from CT-screening; risk-based selection >= 1.4% 5-year lung-cancer death risk

Lung cancer screening

106 - Oral Presentation

A cost-effectiveness analysis of lung cancer prevention strategies at population level combining smoking cessation interventions and early detection with low-dose computed tomography in Spain

Garcia[1], Vidal[1], Santiago[1], Fu[1], Rue[2], Carles-Lavila[3], Trapero-Bertran[4], Diaz[1]
[1]Catalan Institute of Oncology, HOSPITALET DE LLOBREGAT, Spain
[2]University of Lleida- IRBLLEIDA, LLEIDA, Spain
[3]University Rovira i Virgili, REUS, Spain
[4]International University of Catalonia, BARCELONA, Spain

Objective: To assess the cost-effectiveness of smoking cessation approaches combined with screening in Spain
Methods: Markov-based microsimulation models that described the natural history of lung cancer and incorporated several prevention strategies were used. The models were stratified by sex calibrated to age-specific lung cancer incidence and mortality, and general mortality in Spain. Strategies combining smoking cessation interventions (brief and intensive) and screening with low-dose computed tomography (LDCT) at different frequencies and ages in populations with different levels of lung cancer risk were considered. Discounted lifetime quality-adjusted life years (QALYs) and costs at a rate of 3% were used to calculate incremental cost-effectiveness ratios, defined as additional costs in 2017 Euros per QALY gained.
Results: Lung cancer screening was generally less effective and more costly than smoking cessation interventions. In men, the most cost-effective strategy would be to implement intensive intervention at ages 35, 40 and 45, combined with screening every three years between the ages of 55 and 65 at a cost of €21.703 per QALY compared with the next most costly strategy, and €4,732 per QALY compared with no intervention. In women, strategies that consider screening exceed the cost-effectiveness threshold in the incremental analysis (>€25,000 per QALY). To implement brief intervention at ages 35, 40 and 45 would be cost-saving, and adding screening once in a lifetime would cost €29.634 per QALY compared with the next most costly strategy, and €7,388 per QALY compared with no intervention.
Conclusion: In men, the integration of any smoking cessation approach with a screening programme using LDCT is cost-effective and substantially diminishes the burden of lung cancer, especially when providing several intensive interventions for quitting smoking at early ages. In women, the pattern seems to be different with screening strategies being less cost-effective.

Lung cancer screening

119 - Poster Presentation

Identifying high-risk individuals for lung cancer screening -going beyond NELSON and NLST eligibility criteria

Garcia, Fu, Travier, Vidal
Catalan Institute of Oncology, HOSPITALET DE LLOBREGAT, Spain

Background: Individuals at high risk of developing lung cancer may benefit from early detection through screening based on low-dose CT. However, because low-dose CT screening has non-negligible adverse, identifying the most appropriate target population is essential to maximise screening benefits and minimize adverse effects.
Objective: To compare different strategies to identify the proportion of the Spanish population at high risk of developing lung cancer.
Methods: Data from the Spanish National Interview Health Survey of 2011-2012 (21,006 individuals) was used. The proportion of participants at high risk of developing lung cancer was calculated using the Dutch-Belgian *Lung Cancer Screening* trial (NELSON) criteria, the U.S. national lung screening trial (NLST) criteria, and a 6-year prediction model ($PLCO_{2012}$).
Results: The prevalence of individuals at high risk of developing lung cancer according to the NELSON criteria was 6.6% (9.7% for men, 3.9% for women) and for the NLST criteria was 4.9% (7.9% for men, 2.4% for women).
Among the 1,034 subjects who met the NLST criteria, 533 (508 men and 148 women) had a 6-year lung cancer risk ≥2.0%. The combination of these two selection strategies showed that 2.5% of the Spanish population had a high risk of developing lung cancer. However, we observed that some individuals with a 6-year risk ≥2% did not meet the NLST criteria: <55 years old, often underweight, with extremely high cigarette consumption, individuals who smoked less than 30 pack-years but had other risk factors, such a COPD diagnosis and Individuals who stopped smoking (≥ >15 years) after having smoked for many years
Conclusions: A systematic selection strategy applied may have failed to identify specific subgroups that could also benefit from programmes designed to reduce and/or monitor their lung cancer risk. Further research is needed to determine which selection strategy achieves a higher benefit/ harm ratio.

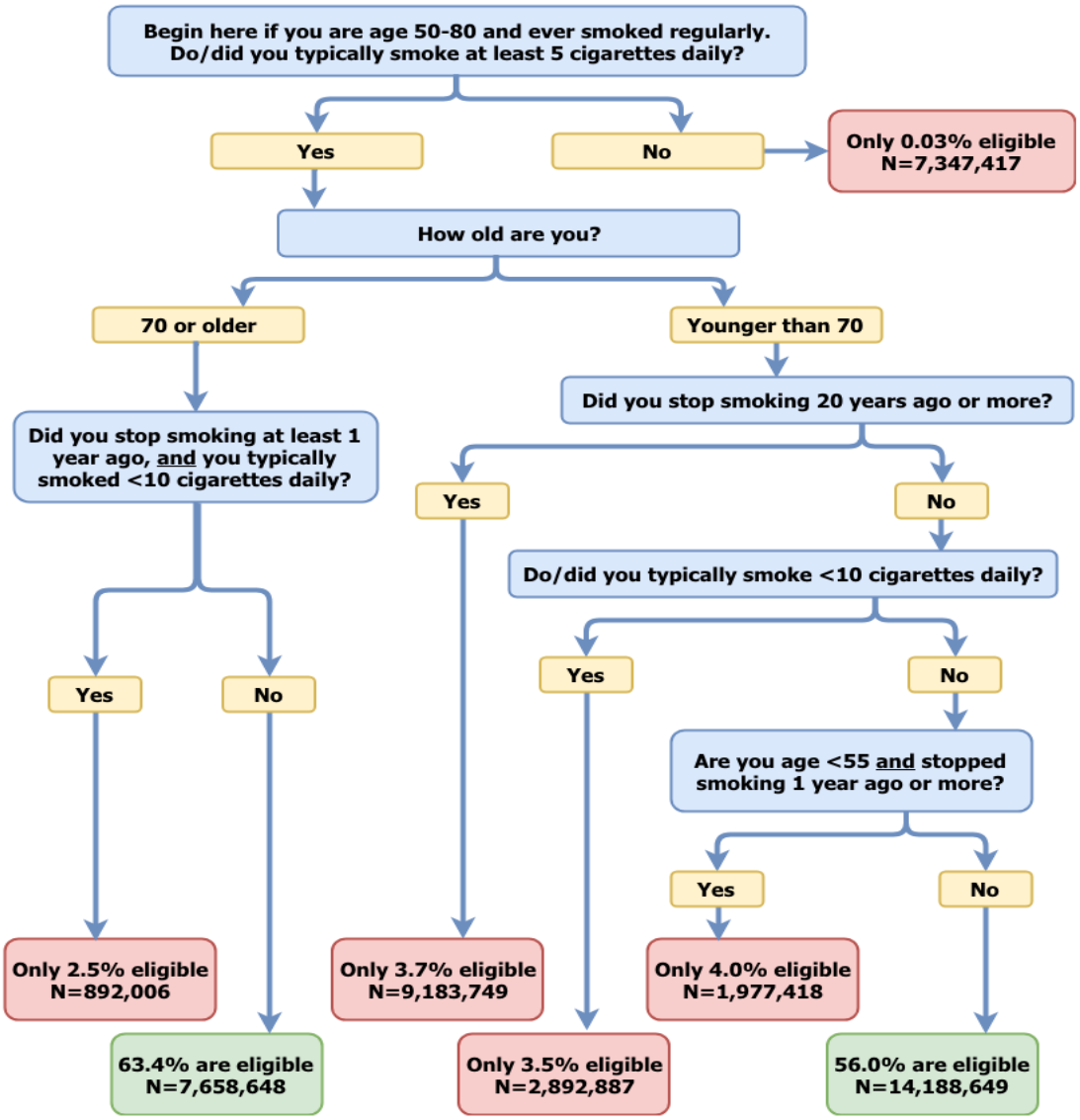
Lung cancer screening

120 - Oral Presentation

A simple tool to prioritize U.S. ever-smokers for CT screening eligibility assessment

Robbins[1], Cheung[2], Callister[3], Crosbie[4], Guida[1], Berg[2], Brennan[1], Katki[2], Johansson[1]
[1]International Agency for Research on Cancer, LYON, France
[2]National Cancer Institute, ROCKVILLE, United States of America
[3]Leeds Teaching Hospitals, LEEDS, United Kingdom
[4]University of Manchester, MANCHESTER, United Kingdom

Background: CT lung screening can be more efficient when risk models are used to determine eligibility. However, detailed risk assessment requires time spent by a healthcare provider and may present a barrier to screening when resources are limited. Here, we developed a tool to identify ever-smokers with low probability of risk-based eligibility.
Methods: We analyzed ever-smokers aged 50-80 in the representative 2015 U.S. National Health Interview Survey. We defined ever-smokers with 6-year risk ≥1.3% by the 12-question PLCOm2012 model as screening-eligible. We considered that detailed risk assessment may be inefficient when the probability of eligibility is less than 5%. Accordingly, we used cross-tabulations of age, cigarettes-per-day, and quit-years to identify groups in whom risk assessment might be avoided.
Results: There are approximately 44,140,774 U.S. ever-smokers aged 50-80 who could consider detailed risk assessment. However, a decision-tree tool involving 5 or fewer questions identified 22,293,477 ever-smokers (50.5%) who are <5% likely to be screening-eligible (Figure). This includes all those who smoke(d) <5 cigarettes-per-day. Over 1 year, approximately 103,512 lung cancers were predicted among eligible ever-smokers. If our tool were used, then 1,784 of these eligible cases (1.7%) would not undergo screening.
Conclusion: When resources are limited, a simple decision-tree tool could avoid detailed risk assessment for more than half of U.S. ever smokers aged 50-80, while still identifying 98.3% of eligible cases. Such a tool could be self-administered by patients in the waiting room or applied automatically to electronic health records to optimize use of provider time.



Picture 1:
Caption 1: Decision-tree tool to prioritize U.S. ever-smokers for CT screening eligibility assessment

Lung cancer screening

138 - Poster Presentation

Estimating Mean Sojourn Time of Lung Cancer Screening with Computed Tomography

Ku[1], Chien[2], Chen[1]
[1]National Taiwan University, TAIPEI, Taiwan
[2]China Medical University Hospital, TAICHUNG, Taiwan

Background
There are few studies reporting mean sojourn time (MST) of lung cancer by chest X-ray (CXR) and computed tomography (CT) in smokers and non-smokers. We aimed to estimate MST from five studies with computed tomography (CT) screening alone and NELSON trial and then aimed to estimate the MST for non-smokers using data from Taiwan by referring to the MST of CT estimated from previous data. countries.
Methods
We elicited information on number of prevalent and subsequent screenees and lung cancer cases from five non-experimental studies and the NELSON trial to estimate MST with 3-state Markov model and Bayesian approach. A hospital-based retrospective study on 2659 lung cancer patients was conducted in Taiwan to estimate the MST of two modalities on CXR and CT. Effectiveness of CT in reducing mortality was projected.
Results
The estimated median and 95%CI of MST(year) were 3.86 (3.42-3.99), 1.38 (0.63-3.18), 1.68 (1.06-3.02), 2.02 (1.06-3.63) and 2.13 (0.96-3.75) for one-arm screening with CT. The estimated median MST(95%CI) as a whole was 2.06 (0.42-3.83). Regarding the randomized controlled trial (RCT) with two arms (CT scan vs chest X-ray(CXR)), the MST with CT was estimated as 2.53 (1.50-3.88), advanced diagnosis by around 1.5 year compared to CXR (1.01 years). the estimated median (95% CI) of MST (months) for smokers and non-smokers were 3.33 (3.00-6.07) and 6.72 (4.32-10.03). It was estimated that the MST for non-smokers ranged from 3.5 years to 4.5 years. Effectiveness of various screening polices was estimated.
Conclusion
Longer MST for CT screening compared to CXR has suggested that CT scan may be more effective in early detection for lung cancer. Borrowing information on the estimated MST from Western countries, the MST of CT for non-smokers was longer than that of smokers. These estimates were used for projecting the effectiveness of CT in different target populations.

Lung cancer screening

152 - Poster Presentation

Screening for early lung cancer, COPD and cardiovascular disease using low-dose chest CT in China: Rationale and design of the NELCIN-B3 study

Y Du[1], Q Li[2], G Sidorenkov[1], M Vonder[1], GH De Bock[1], R Vliegenthart[1], M Rook[1], MD Dorrius[1], MA Heuvelmans[1], HJM Groen[1], P Van der Harst[1], Y Zhao[3], X Cui[1], Y Huang[3], K Chen[3], Y Zhang[4], X Xie[4], Z Ye[3], M Oudkerk[5], S Liu[2]
[1]University of Medical Center Groningen, GRONINGEN, The Netherlands
[2]Shanghai Changzheng Hospital, SHANGHAI, China
[3]Tianjin Medical University Cancer Institute and Hospital, TIANJIN, China
[4]Shanghai General Hospital, SHANGHAI, China
[5]University of Groningen, GRONINGEN, The Netherlands

Objective: To assess the diagnostic performance of the new NELCIN-B3 protocol (an extension to NELSON protocol) using low-dose computed tomography (CT) for early detection of lung cancer, chronic obstructive pulmonary disease, and cardiovascular disease (the Big-3 diseases) in a Chinese population, to optimize the methods of early detection of these diseases in a Chinese population.
Methods/design: Diagnostic randomized controlled and prospective cohort studies will be conducted in three hospitals in China in 2017-2021. 12,000 participants will be recruited and randomized into the screening and control arms. The participants in the screening arm will undergo low-dose chest computed tomography (CT) and management according to the NELCIN-B3 protocol. This protocol is optimized for quantitative assessment of early imaging biomarkers of Big-3 diseases: lung nodule volume, volume doubling time, coronary calcium score, emphysema score and bronchial wall thickness. In addition, data on laboratory parameters and lung function test will be collected. The participants in the control arm will be managed according to the standard hospital protocol that is merely based on visual assessment of the Big-3. All the participants will fill the questionnaire about potential risk factors of Big-3, medical history and overall health status. Four years after the initial assessment the incidence of the Big-3 and related mortality will be evaluated.
Discussion: We expect to assess and discuss the performance of the NELCIN-B3 CT screening protocol as compared to currently used methods, optimize cut-off values of imaging biomarkers of Big-3 in a Chinese population, with the aim to reduce the false-positive rate and the number of unnecessary follow-up tests. The ultimate goal is to improve the early detection of Big-3 in China and explore the role of other collected data that may be integrated into personalized health strategies for early detection.

Lung cancer screening

188 - Poster Presentation

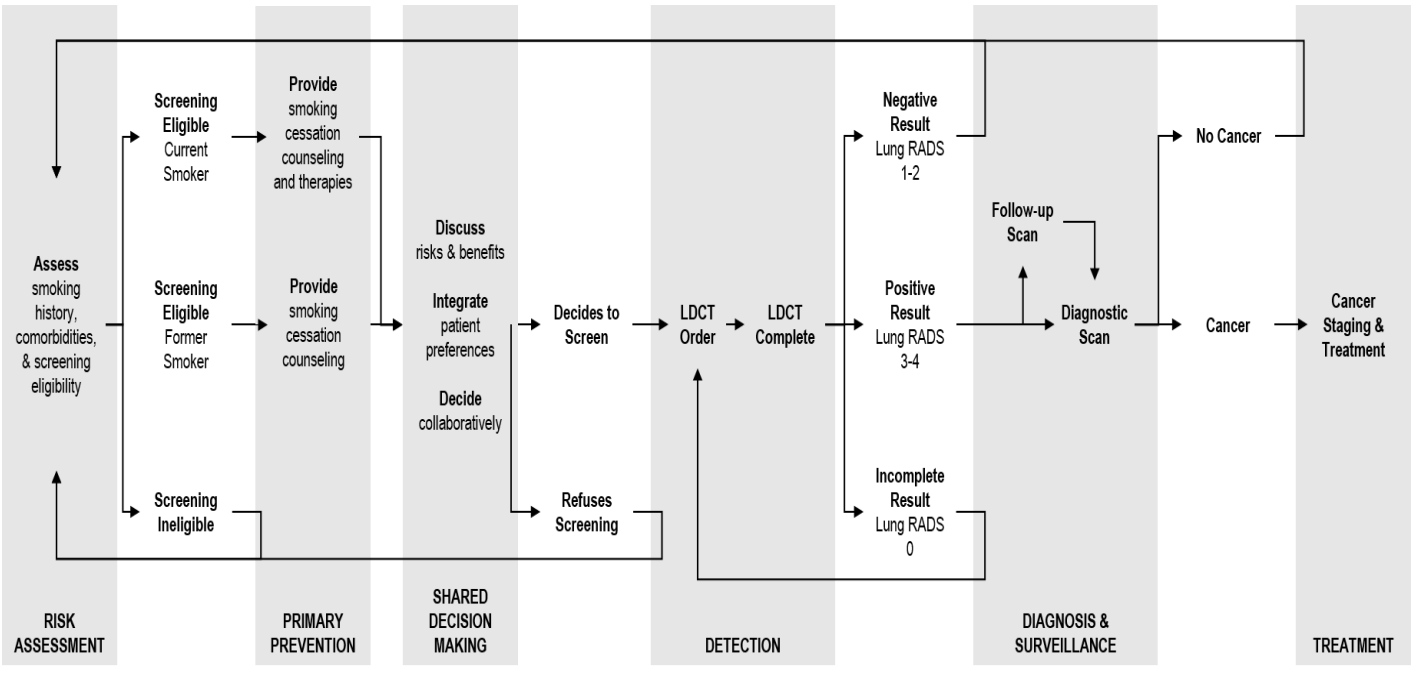
Describing Lung Cancer Screening Processes and Outcomes Across US Healthcare Systems: The Lung Population-based Research to Optimize the Screening Process (PROSPR) Research Center

Rendle[1], Burnett-Hartman[2], Neslund-Dudas[3], Greenlee[4], Honda[5], Elston Lafata[6], Marcus[7], Cooley[8], Meza[9], Oshiro[5], Schnall[1], Vachani[1], Doria-Rose[7], Ritzwoller[2], Doubeni[1]
[1]University of Pennsylvania, Perelman School of Medicine, PHILADELPHIA, United States of America
[2]Kaiser Permanente Colorado Institute for Health Research, DENVER, United States of America
[3]Henry Ford Health System, DETROIT, United States of America
[4]Marshfield Clinic Research Institute, MARSHFIELD, United States of America
[5]Kaiser Permanente Regional Laboratories - Hawai'i, HONOLULU, United States of America
[6]University of North Carolina, CHAPEL HILL, United States of America
[7]National Cancer Institute, BETHESDA, United States of America
[8]Dana-Farber Cancer Institute, BOSTON, United States of America
[9]University of Michigan, ANN ARBOR, United States of America

Numerous organizations, including the United States Preventive Services Task Force, recommend annual lung cancer screening (LCS) with low-dose computed tomography (LDCT) for high-risk adults who meet specific age, smoking, and health-status criteria. In 2015, The Centers for Medicare and Medicaid Services established national coverage for LCS in the US, requiring that shared decision-making and tobacco cessation counseling occur prior to screening to be eligible for reimbursement. Despite recommendations and coverage, LCS uptake in the United States remains low (<4%). In recognition of the need to improve and understand LCS across the population, the National Cancer Institute funded a large multisite collaborative—the Lung Population-based Research to Optimize the Screening PRocess (PROSPR) Research Center—consisting of five healthcare systems across the US (located in Colorado, Hawaii, Michigan, Pennsylvania, and Wisconsin). Using a variety of methods and data sources, the center aims to assess utilization and outcomes of LCS across diverse populations, and to identify key challenges and opportunities to improve LCS. The center will also characterize how contextual factors at multiple levels shape processes and outcomes of LCS across the screening process. In this presentation, we will present our LCS screening process model (Figure 1) outlining the steps needed to complete the screening process from risk assessment to treatment. Drawing from experiences and variations in early outcomes and screening programs across our healthcare systems, we use this process map to illustrate how at each stage there are opportunities and challenges for reducing lung cancer mortality and health disparities across the population.

Picture 1:

Figure 1. Lung Cancer Screening Process in Community Healthcare Systems



Lung cancer screening

205 - Poster Presentation

Lung cancer screening implementation in community practice: Kaiser Permanente Washington experience 2015-2018

KJ Wernli[1], G Gao[1], Leblanc[2], JS Nazarko[3], DSM Buist[1]
[1]Kaiser Permanente Washington Health Research Institute, SEATTLE, United States of America
[2]Washington Permanente Medical Group, SEATTLE, United States of America
[3]Community Memorial Hospital, VENTURA, United States of America

PURPOSE: Since the 2013 US Preventive Services Task Force recommendation of lung cancer screening, data is scarce on the implementation methods supporting adoption, and whether community experience is similar to clinical trials. We evaluated the Lung Cancer Screening Program at Kaiser Permanente Washington (KPWA), based in Washington state.
METHODS: The Lung Cancer Screening Program with low-dose CT (LDCT) launched in January 2015. Implementation components of the program included: 1) Adoption of evidenced-based guidelines to support identifying eligible members; 2) Clinical education and messaging to support rollout; 3) Electronic health record build for tracking and smartset orders to identify eligible members, orders, and exam completion; 5) Radiologic results using American College of Radiology Lung-RADS™ system and diagnostic follow-up using Fleischner Society guidelines; 6) Care coordinator to follow-up; and 7) Development of a shared decision making tool for patient discussions. We describe the uptake of LDCT in an age- and smoking-eligible population and alignment of Lung-RADS™ with expected population estimates overall among exams conducted from 2015-2018.
RESULTS: A total of 3,895 LDCT exams completed (2,521 initial and 1374 subsequent exams), among approximately 16,000 eligible members (15.8% adherence). Among initial LDCT exams, 85.9% screened negative, which increased to 88.5% on subsequent LDCT exams. On initial LDCT, the proportion of positive exams were: Lung-RADS™ 3 (6.9%); Lung-RADS™ 4A (3.2%), and Lung-RADS™ 4B, C, X (2.7%). On subsequent LDCT exams, these proportion decreased slightly to 6.1% and 2.2% for Lung-RADS™ 3 and 4A, respectively. Results were aligned with expected estimates.
DISCUSSION: KPWA program implementation demonstrates the ability to: identify eligible patients, adherence to LDCT and use of Lung-RADS™ assessment, and return to subsequent LDCT exam. System improvements to support lung cancer screening should include key implementation strategies to meet patient, clinician, and system needs to minimize potential harms and maximize benefits of screening.

Lung cancer screening

207 - Poster Presentation

Factors Associated with Adherence to Lung Cancer Screening in Academic and Community Settings

LM Henderson[1], S Sites[1], TD Tailor[2], SC Bearden[1], A Throneburg[1], R Huamani[1], MP Rivera[1]
[1]University of North Carolina at Chapel Hill, CHAPEL HILL, United States of America
[2]Duke University, DURHAM, United States of America

Background. Lung cancer screening (LCS) with low dose computed tomography (LDCT) is recommended for high-risk adults in the United States. An estimated 3-7% of eligible adults undergo LCS. Among patients who are screened, rates of adherence to the recommended annual LCS interval and factors associated with adherence are unknown.
Methods.

We utilized self-reported risk factor data and medical record data from 1,252 high-risk patients ages 55-79 years who underwent LDCT for LCS at four academic and community sites from 2014-2018. Among patients with a negative baseline LCS exam, we ascertained whether they returned for a subsequent LCS exam and if so, classified them as being adherent to recommended LCS guidelines. We examined patient characteristics associated with adherence using multivariate logistic regression and reported adjusted odds ratios (aOR) and 95% confidence intervals (95% CI).
Results.

The overall adherence rate was 37.5%. The median time between the baseline LCS exam and the subsequent exam was 396 days (13.2 months) with an interquartile range of 369-511 days (12.3-17.0 months). There were no differences in adherence by patient race, sex, body mass index, educational level, or family history of lung cancer. Patients who were 55-64 years of age were significantly more likely to be adherent than patients 65 years of age or older (aOR=1.63, 95% CI: 1.24-2.15). In a subset analysis, patients with COPD had an adherence rate of 69.4% compared to 44.3% in those without COPD (p-value=0.008).
Conclusions. Using data from a diverse group of patients undergoing LCS in academic and community settings, we found that adherence to LCS recommendations is low, with younger patients and patients with COPD more likely to undergo subsequent screening than older patients. Future work should evaluate why adherence rates are low and determine strategies to increase continued LCS in those who meet recommended screening criteria.

Lung cancer screening

218 - Poster Presentation

Lung Cancer Screening Pilot for People at High Risk: First Year Results on Cancer Detection and Staging

LS Della Mora, G Darling, H Schmidt, S Ramkissoon, MJ Walker, M Luettschwager, B Pylypenko, T Patel, V Rivera, K Pearson, K Larson, MC Tammemägi
Cancer Care Ontario, TORONTO, Canada

Background
In June 2017, Cancer Care Ontario initiated organized lung cancer screening at three pilot sites in Ontario. A key indicator of pilot success is detection of lung cancers at early stages. The Ontario Cancer Registry (OCR) tracked lung cancer diagnosis, stage and histology.
Methods
Participant data were collected from administrative databases, the OCR pathology database (eMaRC) and OCR clinical source records (Resolink). Confirmed lung cancer cases were staged using the AJCC 8th edition by a team of cancer staging analysts.
Results
As of May 2018, 1,624 participants received a baseline LDCT scan. The distribution of Lung-RADS™ scores was: Lung-RADS™ 1: 575 participants (35%); Lung-RADS™ 2: 748 (46%); Lung-RADS™ 3: 183 (11%); and 118 (7%) had Lung-RADS™ scores of 4A, 4B or 4X, which triggered additional follow-up and/or diagnostic workup. 26 lung cancers were confirmed and fully staged.
Of the 26 staged cases: 62% (n=16) were stage I; 8% (n=2) were stage II; 11% (n=3) were stage III; and 19% (n=5) were stage IV. Even assuming that 5 early stage lung cancers (19%) resulted from over-diagnosis, this represents a statistically significant increase in the proportion of early stage lung cancers (stage I and II) compared to historical Ontario proportions (p=0.003). The majority of cases (77%; n=20) were adenocarcinoma. The median risk score (i.e., PLCOm2012 risk prediction model probability of developing lung cancer in 6 years) was 8.7%, versus the median risk score of the overall pilot cohort (2.9%). Among cases, 62% (n=16) had baseline Lung-RADS™ scores of 4X, 19% (n=5) had 4B and 62% (n=16) were current smokers. Updated results will be presented.
Conclusion
First year pilot results demonstrate success in detecting early stage lung cancers with a statistically significant greater proportion of earlier stage cancers at diagnosis. The OCR efficiently enabled capturing important incidence, staging and histological pilot data.

Lung cancer screening

223 - Oral Presentation

Missing the train: The potential high impact of joint screening and cessation programs in the US that we are likely to miss due to low screening uptake rates

Meza[1], Cao[1], Levy[2], Jayasekera[2], Cadham[2], M Advani[2], Mandelblatt[2], Taylor[2], Jeon[1]
[1]University of Michigan, ANN ARBOR, United States of America
[2]Georgetown University, Lombardi Cancer Center, WASHINGTON DC, United States of America

Background. Smoking cessation interventions at the point of lung cancer screening are recommended because ~50% of screening eligible individuals are current smokers. However, there is limited information about the short- and long-term population impacts of effective joint screening and cessation interventions. We apply a simulation model of smoking, lung cancer incidence, screening and cessation to project the potential impact of joint screening and cessation programs on smoking, lung cancer and overall mortality.
Methods. We used an established Cancer Intervention Surveillance Modeling Network (CISNET) model (Michigan) of lung cancer natural history and a Smoking History Generator to project the impact of joint lung screening and cessation programs for different US cohorts. Two million individual smoking and life histories were generated by cohort. Simulated individuals were screened annually according to current US guidelines under different assumptions of coverage/uptake. We simulated a cessation intervention at the time of the first screen under different assumptions of efficacy (probability of quitting), informed by a meta-analysis of cessation interventions among populations similar to those eligible for screening.
Results. Joint screening and cessation programs could lead to considerable reductions in lung cancer and overall mortality. Under a 40% screening uptake scenario and a cessation intervention with 10% success probability, the model predicts that for the 1950 US birth-cohort screening/cessation programs would prevent ~385 per 100,000 lung cancer deaths and lead to ~8,540 life-years gained (LYG) per 100,000 individuals (20% and 90% increases over screening alone, respectively). These gains would decrease to ~45 lung cancer deaths prevented and ~670 LYG per 100,000 at a 5% screening rate.
Conclusions. Delivery of joint screening and effective cessation interventions could greatly reduce the burden of smoking-related conditions including lung cancer. Unfortunately, at current screening uptake rates (<5%), most of these potential gains will be not be realized.

Lung cancer screening

228 - Oral Presentation

Poor performance of lung cancer risk models among smokers with <30 pack-years in the US: Implications for using risk-models to select smokers for lung-cancer screening

Landy[1], Cheung[1], Chaturvedi[1], Berg[1], Tota[1], Robbins[2], Katki[1]
[1]National Cancer Institute, ROCKVILLE, United States of America
[2]IARC, LYON, France

Background: An important benefit of using risk models to identify smokers for lung cancer screening, versus simple age/pack-year/quit-year criteria, is to identify which smokers with <30 pack-years have high enough lung cancer risk to benefit from screening. However, the performance of important risk models (Bach, $PLCO_{M2012}$, and LCRAT) has not been specifically validated for lighter smokers (<30 pack-years). Similarly, the number of light smokers eligible for screening at low thresholds, such as 1.3% 6-year lung cancer risk according the US National Comprehensive Cancer Network guidelines, is unknown.
Methods: For each model, we calculated the ratio of expected to observed number of lung cancers (E/O) among 337,000 ever-smokers in the NIH-AARP cohort. We used the US-representative 2015 National Health Interview Survey (NHIS) to estimate the number of ever-smokers aged 50-80 years eligible for screening under each risk-model using the 1.3% 6-year risk-threshold.
Results: All three models severely underestimate lung cancer risk among current smokers with <15 pack-years ($PLCO_{M2012}$: E/O=0.20 (95% CI=0.09-0.41); LCRAT: E/O=0.25 (95% CI=0.12-0.53); Bach: E/O=0.10 (95% CI=0.05-0.19)). All 3 models underestimate risk among current smokers with 15-29 pack-years ($PLCO_{M2012}$: E/O=0.57 (95% CI=0.50-0.65); LCRAT: E/O=0.74 (95% CI=0.65-0.85); Bach: E/O=0.84 (95% CI=0.76-0.93)). At the 1.3% risk-threshold, the models greatly disagreed on the number of US current smokers selected with <15 pack-years ($PLCO_{M2012}$=0.05M; LCRAT=1.8M; Bach=1.3M) and with 15-29 pack-years ($PLCO_{M2012}$=1.7M; LCRAT=2.3M; Bach=2.6M).
Conclusions: Current risk models underestimate lung cancer risk among current smokers with <30 pack-years, and also disagree on how many should be eligible for screening. The source of this model under-calibration is unclear, but it is possible that millions more current smokers should be eligible for screening than are selected by current models.

Lung cancer screening

229 - Poster Presentation

Recruitment Strategies for the Lung Cancer Screening Pilot for People at High Risk

LS Della Mora, G Darling, N Sandhu, S Ramkissoon, MJ Walker, MC Tammemägi
Cancer Care Ontario, TORONTO, Canada

Background
In June 2017, Cancer Care Ontario initiated organized screening for lung cancer at three pilot sites in Ontario. The PLCOm2012 risk prediction model was used to identify eligible individuals. Those with a risk score ≥2% were eligible. One aim of the pilot was to recruit individuals with the highest rates of smoking, including: people with lower socioeconomic status, and First Nations, Inuit and Métis (indigenous) people.

Methods
Potential recruitment strategies for lung cancer screening include provider referral, media or internet campaigns, or mass mailing. Ontario's pilot used provider and public-led recruitment strategies. Areas with predicted high concentrations of populations at high risk for lung cancer were identified within the catchment of each pilot site. Market research was used to recommend recruitment modalities. An accredited Continuing Professional Development course was developed for primary care and collaborative educational sessions were held with primary care providers. CCO has processes to engage and adhere to OCAP®, which are First Nation data management principles to ensure communities are involved throughout the pilot and inform recruitment and educational efforts.

Results
Of the 4,205 individuals recruited (contacted for initial triage) during the first year, 3,496 (83%) were physician-referred. The most common methods of recruitment reported by recruited individuals were: physician referrals (67%), newspaper advertisements (11%), nurse practitioners (6%) and word of mouth (5%). Approximately half of recruited individuals were male and had a high school education or lower, approximately 60% were 55-64 years of age and current smokers and 4% self-identified as indigenous.

Conclusion
First year pilot results show that provider-led recruitment strategies are effective in enrolling appropriate individuals and is the primary source of recruitment for the pilot. Our results demonstrate that support from primary care physicians is important in successful recruitment to lung cancer screening.

Lung cancer screening

231 - Oral Presentation

Risk-Based Cancer Screening: Promoting the Intersections of Evidence, Policy and Practice

Aruna Kamineni[1], Haas[2], Neslund-Dudas[3], Ritzwoller[4], Beaber[5], Rendle[6], Chubak[1], Doria-Rose[7]
[1]Kaiser Permanente Washington, SEATTLE, United States of America
[2]Massachusetts General Hospital, BOSTON, United States of America
[3]Henry Ford Health System, DETROIT, United States of America
[4]Kaiser Permanente Colorado, DENVER, United States of America
[5]Fred Hutchinson Cancer Research Center, SEATTLE, United States of America
[6]Perelman School of Medicine, PHILADELPHIA, United States of America
[7]National Cancer Institute, ROCKVILLE, United States of America

The development and demonstrated effectiveness of cancer prevention tools have led to implementation of screening for breast, cervical, colorectal, and lung cancers. Improved understanding of the risk for these cancers has enabled the shift from one-size-fits-all screening strategies to more tailored approaches that seek to personalize age at screening entry, screening modality, screening intensity, and age at screening exit based on an individual's risk.
While there is general agreement that risk-based cancer screening could optimize the balance of benefits and harms of screening, there is growing concern that risk-based approaches also increase the complexity of clinical prevention and present considerable implementation challenges across multiple levels of health care delivery. Implementing complex, personalized screening regimens may strain already limited resources, increase disparities, and worsen outcomes, especially if the efforts required to identify and communicate varying levels of risk and implement appropriate screening detract from the ability to track and intervene on screen-detected abnormalities. Ultimately, this could also detract from the population impact of these cancer prevention and control strategies.
The objective of this session is to promote cross-cutting dialogue across the domains of evidence (including information from risk prediction), policy (screening guidelines), and practice (guideline implementation) in the era of risk-based cancer screening. We will provide a brief overview of the evolution and current context for risk-based breast, cervical, colorectal, and lung cancer screening in the United States (U.S.). Panelists will include modelers, policymakers, and physicians who will share their perspectives on risk-based screening in the U.S. and internationally. The moderator will lead a discussion focused on the intersections of evidence, policy, and clinical practice to promote a more cohesive and pragmatic paradigm of risk-based screening.

Lung cancer screening

258 - Oral Presentation

Down Staging and Less Expenditure Preliminarily Observed in A Lung Cancer Screening Cohort in China

Liu, Shi, Ren, Wang, Huang, Wang, Zhang, Liu, Li, Wu, Chen, Dai
National Cancer Center/National Clinical Research Center for Cancer/Cancer Hospi, BEIJING, China

BACKGROUND
Lung cancer screening could be cost-effective in reducing lung-cancer mortality, but evidence from population-based perspective cohort in China is sparse. Based on the Cancer Screening Program in Urban China (CanSPUC), this study aims to evaluate preliminary cost-effectiveness of lung cancer screening, .

METHODS
As one of the components of health economic evaluation in the CanSPUC program, multi-center dynamic cohorts were initiated, and then followed up at least 5 rounds by annual questionnaire interview. Data on new cancer development and death, expenditure and quality of life were collected. Eligible participants covered several subgroups, including those screening positive, screening negative, 'high-risk' for cancer but without screening, 'low risk' for cancer. The entire evaluation involved six common cancers. This analysis only presents preliminary results of lung cancer based on the first 2-round follow-ups. Expenditures were shown as US$ discounted to 2015.

RESULTS
13781 participants were enrolled in this study with a median follow-up of 3.08 years. By June 2018, a total of 37 primary new lung cancer cases were pathologically identified within 1 year after low dose computed tomography screening. This screening cohort found that 70.3% of 37 lung cancer patients were diagnosed at early stage. The annual medical expenditure per case was US$2407 (287-6743), and the EQ-5D utility score was 0.89 (95% CI: 0.83-0.94). In comparison, the corresponding values of routine diagnosis and treatment practice in China were 35.5%, $10447, 0.77(0.76-0.78), respectively.

CONCLUSION
This 2-round follow-up results preliminarily suggests that lung cancer screening in Chinese population could shift to earlier stage of lung cancer, gain higher quality of life with less expenditure. The ongoing long-term follow-up is expected to provide more robust and comprehensive health economic evidence for lung and other cancers in the future.

Lung cancer screening

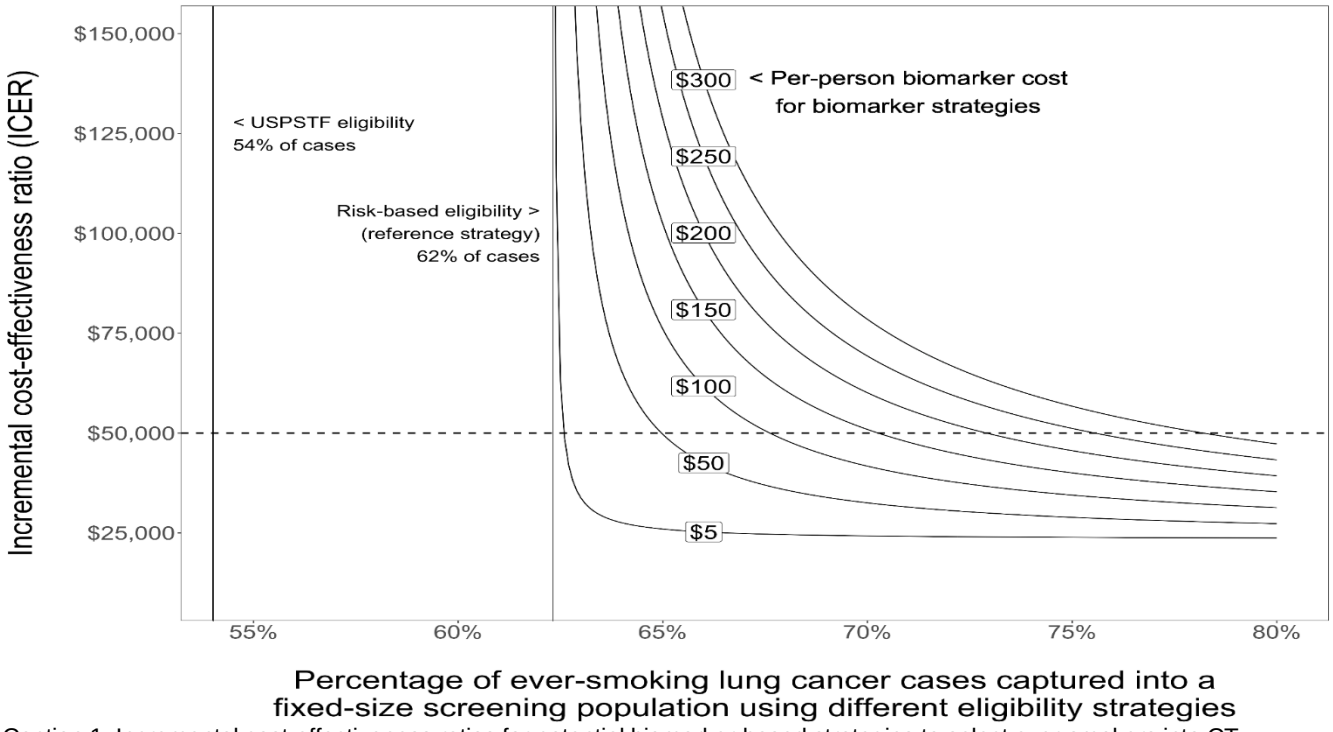
266 - Poster Presentation

Could biomarker-based eligibility for lung cancer screening be cost-effective?

Larose, Robbins, Brennan, Meheus, Johansson
International Agency for Research on Cancer, LYON, France

Background: Risk-based eligibility for CT lung screening is more efficient than categorical criteria, but could be further improved by using biomarkers to increase the discrimination of risk models. However, biomarker testing would involve substantial additional cost, so it is unknown whether this strategy could be cost-effective.
Methods: In a preliminary cost-effectiveness analysis, we assumed that incorporating a biomarker into lung cancer risk models could increase the proportion of future cases captured into a fixed-size screening population (improve the sensitivity-of-eligibility). Assuming NLST-like screening of 9.0 million US ever-smokers, and biomarker testing for half of ever-smokers (21.7 million), we varied the sensitivity-of-eligibility and calculated the expected number of cases, false-positive screens, and life-years saved. For a range of possible biomarker costs, we calculated the incremental cost-effectiveness ratio (ICER) comparing biomarker-based to risk-based (non-biomarker) eligibility. We assumed a willingness-to-pay threshold of US$50,000 per life-year gained.
Results: Non-biomarker risk-based eligibility (reference) captured 62% of ever-smoking lung cancer cases into screening. Some, but not all, biomarker scenarios were cost-effective (**Figure**). For example, if a biomarker improved sensitivity-of-eligibility from 62% to 70%, the ICER was $32,530 for a $50 test. However, at the same sensitivity, a $150 test was not cost-effective (ICER=$50,910). If sensitivity improved only slightly, to 65%, a biomarker would have to cost under $50 to be cost-effective. However, if sensitivity improved to 80%, even a $300 biomarker could be cost-effective.
Conclusion: Using biomarkers to optimize risk-based eligibility for CT screening could be cost-effective, depending on the trade-off of improved sensitivity and biomarker cost.

Picture 1:



Caption 1: Incremental cost-effectiveness ratios for potential biomarker-based strategies to select ever-smokers into CT lung cancer screening

Lung cancer screening

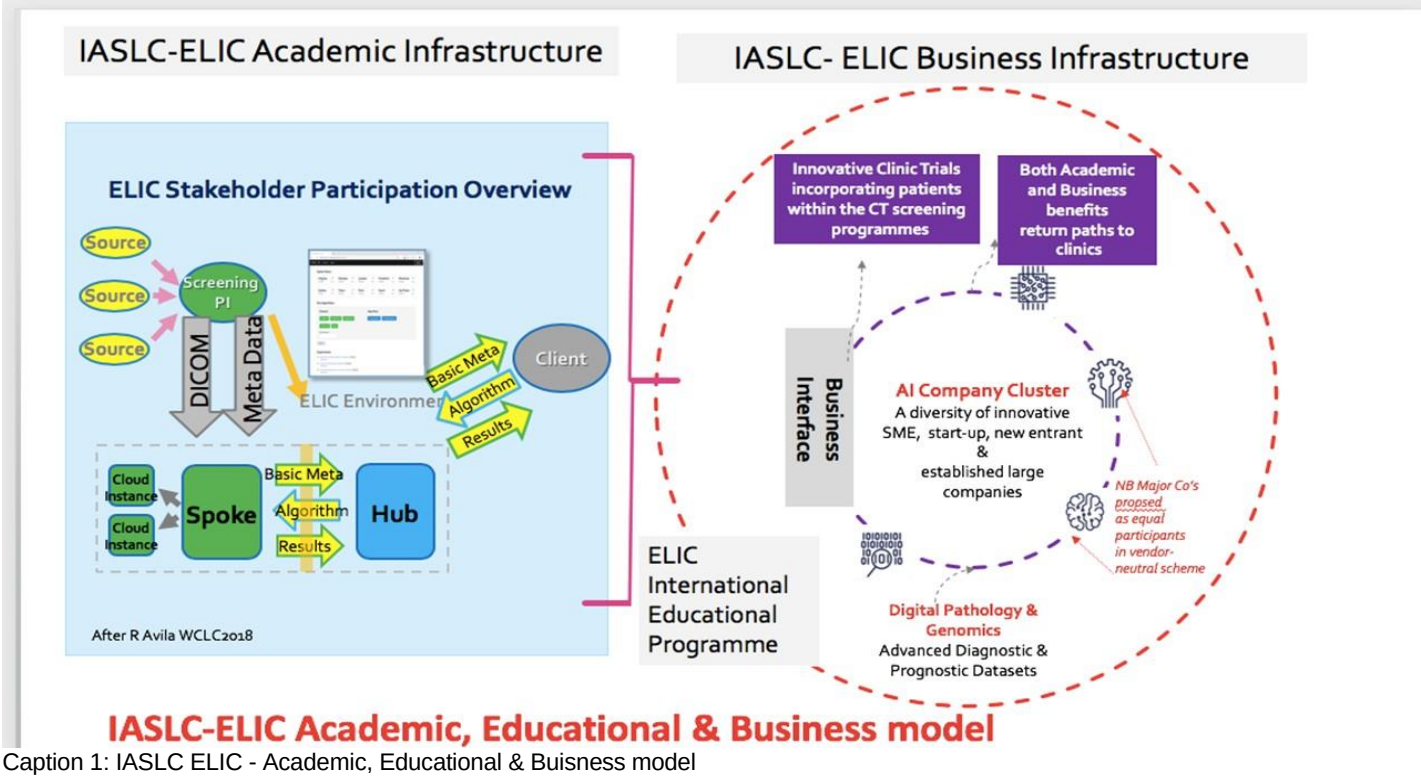
270 - Poster Presentation

The IASLC Early Lung Imaging Confederation (ELIC) Initiative

JK Field[1], R Avila[2], JL Mulshine[3]
[1]The University of Liverpool, LIVERPOOL, United Kingdom
[2]Accumetra, NEW YORK, United States of America
[3]Rush University, CHICAGO, United States of America

It has been shown that early detection by low-dose CT screening can decrease lung cancer mortality by 20-61% among high risk populations[1] however, only 16% of lung cancer patients are diagnosed with stage I disease.
ELIC is working with an international consortium of investigator and clinicians to develop a repository of anonymised scanned images and clinical data that could support the development of deep learning methods or artificial intelligence approaches. The IASLC ELIC project has functionality to facilitate the high-quality implementation of low-dose CT screening by disseminating validated software tools for the early detection of thoracic diseases through a Hub and Spoke platform. The ELIC project has created a globally-accessible, privacy-secured environment to analyse large collections of quality-controlled CT lung cancer images and associated biomedical data from around the world.
The IASLC ELIC pilot project represents what a global collaboration and technological advancement can achieve. The IASLC ELIC pilot program consisted of a central server, hub and 10 globally distributed servers running on a number of platforms including a cloud service.
This is still very early developmental stage of the ELIC project, however, we have successfully demonstrated our concept will work by distributing a test panel of 100 thoracic images to 10 international cloud sites and we examined those images with two tools to measure different factors about those images; demonstrating reproducibility of the analyses of those images.
We plan for ELIC to be accessible to any serious lung cancer researcher that has legitimate research protocols or goals in mind. ELIC can also be used to perform image acquisition quality analysis. And, we are working with Accumetra to ensure a site safe and secure via encryption and undertaken in with best-practice principles. We will have very robust security provisions to enable ELIC to emerge as a useful international resource.

Picture 1:



Caption 1: IASLC ELIC - Academic, Educational & Buisness model

Lung cancer screening

272 - Poster Presentation

A novel Computer-Aided Diagnosis Systems for Lung Nodules Screening in Low-Dose Computed Tomography

Ren, Wei, Chen
Cancer Hospital, Chinese Academy of Medical Sciences, BEIJING, China

Background: Low-dose computed tomography (CT) is widely applied for lung nodule screening, but image reading is time consuming and relies on the ability of radiologist. We aim to develop a novel computer-aided diagnosis system (CADs) to assist radiologists in characterizing lung nodules in low-dose CT.
Methods: Low-dose CT images of 3078 patients were obtained from LUNA16 LIDC-IDRI, Kaggle Data Science Bowl and TianChi. A total of 3954 nodules were confirmed and labeled by experienced radiologists for training and testing of models. Among them, 1595 nodules were used to train a model in discriminating malignant from benign lung nodules. Firstly, we adjusted the structure of U-net with the residual module to segment lung nodule candidates. Then, a classifier based on a simple hidden layer neural network was designed to distinguish true nodules from the candidates for false positive reduction. Secondly, we computed the density, volume, short and long diameter of nodules by combining the segmentation result and the properties of pixel value (Hounsfield Unit). Finally, the feature map of the second network and traditional image feature (histogram of oriented gradient, statistic, texture and wavelet filter features) were fused to train the final diagnosis model, the work of diagnosis included two parts, one part was discriminating malignant nodule from benign lung nodules, the other part was classification of solitary, part-solid, ground-glass and calcified nodules.
Results: We divided the dataset into 80% training set and 20% testing set. Sensitivity of nodule detection model was 95.4% while the false positive rate was controlled within 5%. The accuracy of the model in predicting malignancy of lung nodules was 87.6%, and the overall accuracy of model in classification of solitary, part-solid, ground-glass and calcified nodules was 86.4%.
Conclusion: The developed CAD system is a powerful tool for lung nodule screening.

Controversial issues in screening

1 - Oral Presentation

Overdiagnosis in the population-based organized breast cancer screening program estimated by a non-homogeneous multi-state model: a cohort study using individual data with long term follow-up

Wu[1], Törnberg[2], K. Elfström[3], Liu[1], Nyström[1], Jonsson[1]
[1]Umeå University, UMEÅ, Sweden
[2]Karolinska Institute, STOCKHOLM, Sweden
[3]Regional Cancer Center Stockholm-Gotland, STOCKHOLM, Sweden

Background:
Overdiagnosis, defined as the detection of a cancer that would not become clinically apparent in a woman's lifetime without screening, has become a growing concern. Similar underlying risk of breast cancer in the screened and control groups is a prerequisite for unbiased estimates of overdiagnosis, but a contemporary control group is usually not available in organized screening programs.
Methods:
We estimated the frequency of overdiagnosis of breast cancer due to screening in women aged 50-69 years using individual screening data from the population-based organized screening program in Stockholm County 1989-2014. A hidden Markov model with four latent states and three observed states was constructed to estimate the natural progression of breast cancer and the test sensitivity. Piecewise transition rates were used to consider the time-varying transition rates. The expected number of detected non-progressive breast cancer cases was calculated.
Results:
During the study period, 2,333,153 invitations were sent out and on average the participation rate in the screening program was 72.7% while the average recall rate was 2.48%. In total 14,648 invasive breast cancer cases were diagnosed and among the 8305 screen-detected cases, the expected number of non-progressive breast cancer cases was 35.9 equivalent to 0.43% (95%CI=0.10%-2.2%) overdiagnosis. The corresponding estimates for the prevalent and subsequent rounds were 15.6 (0.87%, 95%CI=0.20%-4.3%) and 20.3 (0.31%, 95%CI=0.07%-1.6%), respectively. The likelihood ratio test showed that the non-homogeneous model fitted the data better than an age-homogeneous model (p-value<0.001).
Conclusion:
Our findings suggest that overdiagnosis in the organized biennial mammographic screening for women aged 50-69 in Stockholm County is a minor phenomenon. The frequency of overdiagnosis in the prevalent screening round was higher than that in subsequent rounds. The non-homogeneous model performed better than the simpler, traditional homogeneous model.

Controversial issues in screening

5 - Poster Presentation

Breast cancer mortality pattern in women with breast symptoms reported at mammography screening visit: a matched cohort analysis

Singh, Malila, Pitkäniemi, Anttila
Finnish Cancer Registry, HELSINKI, Finland

Background: Efforts to reduce mortality in high-risk groups through risk-based screening strategies is intensified in the recent decade. We conducted a prospective analysis of the association between breast symptoms reported at screening visit and the risk of breast cancer mortality and all-cause mortality followed-up over a period of 24 years.
Methods: This population based matched cohort study was based on the follow up of the ongoing Finnish National Breast Cancer Screening Program (FNBCSP). Screening visits with symptoms were matched based on background variables with the respective asymptomatic controls in a ratio of 1:1 for lump and retraction and 1:2 for nipple discharge. The primary outcomes were breast cancer mortality and all-cause mortality.
Results: Women who reported lump or retraction had about 3-fold risk of breast cancer mortality and all-cause mortality respectively than those without respective symptoms. We found a substantial difference in mortality rates (p-value<0.05) between these groups throughout the follow-up. In absolute terms, after the follow-up period for women who reported lump, 180 died from breast cancer as compared to 70 deaths in those without lump, per 10000 person-years of follow-up, and 315 versus 160 all-cause deaths per 10000 person-years in women with and without lump respectively. We also found difference in the number of deaths in women who reported retraction or nipple discharge.
Conclusion: Women with breast symptoms remain in a higher risk of dying over a very long period. The findings indicate an urgent need to develop improvements in the guidelines for screening and clinical services for women presenting with symptoms.

Picture 1:

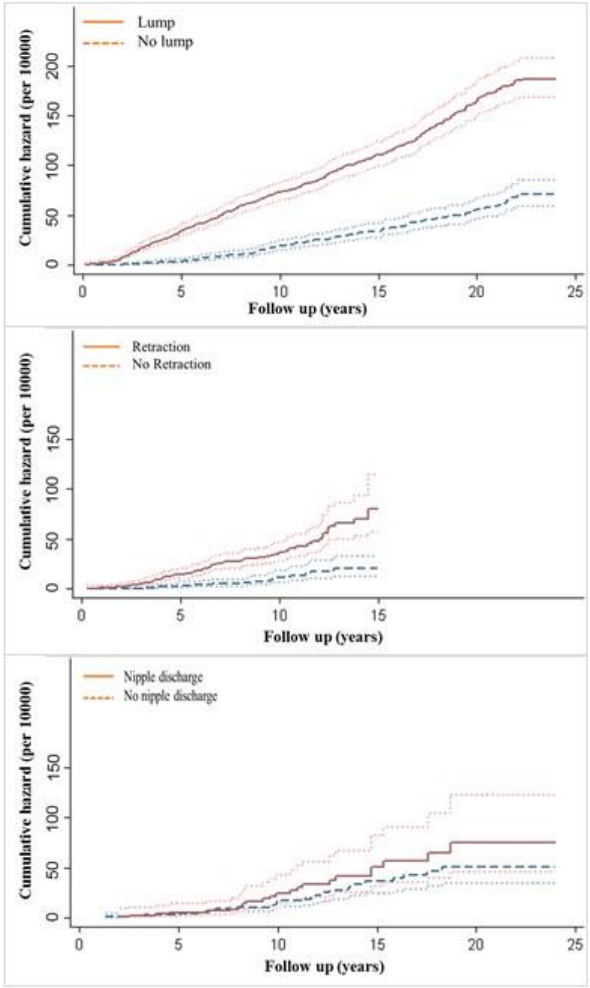


Figure: Cumulative hazard of breast cancer mortality per 10000 person-years of follow-up in women with symptoms than those without symptoms at screen

Controversial issues in screening

7 - Poster Presentation

Cumulative risk of false-positive results of fecal immunochemical tests over four biennial screening rounds.

Garcia[1], Ibañez-Sanz[1], Milà[1], Vidal[1], Binefa[1], Benito[2], Moreno[1]
[1]Catalan Institute of Oncology, HOSPITALET DE LLOBREGAT, Spain
[2]Faculty of Medicine and Health Sciences, University of Barcelona, HOSPITALET DE LLOBREGAT, Spain

Background: Effectiveness assessment in preventive interventions should take into account the balance of benefits and harms of the preventive modality. Randomized controlled trials support the efficacy of faecal occult blood testing in decreasing colorectal cancer (CRC) mortality. However, there are few studies that had investigated the adverse effects in mid and long term.

Objective: To estimate the cumulative risk of having a false-positive (FP) result in four screening rounds with immunochemical faecal test (FIT), and to identify factors associated with FP results in a CRC screening programme in Catalonia, Spain.
Methods: Retrospective cohort study which included participants aged 50-69 years of the L'Hospitalet CRC screening programme from 2010-2017. During this period, the FIT was used and a haemoglobin level of 20µg Hb/g faeces (100 ng/mL) was used to define a positive FIT result. We adjusted logistic regression models to analyse risk factors of receiving a positive FIT with no CRC or high risk-adenoma or CRC in the follow-up colonoscopy. We estimated the probability of having at least one FP over four screening rounds.
Results: Participants who began screening at age 50 had 12.4% (95% CI: 11.00-13.94) cumulative risk of a FP result with 4 screening rounds of FIT. Age, first or successive screening and personal screening participation number were factors associated with a cumulative risk of a FP result.

Conclusion: The cumulative risk of FP in CRC screening using FOBT seems acceptable as the diagnostic procedure (colonoscopy), with its high accuracy, lengthens the time for which it protects against CRC whereas complication rates remain low.

Funding: This study was partially cofunded by the Carlos III Health Institute, the European Regional Development Fund – a way to build Europe- (PI16/00588) and by the Department of Universities and Research (2017 SGR 1283) of the Government of Catalonia.

Controversial issues in screening

9 - Poster Presentation

Estimating frequency of indolent breast cancer in screening trials

Ys dr. Shen[1], Wenli[1], Rg Gulati[2], Ryser[3], Etzioni[4]
[1]UT MD Anderson Cancer Center, HOUSTON, United States of America
[2]Fred Hutchinson Cancer Institute, SEATTLE, United States of America
[3]Duke University Medical Center, DUHRAM, United States of America
[4]Fred Hutchinson Cancer Research Center, SEATTLE, United States of America

Background: Cancer screening can detect cancer that would not have been detected in a patient's lifetime without screening. Standard methods for analyzing screening data do not explicitly account for the possibility that a fraction of tumors may remain latent indefinitely.
Methods: We extend these methods by representing cancers as a mixture of those that progress to symptoms (progressive) and those that remain latent (indolent). Given sensitivity of the screening test, we derive likelihood expressions to simultaneously estimate (1) the rate of onset of preclinical cancer, (2) the average preclinical duration of progressive cancers, and (3) the fraction of preclinical cancers that are indolent. Simulations demonstrate satisfactory performance of the estimation approach to identify model parameters subject to precise specifications of input parameters and adequacy of interval case sample sizes.
Results: In application to four breast cancer screening trials, the estimated indolent fraction varies between 2% and 35% when assuming test sensitivity at 80% and varying specifications for the earliest time before the start of the trial that participants could plausibly have developed cancer.
Conclusion: We conclude that, in principle, standard methods for screening data can be extended to allow some preclinical cancers to remain indolent, but accurate estimation depends on correctly specifying related inputs.

Controversial issues in screening

15 - Oral Presentation

Longitudinal adherence to Immunochemical fecal occult blood testing vs guaiac-based FOBT in an organized colorectal cancer screening program

Garcia[1], Benito[2], Travier[1], Binefa[1], Vidal[1], Milà[1], Espinosa[1]
[1]Catalan Institute of Oncology, HOSPITALET DE LLOBREGAT, Spain
[2]Faculty of Medicine and Health Sciences, University of Barcelona, HOSPITALET DE LLOBREGAT, Spain

Objective: We analyzed longitudinal adherence to biennial fecal occult blood testing in Catalonia (Spain) over seven screening rounds.
Methods: The analysis was restricted to subjects invited to participate in a Catalan colorectal cancer screening program at least twice between 2000 and 2017 (n=103,122). Two measures of longitudinal adherence were calculated: 1) Continued participation. The numerator included the individuals that had been screened every time they had been invited and the denominator the invited individuals for screening during the study period. 2) Adequately screened individuals. This measure was calculated considering individuals who had been screened every time they had been invited divided by the total number of ever screenees. It is affected by the overall participation and how many continued participation in the screening program.
For every measure of adherence three categories were considered: never screened individuals, inconsistent and consistent screenees. Logistic regression models were used to assess the independent effect of sex, age at first invitation, deprivation and the type of screening test on adherence. They were further adjusted for the number of invitations and average uptake after the first screening invitation
Results: The overall rate of individuals adequately screened after seven rounds of screening was 14.2%, being 20.6% for those individuals who used fecal immunochemical test (FIT) and 14.3% for those who used guaiac test. The model that compared full adherents to irregular ones showed that longitudinal adherence was associated with age, screening test type, and number of invitations. Continued participation was lower in individuals who were screened using FIT than among those screened using the guaiac test (OR:0.68; 95%CI:0.57-0.81).
Conclusions: Despite lower continued participation, the overall rate of adequately screened was higher with FIT than guaiac test. Studying the rate of individuals being current for screening may help to anticipate potential benefits before long-term outcome data are available.

Controversial issues in screening

28 - Poster Presentation

Systematic review of overdiagnosis in cervical cancer screening

CH Hamashima[1], KH Hoshi[2], SS Sasaki[3], SH Satoyo[4], TT Terasawa[5], TK Katayama[6]
[1]Teikyo University, TOKYO, Japan
[2]Kitazato University, SAGAMIHARA, Japan
[3]St.Luka International Hospital, TOKYO, Japan
[4]Nagoya City University, NAGOYA, Japan
[5]Fujita Medical University, NAGOYA, Japan
[6]Hyogo Prefecture University, AKASHI, Japan

Objective: Cervical cancer screening is a common strategy for cancer control. Although its real target is invasive cervical cancer, the incidence has not been high in developed countries and precancerous lesions have now become the actual target of cervical cancer screening. To clarify the overdiagnosis rate in cervical cancer screening, a systematic review was performed.
Methods: To determine the overdiagnosis rate in cervical cancer screening, a systematic review was performed by searching Medline, Cochrane Central, Embase, and Igaku-Cyuo Zasshi (for Japanese articles) before July 2018. The articles were original articles limited to English-language or Japanese-language publications.
Results: Of 1783 articles identified, 2 studies calculated the overdiagnosis rate of cervical cancer screening. One modeling report from the Netherland and one article from a Finnish RCT for HPV testing were selected. In the Finnish study, overdiagnosis was estimated based on the diagnosis of cervical intraepithelial neoplasia (CIN) 3 at screening and interval cancer based on 4.5 years of follow-up after the first round of RCT. The overdiagnosis rate was 69% for HPV testing and 52% for cytology. In the Dutch modeling study, the estimated overdiagnosis rate was 50% from the population perspective and 55% from the individual perspective when including CIN3 and invasive cancer.
Discussion: In cervical cancer screening, precancerous lesions have been identified as the target of cancer screening. These lesions have been resected, and the adoption of this approach has expanded despite the high possibility of disappearance of these lesions. Overdiagnosis of cervical cancer screening has not been investigated and the studies regarding overdiagnosis have been few. Until recently, overdiagnosis has been ignored in cervical cancer screening and has led to overtreatment of precancerous lesions. **Conclusion:** Although cervical cancer screening has a high impact on reduction from cervical cancer, the balance of benefits and harms including overdiagnosis should be reconsidered.

Controversial issues in screening

48 - Oral Presentation

Effectiveness of population-based mammography screening for women aged 70-74 years in Sweden

Mao
Umeå University, LINKÖPING, Sweden

Background: Consensus has been achieved on the effectiveness of inviting women 50-69 years to mammography screening but for older women the evidence of effectiveness is scarce. The aim of this study was to estimate the marginal effectiveness of inviting women to mammography screening with an upper age limit 74 years vs. stopping at age 69 using data from the Swedish service screening program.
Methods: Data on breast cancer cases and breast cancer deaths were retrieved from the national cancer and cause-of-death register, respectively and individual information on participation in screening was collected from the screening centers. A cohort design was used to compare the breast cancer mortality 1986-2012 between the geographical areas and periods where women were invited to screening up to the age of 74 years (study cohorts) with those where women were invited up to age 69 (control cohorts). The study cohorts and the control cohorts were then merged into a study group and a control group, which were compared using the mortality rate ratio, where only breast cancer deaths in cases diagnosed with breast cancer in age 70-74 were counted. Both breast cancer mortality and excess mortality were used as outcome measures. Adjustments were made for potential biases.

Results: After 20 years follow-up there were 1040 and 1173 breast cancer deaths in the study group and the control group, respectively. The estimated marginal breast cancer mortality rate ratio for women who were invited up to age 74 vs. women invited up to 69 was 0.80 (95% CI: 0.75-0.85) after adjustment for biases. The corresponding rate ratio for participating women was 0.76 (95% CI: 0.70, 0.83).
Conclusion: Continuing screening women up to age 74 years is effective compared to stopping screening at 69 years.

Controversial issues in screening

53 - Oral Presentation

Is active surveillance of early prostate cancer stages necessarily beneficial? - Predictions of the ONCOTYROL PCOP model

Mühlberger[1], kristijan Boskovic[1], Krahn[2], Bremner[3], Oberaigner[4], Klocker[5], Horninger[5], Sroczynski[1], Siebert[1]
[1]UMIT - University for Health Sciences, Medical Informatics and Technology, HALL I.T., Austria
[2]Toronto Health Economics and Technology Assessment (THETA) Collaborative, TORONTO, Canada
[3]Toronto General Hospital Research Institute, University Health Network, TORONTO, Canada
[4]Cancer Registry of Tyrol, Tirol Kliniken GmbH, INNSBRUCK, Austria
[5]Department of Urology, Medical University of Innsbruck, INNSBRUCK, Austria

Background:
Active surveillance (AS) rather than immediate treatment of early-stage prostate cancer (PCa) is proposed to reduce overtreatment and thus improve the benefit-harm balance of screening. However, postponing treatment may result in lower cure rates. We evaluated the effect of AS on the benefit-harm balance of PCa screening in men with average and elevated familial PCa risk using the ONCOTYROL Prostate Cancer Outcome and Policy (PCOP) model.
Methods:
The PCOP state-transition micro-simulation model simulates the onset and progression of PCa and the consequences of screening and treatment on quality-adjusted life expectancy (QALE). Benefit-harm analyses were performed separately for men with average and elevated familial PCa risk for which we assumed a 2-fold higher lifetime risk of PCa caused by increased cancer onset and speed of progression. We evaluated various one-time and interval screening strategies followed by immediate treatment or AS of localized, low grade PCa with biennial biopsies with treatment upon grade progression to Gleason scores ≥ 7.
Results:
Screening with immediate treatment reduced QALE in men with average PCa risk, whereas men with elevated familial risk gained QALE. AS strongly reduced overtreatment in both risk groups. However, gains by averted overtreatment were opposed by losses due to delayed treatment, especially in the high-risk population with assumingly faster disease progression. As a consequence, screening combined with AS resulted in lower QALE losses in men with average risk, and lower QALE gains in men with elevated familial risk.
Conclusions:
The benefit of AS depends on the effects of delaying or averting treatment, given the speed of PCa progression. In risk groups with faster tumor progression, QALE gains by averted overtreatment may be outweighed by QALE losses due to delayed treatment. Gleason score progression to 7 seems to be an inadequate criterion for treatment initiation under AS.

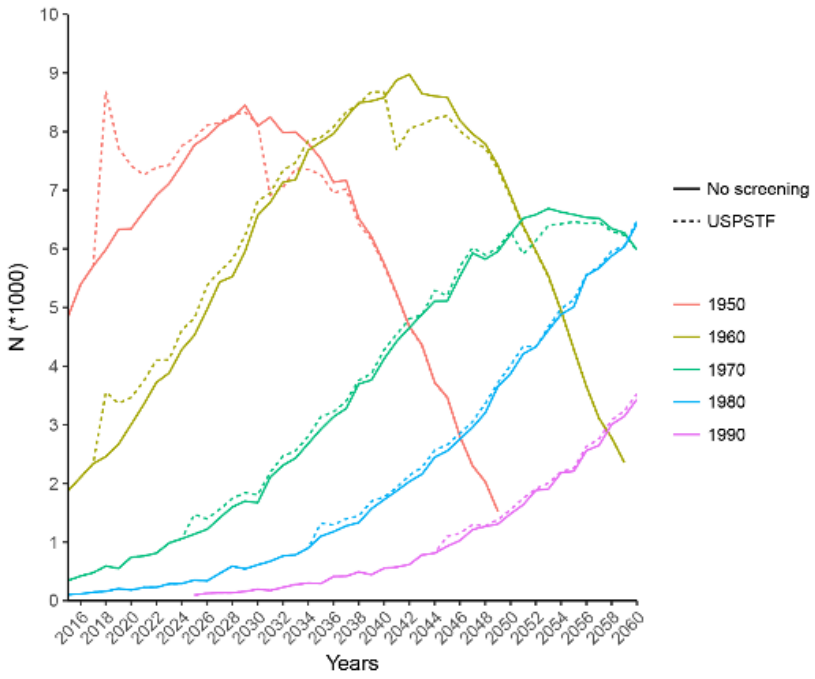
Controversial issues in screening

59 - Oral Presentation

Trends in background lung cancer incidence and screening eligibility affect overdiagnosis estimates

E.F. Blom, K. Ten Haaf, H.J. De Koning
Erasmus MC University Medical Center Rotterdam, ROTTERDAM, The Netherlands

Background
A common approach to estimating overdiagnosis in cancer screening programs uses excess-incidence in a screened group compared to a control group. Overdiagnosis estimates using this approach vary widely for lung cancer screening. We investigate the appropriateness of using the excess-incidence approach in a population-based continuous lung cancer screening program.
Methods
The MISCAN-Lung microsimulation model was used to project future lung cancer incidence in the Unites States, based on birth-cohort specific smoking trends and life expectancies. We assessed the effect on lung cancer incidence of implementing annual lung cancer screening in 2018, using the United States Preventive Task Force eligibility criteria. 50% screening adherence was assumed.
Results
Implementing screening in 2018 increased incidence by 28.7% in that year. However, from 2028 onwards incidence in the presence of screening approximated incidence in the absence of screening. Therefore, the excess-incidence approach suggests that no overdiagnosis occurs after 2028. We stratified results by birth-cohorts (see Figure). The incidence peaks due to lead-time and overdiagnosis during screening eligible ages were higher for older birth-cohorts than for younger birth-cohorts, as were the compensatory drops after screening eligibility stopped. This difference is due to declining smoking trends, which reduces background incidence and screening eligibility. The net effect of the overlapping incidence peaks and drops across birth-cohorts produces biased overdiagnosis estimates.
Conclusions
Lung cancer screening overdiagnosis estimates using the excess-incidence approach in a continuous screening program are biased, as declining smoking trends cause background incidence in the absence of screening and screening eligibility to vary across cohorts.



Picture 1:
Caption 1: Figure. Projected lung cancer incidence in the presence and absence of screening, stratified by birth cohort.

Controversial issues in screening

76 - Oral Presentation

Studying impact of mammographic screening: large differences in the proportion of advanced-stage breast cancer irrespective of varying definitions

L de Munck[1], S. Siesling[1], J. Fracheboud[2], G.J. den Heeten[3], M.J.M. Broeders[4], G.H. de Bock[5]
[1]Netherlands Comprehensive Cancer Organisation (IKNL), ROTTERDAM, The Netherlands
[2]Erasmus MC, University Medical Center Rotterdam, ROTTERDAM, The Netherlands
[3]Department of Radiology, Academic Medical Centre Amsterdam, AMSTERDAM, The Netherlands
[4]Dutch Reference Centre for Screening / Radboud University Medical Center, NIJMEGEN, The Netherlands
[5]University of Groningen, University Medical Center Groningen, GRONINGEN, Taiwan

Background
To add some clarification to the ongoing debate on the effect of breast cancer screening, we evaluated the impact of the Netherlands screening program on the stage distribution of screen-detected (SDBC), interval (IBC), and non-screened breast cancers (NSBC), using three definitions of advanced breast cancer. To study the effect of overdiagnosis, we performed sensitivity analyses assuming 10%, 20%, 30% overdiagnosis.
Methods
Data of women, aged 49-74, diagnosed with breast cancer between 2006-2011 were retrieved from the Netherlands Cancer Registry, and linked to the screening registry. Cancers were defined as SDBC (diagnosed <24 months after positive screening), IBC (diagnosed <24 months after negative screening) or NSBC (never or not recently screened). Proportions advanced-stage cancers were calculated using three definitions: 1) TNM-stages III-IV (versus 0-I-II); 2) Tumors with positive lymph nodes and/or metastasis (versus negative nodes without metastasis); 3) T-stage ≥15mm (versus <15mm or DCIS). Additional analyses was performed after randomly excluding the percentage of assumed overdiagnosis of all SDBCs (n=27,589) from the early-stage SDBCs.
Results
In total 27,589 SDBC, 10,012 IBC and 11,807 NSBC were included. Using TNM-stage, 5.1% of SDBC were advanced, compared to 20.7% IBC and 25.8% NSBC ($p<0.001$). Using the other definitions resulted in higher proportions of advanced stage in all groups, but SDBC were still significantly less often advanced. Depending on the definition, IBC were 2-3 times more likely to be advanced, NSBC 2-5 times. Assuming 10%, 20%, 30% overdiagnosis resulted in 5.6%, 6.4% or 7.3% advanced stage SDBC respectively, still less compared to IBC and NSBC ($p<0.001$).
Conclusions
SDBC were considerably less frequently diagnosed in advanced-stage, even after assuming overdiagnosis. Regardless of the definition used, these results support that breast cancer screening in a steady-state situation causes a stage shift to less advanced cancers, and as such has the potential to reduce breast cancer mortality.

Controversial issues in screening

81 - Poster Presentation

Radiologists' characteristics that influence the detection of ductal carcinoma in situ: analysis stratified by nuclear grade

Théberge, Vandal, Guertin, Perron
Institut national de santé publique du Québec, QUEBEC CITY, Canada

Background: Among the shortcomings of screening mammography, there is the plausible detection and treatment of some ductal carcinoma in situ (DCIS) that would have never progressed toward invasiveness. Low and intermediate nuclear grade DCIS are perhaps less likely to progress toward invasiveness than high-grade DCIS. To our knowledge, the relation between radiologists' characteristics and the detection of low risk DCIS has never been evaluated. We measured the association between some radiologist's characteristics and the detection rate of all DCIS, and DCIS stratified by nuclear grade.
Methods: This study included 1,750,002 digital screening mammograms (2,145 screen-detected DCIS; 1,030 low-intermediate grade, 727 high-grade, 388 unknown) performed between 2007 and 2015 in 50-69 year old women participating to the Quebec breast cancer screening program. The associations between radiologists' gender, year of graduation, screening volume, and recall rate, and the DCIS detection rate were assessed by logistic regression with GEE estimates to account for correlation among mammograms. All models were adjusted for potential confounders, including characteristics of women, radiologists and facilities.
Results: DCIS detection rate of radiologists with a recall rate ≥20% was twice that of radiologists with a recall rate <5% (adjusted DCIS detection rate ratio = 2.07, 95% confidence interval = 1.49-2.88). This association between radiologist global recall rate and DCIS detection rate was statistically significant on the stratum of low-intermediate nuclear grade DCIS (p-value <0.01), but not on the stratum of high nuclear grade DCIS (p-value = 0.25). The other radiologists' characteristics were not associated with the DCIS detection rate.
Conclusions: In comparison to radiologists with a low recall rate, those with a high recall rate detect substantially more low-intermediate grade DCIS, a group perhaps less likely to progress toward invasiveness.

Controversial issues in screening

96 - Oral Presentation

Are screen-detected ductal carcinoma in situ associated with invasive interval breast cancers in the Quebec breast cancer screening program?

Guertin, Vandal, Perron, Pelletier, Theberge
Institut national de santé publique du Québec, QUÉBEC, Canada

Background: A recent study showed that an increase in ductal carcinoma in situ (DCIS) detection was associated with a subsequent reduction in invasive interval cancers in a screening program. We aimed to assess whether this association was present in the Quebec breast cancer screening program (PQDCS).
Methods: For the 86 centres with ≥5000 screening mammograms in the PQDCS over the period 2002 to 2014, we calculated the average number of screen-detected DCIS and invasive interval cancers (within 24 months of screening). Log-binomial and logistic models, adjusting for women characteristics and including random coefficients for radiologists and centres, were carried out to assess the association between DCIS detection rates and invasive interval cancer rates. The screen-detected DCIS rate was assessed at the centre level, first as a continuous variable and then in quartiles.
Results: Data from 3 337 435 screening mammograms, including 3 783 screen-detected DCIS (1.1 per 1000) and 6 219 invasive interval cancers (1.9 per 1000) were analysed. When modeled as a continuous variable, an increase in one detected DCIS per 1000 screens, in the logarithm scale, resulted in an 8% decrease in the invasive interval cancer rate (rate ratio=0.92, 95% confidence interval (CI)=0.82 –1.04, p=0.17). Compared with centres in the lowest quartile of DCIS detection rates, centres in the 2nd, 3rd and 4th quartiles had rate ratios of invasive interval cancers of 0.91 (95%CI=0.82 – 1.01), 0.92 (95%CI=0.83 – 1.01) and 0.98 (95%CI=0.88 – 1.08) respectively. Additional adjustment for the invasive breast cancer detection rate did not substantially change the results.
Conclusions: An increase in DCIS detection rates was associated with a non-statistically significant decrease in invasive interval cancer rates in the PQDCS. Sensitivity analyses assessing high grade DCIS detection rates instead of overall DCIS detection rates and sensitivity analyses restricted to digital mammograms are currently underway.

Controversial issues in screening

101 - Poster Presentation

Modelling the impact of aspirin prophylaxis on colorectal cancer and screening efficacy in Australia

Worthington[1], Lew[1], Feletto[1], He[1], Macrae[2], Jenkins[3], Mitchell[3], Canfell[1]
[1]Cancer Council NSW, WOOLLOOMOOLOO, Australia
[2]The Royal Melbourne Hospital, MELBOURNE, Australia
[3]University of Melbourne, MELBOURNE, Australia

Background: Evidence suggests that daily low-dose aspirin may have a chemopreventive effect for colorectal cancer, improving incidence and mortality rates. Recommendations advise daily aspirin for people aged 50-70 at average risk of colorectal cancer in Australia, in addition to the current screening program of immunochemical faecal occult blood testing offered biennially at ages 50-74. However, there are other effects, including harms, particularly in older populations. The study aim is to develop and validate a microsimulation model (*Policy1-Bowel*) to simulate aspirin prophylaxis based on recommendations for colorectal cancer in Australia alongside screening, with careful consideration of the associated benefits and harms.
Methods: We completed a literature review to assess the relationship between aspirin intake and colorectal outcomes (including adenoma incidence, cancer incidence, and cancer mortality). The findings were used to inform parameterisation and calibration of *Policy1-Bowel*, which simulates the natural history of colorectal cancer including the adenoma-carcinoma and serrated pathways.
Results: Literature suggests that the chemopreventive effect of aspirin on colorectal cancer may be delayed, but persists beyond medication cessation. This was incorporated in preliminary modelling. The model was calibrated to the cancer reductions reported in the RCTs from a published literature review by reproducing trial conditions including age range, gender, and length of aspirin use. The calibrated model was used to explore the benefit, harm and cost-effectiveness of daily low-dose aspirin use with and without colorectal screening interventions.
Conclusions: *Policy1-Bowel* will be used to simulate daily aspirin intake for 50-70 year old Australians for chemoprevention alongside the existing screening program. Considering the short-term harms and longer-term benefits of aspirin, modelling can be used to explore the overall impact associated with a population experiencing both guideline-recommended chemopreventive aspirin use and screening. As new evidence emerges on the relationship between aspirin and bowel cancer, *Policy1-Bowel* will be equipped to explore the implications.

Controversial issues in screening

112 - Poster Presentation

Histological distribution of interval and screen detected cervical cancer cases in organized screening programme in Poland

A Macios, A Nowakowski, J Didkowska, U Wojciechowska
Maria Sklodowska-Curie Memorial Cancer Center and Institute of Oncology, WARSAW, Poland

Background
Women between 25 and 59 years old are entitled to participate in the Polish cervical cancer screening programme every 3 years. The programme was implemented in 2006, but neither the burden of interval cancers nor the histological distribution of these cases has been investigated in Poland before.
Materials and methods
Cytological results collected in the screening database in 2010 and 2011 were linked with the data from National Cancer Registry to look for women diagnosed with invasive cervical cancer within 3 years after screening with negative (interval cancers) or positive (screen detected cancers) result. Odds ratios were calculated using logistic regression. Univariate analysis was carried out using two-sided Pearson's chi square test.
Results
309 interval and 693 screen detected cancers were identified. The distribution of histological diagnosis differed significantly between these groups (p-value=0.000). Women with squamous cell carcinoma had reduced odds of receiving false negative result (OR=0.32, 95%CI 0.22-0.45), especially those over 40 years old (OR=0.29). On the contrary, the odds among women diagnosed with adenocarcinoma are raised (OR=3.69, 95%CI 2.45-5.56) particulary in the older group (OR=4.25). Odds ratios for other types of cancer were not significant (p-value>0.05).
Conclusions
The burden of interval cancers in Polish cervical cancer screening programme is significant. Sensitivity of cytology for detecting adenocarcinoma is remarkably lower than for detecting squamous cell carcinoma (41% vs. 73%), especially in older women (40% vs. 74%). This finding is consistent with results from other countries.

Picture 1:

Histological type of cancer	Age group	Basic statistics		Logistic regression				Univariate analysis
		number, %		odds ratio	p-value	95% confidence interval (CI)		p-value
		interval cancer	screen detected cancer					
squamous cell carcinoma	<40	58 (70.7%)	125 (85.0%)	0.43	0.01	0.22	0.82	0.01
	>=40	171 (75.7%)	499 (91.4%)	0.29	0.00	0.19	0.44	0.00
	total	229 (74.1%)	624 (90.0%)	0.32	0.00	0.22	0.45	0.00
adenocarcinoma	<40	18 (22%)	15 (10.2%)	2.48	0.02	1.17	5.23	0.02
	>=40	45 (19.8%)	30 (5.5%)	4.25	0.00	2.60	6.96	0.00
	total	63 (20.4%)	45 (6.5%)	3.69	0.00	2.45	5.56	0.00
other types	<40	6 (7.4%)	7 (4.5%)	1.58	0.43	0.51	4.87	0.42
	>=40	11 (4.8%)	17 (3.1%)	1.58	0.24	0.73	3.44	0.24
	total	17 (5.5%)	24 (3.5%)	1.62	0.14	0.86	3.07	0.13

Caption 1: Table 1 Analysis of histological distribution of interval and screen detected cervical cancer cases.

Controversial issues in screening

117 - Poster Presentation

Pilot review of cytological slides of interval cervical cancers in Poland

K Spych, A Macios, A Nowakowski, J Didkowska, U Wojciechowska
The Maria Sklodowska-Curie Memorial Cancer Centre and Institute of Oncology, WARSAW, Poland

Background
Interval cancers have never been identified in the Cervical Cancer Prevention Programme and false-negative slides have never been reviewed in Poland before. The aim of our pilot review was to identify and review cytological slides from women diagnosed with interval cancers.
Methods
We used data from screening database and linked them with those from National Cancer Registry (NCR). Pap smears taken in 2010-2011 were selected. Then cancers registered in NCR after having obtained negative Pap results were identified. Interval cancers were defined as cancers that occurred in 42 months after the negative result of cytology. We have performed a pilot review of the first 48 slides from 3 laboratories seeded among 94 slides randomly selected from the same laboratories (with both negative and positive results). Blinded review was performed by 3 independent experienced cytologists. We classified slide as a false-negative only when all 3 experts detected abnormal cells.
Results
Of the 48 cervical pap smears:
27 (56,25% of all interval cancers) previously negative results were diagnosed as abnormal by all 3 cytologists,
8 (16,7%) were considered to be of insufficient quality for diagnosis by all 3 cytologists,
6 (12,5%) were diagnosed normal by all 3 cytologists.
Conclusions
It is well-documented that cervical cancer screening based on cytology has limited accuracy. In our study we identified reasons why false negative reports may be generated in organised cervical cancer screening in Poland. The most common were: 1) interpretation errors followed by 2) incorrect classification of smears of insufficient quality as normal and 3) true lack of abnormal cells on the slides. Comprehensive review of all slides preceding diagnosis of interval cancers is planned for further analysis in order to improve quality of Polish cervical cancer screening.

Controversial issues in screening

130 - Oral Presentation

Modeling Over-detection of Population-based Cancer Screening

Lin[1], Fann[2], Chen[1]
[1]National Taiwan University, TAIPEI, Taiwan
[2]Kainan University, TAO-YUAN, Taiwan

Introduction
Over-detection resulting from population-based cancer screening has been noticed over the past decade. Estimating over-detected screen-identified cancers is a thorny issue in population-based service screening data as there is lacking the control group that renders the conventional incidence-based method infeasible. It is therefore of great interest to develop a novel quantitative model to quantify the proportion of over-detection of population-based cancer screening dispensing with the use of control group.
Methods and Data
The Markov process with a variant Coxian phase-type distribution making allowance for these non-progressive (over-detected) cancers is therefore proposed to quantify the proportion of over-detection in various types of population-based screening by combining the concept of the cure model. The proposed model was applied to data on two previous population-based randomized controlled trials for breast cancer, called the W-county trial, and prostate cancer, the Finnish trial, two randomized controlled trials for colorectal cancer from Nottingham in UK and Denmark, and one service screening program for colorectal cancer in Taiwan to estimate the proportion of over-detection resulting from screening.
Results
The applications show a small fraction of over-detected breast cancer (3%) from mammography using the W-county trial. The estimated proportions of over-detection for colorectal cancer was 9% with g-FOBT and 10% with fecal immunological test.
A substantial proportion of over-detected prostate cancer (60%) resulting from prostate specific antigen test in the Finnish randomized controlled trial was noted.
Conclusions
Such heterogeneous findings on over-detection imply over-detection is not only subject to the screening method but also affected by the underlying disease natural history. Such a kind of model and results make great contribution to evaluating the harm of population-based cancer screening caused by over-detection of screen-identified cancers, which play a crucial role in share-decision making for patients and physicians and also the economic decision-making for policy-makers.

Controversial issues in screening

133 - Oral Presentation

Zero-Inflated Model for Estimating Overdiagnosis Only Using Survival of Cancer by Detection Mode

Fann[1], Hsu[2], Chang[3], Yen[4], Tabar[5]
[1]College of Healthcare Management, Kainan University, TAOYUAN, Taiwan
[2]College of Public Health, National Taiwan University, TAIPEI, Taiwan
[3]National Taiwan University Hospital, TAIPEI, Taiwan
[4]Taipei Medical University, TAIPEI, Taiwan
[5]Falun Central Hospital, FALUN, Sweden

Background: Most studies estimated overdiagnosis by excess incidence that requires population incident-based data and the strong assumption of lead-time distribution. Since the hospital-based data is more accessible and information on detection modes is also available, a quantitative approach to estimating overdiagnosis only relying on cancers and dispensing with population-based data is worthy of being developed. We applied a zero-inflated statistical model to a longitudinal follow-up empirical data with sufficient information based on patient-based data.
Methods: We illustrated the proposed method by using a retrospective cohort study that was composed of 1,346 patients diagnosed with invasive breast cancer in Falun Central Hospital of Dalarna County, Sweden. A novel zero-inflated cured regression model was conducted. The zero part represents both types of non-progressive cancer without potential of dying from BC, the cured due to treatment and the over-diagnosed due to mammography screening. These two types would be distinguished by detection modes (screen-detected cases and interval cancer plus cancers from non-participants). The count part represents the progressive breast cancer with potential of dying from BC associated with prognostic factors during follow-up.
Results: Overdiagnosis resulting from mammography screening program was 8.94% and high awareness was 2.86%. Among 43.86% progressive BC (the count part), 32.11% patients undergoing subsequent adjuvant therapies still remained alive after 15-year follow-up when adjusting for significant prognostic factors. The 15-year prognosis-adjusted cumulative survival of BC was dropped from 88.25% to 74.80% after correcting for the zero-inflated part of overdiagnosis.
Conclusion: The zero-inflated method could efficiently estimate the proportion of overdiagnosis only using the survival data with available information on detection mode after considering the probability of zero due to curation.

Controversial issues in screening

135 - Oral Presentation

Overdiagnosis: a conundrum to dismiss

Armaroli, Segnan
AOU Città della Salute e della Scienza di Torino, CPO, TORINO, Italy

Some patients receive diagnosis of disease without having any symptoms. These diseases are detected through screening programs, or as incidental findings from unrelated investigations, or via routine checks of various biological variables. Many of these diagnoses may be beneficial, enabling prevention of advanced disease, many others are thought to be overdiagnoses. In the recent years the debate on overdiagnosis focused on cancer screening as the only source of cases that would not be detected without screening. The quantification of the amount of cases, mainly of breast and prostate cancers, was and is harshly disputed, depending on different epidemiological methods and definitions of the numerators that were used for quantifying such cases. In the controversy two points were usually ignored or neglected: the justification of the concept of overdiagnosis and the identification of epidemiological determinants of this epiphenomenon. Considering the meaning of the word overdiagnosis (over:'more than expected'; diagnosis:'the identification of the nature of an illness or other problem by examination of the symptoms') and of disease ('a definite pathological process having a characteristic set of signs and symptoms') it follows that no disease can occur without symptoms or signs. Therefore the concept of overdiagnosis, as'finding cases of cancer with a screening test (such as a mammogram or PSA test) that will never cause any symptoms',seems not justified. We suggest instead to use the term pseudodisease, literally false-disease, and we consider a pseudodisease any indolent, non-progressive or regressive lesion,irrespective of the presence of symptoms. We propose to substitute the concept of overdiagnosis in clinics with the concept of pseudodisease and in epidemiology with the concept of excess cancer incidence when estimating the amount of pseudodisease and its components. We will discuss available evidence supporting that breast cancer pseudodisease cases in screening are only a fraction of overall pseudodisease breast cancer cases.

Controversial issues in screening

137 - Poster Presentation

Molecular characterization of colorectal cancer diagnosed in screening participants

Garcia, Sanz-Pamplona, Milà, Vidal, Binefa, Moreno
Catalan Institute of Oncology, HOSPITALET DE LLOBREGAT, Spain

Background: The experience of breast cancer screening programs have shown that molecular taxonomy have great potential to refine risk classification, enhance our understanding of the disease biology, and improve patient management. Although molecular taxonomy of colorectal cancer (CRC) into consensus molecular subtypes (CMS) categories has attracted great attention, its impact on daily practice is still limited. Some of the concerns that have been raised are related with costs, time and the requirement for sufficient bulk tumor that impide its widespread use.
Objective: To characterize CRC diagnosed in FOBT screenees and interval CRC (invasive CRC diagnosed following a negative screening episode and prior to the next scheduled screening examination) according to the CMS classification using formalin-fixed paraffin-embedded (FFPE) tissue blocks.
Methods: A pilot study was conducted to test feasibility of CRC subtyping with FFPE tissue blocks. RNA from eleven interval tumors and eight screening tumors were extracted using Recoverall™ kit (Thermofisher). Five sample duplicates were included for technical assessment purposes. After quantification and quality control assessment, 5.5 ugr de dsRNA were hybridized in the Clariom S microarray from Affymetrix. Then, a quality control assessment following Affymetrix standards was performed and data was normalized using the RMA algorithm. Next, the gene expression data was used to classify tumors into CMS subtypes using CMS classifier R package.
Results: Microarray gene expression data allowed CRC subtyping. Despite the small size, the results suggest that true interval cancers could be classify mostly in CMS4 whereas a higher proportion of screen-detected cancers would be CSM2 and CSM3. After the pilot study, will proceed to 200 tumors to have enough statistical power to detect differences between groups.
Conclusion: The differentiation between false negative and de novo tumors is difficult in CRC screening but preliminary results suggest molecular differences according to detection type (screening or interval).

Controversial issues in screening

172 - Oral Presentation

Potential for prevention: A cohort study of colonoscopies and adenomas in a FIT-based colorectal cancer screening program

MBL Larsen[1], Njor[1], Jensen[2], Ingeholm[3], Andersen[1]
[1]Randers Regional Hospital, RANDERS NO, Denmark
[2]Horsens Regional Hospital, HORSENS, Denmark
[3]Herlev Hospital, HERLEV, Denmark

Larsen, Mette Bach mailto:metbacla@rm.dk*; Njor, Sisse; Jensen, Thomas Møller; Ingeholm, Peter; Andersen, Berit
*Corresponding author

Background: Colorectal cancer (CRC) screening holds the potential to reduce CRC morbidity and mortality by removing adenomas. The aims of this study were to analyze the need for colonoscopies in a population invited for screening as compared to a not yet invited population and to analyze the effectiveness of the screening program with regard to removing adenomas.
Methods: A register-based retrospective cohort study including individuals resident in Denmark and aged 50-72 years on 1 January 2014. The need for colonoscopies were estimated as numbers of colonoscopies per 1000 invited/not yet invited along with relative risk (RR) of colonoscopy. The effectiveness of the screening program was estimated as no adenoma, non-advanced and advanced adenomas per 1000 invited/not yet invited and RRs of each of the three outcomes.
Results: A total of 1,359,340 individuals were included in the study, 29.6% were invited and 70.4% were not yet invited to participate in CRC screening. The RR of colonoscopy was 2.93 (2.87-2.99) for the invited population compared to the not yet invited. The RR of no adenomas was 2.28 (95% CI: 2.22-2.34) for the invited compared to the not yet invited. The RR of non-advanced adenomas was 4.27 (95% CI: 4.07-4.48) and 7.41 (95% CI: 6.93-7.91) of advanced adenomas for the invited compared to the not yet invited.
Conclusion: When implementing a FIT-based CRC screening program, the need for colonoscopies were three times higher among invited individuals compared to not yet invited. Twice as many invited compared to not yet invited had no adenomas detected. Still, the risk of advanced adenomas were more than seven times higher among the invited indicating that the screening program holds great potential for reducing the CRC burden.

Controversial issues in screening

174 - Oral Presentation

Post-Colonoscopy Mortality in a FIT-based Colorectal Cancer Screening Program

A.I. Kooyker[1], Toes-Zoutendijk[1], Opstal-van Winden[1], Spaander[1], Dekker[2], Buskermolen[1], Van Vuuren[1], Kuipers[1], Van Kemenade[1], Velthuysen[1], Nagtegaal[3], Ramakers[1], De Koning[1], Lansdorp-Vogelaar[1], Monique Van Leerdam[4]
[1]Erasmus Medical Center, AMSTERDAM, The Netherlands
[2]Amsterdam University Medical Center, AMSTERDAM, The Netherlands
[3]Radboud Medical Center, NIJMEGEN, The Netherlands
[4]Netherlands Cancer Institute, AMSTERDAM, The Netherlands

Introduction: As screening involves a healthy population, harms should be closely monitored. This study aims to evaluate the post-colonoscopy mortality in a fecal immunochemical test (FIT) based CRC screening program.
Methods: All participants of the Dutch CRC screening program with assessable FIT between Oct. 2013 and Dec. 2017 were included. Data on their FIT, colonoscopy (complications) and vital status were collected from the national screening database ScreenIT and the complication registration DRCE. Fatal complications were registered until 30 days after colonoscopy. Due to concerns about incomplete registration, two additional analyses were performed, despite their presumable overestimation. First, the 30-day post-colonoscopy excess mortality rate was estimated by comparing 30-day mortality rates. Second, the causes of death within 90 days post-colonoscopy were obtained from the Netherlands Statistics.
Results: A total of 172,834 participants underwent colonoscopy (158,797 without CRC detected) and 3,532,132 participants tested FIT negative. Four fatal complications were registered, resulting in a fatal complication rate of 0.23 per 10,000 participants. The 30-day mortality rate was 3.65 per 10,000 participants among participants with colonoscopy (without CRC detected) and 2.30 per 10,000 participants among FIT negative participants. After age-adjustment, comparing both 30-day mortality rates resulted in a 30-day post-colonoscopy mortality excess rate of 1.07 per 10.000 participants. Reported causes of death from the Netherlands Statistics were available until Dec. 2016. In 112,634 participants that underwent colonoscopy in this period, 240 deaths occurred within 90 days and 13 (1.15 per 10,000 participants) were potentially colonoscopy-related: eight died from cardiovascular disease or infection within 7 days and five by an (endoscopic) intervention within 90 days.
Conclusion: The post-colonoscopy mortality after a positive FIT differed per analysis, ranging between 0.23 per 10,000 participants based on the reported fatal complication rate to 1.15 per 10,000 participants based on cause-of-death statistics potentially related to colonoscopy.

Picture 1:

Analysis	Post-colonoscopy mortality rate per 10,000 participants*	Number of participants* per 1 post-colonoscopy mortality
Fatal complications	0.23 (95%CI: 0.090 – 0.60)	43478
30-day excess mortality	1.07	9346
Colonoscopy-related death causes	1.15 (95%CI: 0.67 – 1.97)	8696

*An individual may have undergone more than one colonoscopy

Controversial issues in screening

179 - Poster Presentation

Fall out from a cervical screening cancer audit; CervicalCheck, the National Cervical Screening Programme in Ireland

Fitzpatrick[1], Cafferty[2], Ryan[2], Mooney[2]
[1]National Screening Service/ University College Dublin, DUBLIN, Ireland
[2]National Screening Service, DUBLIN, Ireland

Background:
CervicalCheck, the National Cervical Screening Programme in Ireland commenced in 2008, achieving 80% 5-year coverage and an annual 7% cancer incidence reduction 2010-2015. US and Irish laboratories undertook cytology, with excellent turnaround times. Fifteen colposcopy units provided follow-up care under service level agreements with the National Screening Service. CervicalCheck was considered highly successful. Open disclosure was implemented on a discretionary basis into Irish healthcare in 2013.
Methods:
CervicalCheck undertook an audit of cervical cancers identified in women of screening age. Screening histories were reviewed and where a cervical cancer was diagnosed in a woman who adhered to recommended screening intervals, a review of previous slides was undertaken. A small number of cancers were identified where on reviewing the slide the reader gave a different interpretation which would have resulted in a different referral pathway for the woman. Open disclosure to the women identified as above did not occur in most cases.
Results:
Two cases came to public attention in 2018 when affected women won legal cases against the laboratories and went public with their stories and how audit results had not been communicated with them. A political and media controversy arose, with error-laden reports, headlines and articles appearing daily, with intense social media activity. The public perception was that CervicalCheck had delayed cancer diagnosis/treatment or had given a misdiagnosis by doing the audit. The political and media environment became frenzied. CervicalCheck Clinical Director and the Director General of the Health Service Executive resigned. An independent enquiry was established.
Conclusion:
The independent inquiry found system-wide failures encompassing the audit process, communication regarding benefits and limitations of screening, including the chance of a false-negative result and open disclosure. CervicalCheck accepted and is implementing the recommendations of the enquiry. CervicalCheck is moving to HPV as the primary screening test with reflex cytology.

Controversial issues in screening

195 - Oral Presentation

False positive FIT test - impact on return to screening in subsequent round; BowelScreen, the National Bowel Screening Programme in Ireland

Fitzpatrick[1], Xian Ch'Ng[2], Mooney[3], O'Donoghue[3]
[1]National Screening Service/ University College Dublin, DUBLIN, Ireland
[2]School of Medicine, University College Dublin, DUBLIN, Ireland
[3]National Screening Service, DUBLIN, Ireland

Background:
Little research exists on screening return post false-positive FIT test. False-positivity was defined as a positive test with subsequent colonoscopy showing no evidence of malignancy or adenoma(s) requiring surveillance. The aim was to quantify the impact of false-positive FIT screening results in the first round on re-attendance in the second round of BowelScreen, the national bowel screening programme in Ireland.

Methods:
A retrospective cohort study was conducted. Participation in the second screening round was compared in those with a false positive FIT and those FIT-negative. In those with a false-positive FIT, logistic regression was used to predict repeat participation in the second round.

Results:
Second round uptake was higher in those clients who were FIT-negative compared to those who were false-positive (87.5% vs 73.1%; $p<0.001$); this finding was similar in all subgroups after age and gender stratification. Older age (≥65 years) (OR 0.75; 95%CI 0.60-0.94), CT colonography (due to unsuitability for or failed colonoscopy) (OR 0.40; 95%CI 0.21-0.75) and longer duration from screening invitation to FIT result (OR 0.994; 95%CI 0.992-0.996) were significant negative predictors of re-attendance in the next screening round.

Conclusion:
This study shows a significant reduction in re-attendance rates for clients having a false-positive FIT result. Gastroenterologists giving colonoscopy results need to be aware they need to emphasise the importance of regular FIT tests after a negative colonoscopy.

Controversial issues in screening

196 - Poster Presentation

How Complete is the Evidence that Biennial Mammography in Average Risk Women is Cost-Effective? Revisiting the Literature

J F O'Mahony
Trinity College Dublin, DUBLIN, Ireland

BACKGROUND
Population screening for breast cancer is established practice in many developed countries. Biennial mammography is often cited as a cost-effective intervention.

METHODS
We assessed 26 simulation-based cost-effectiveness analyses (CEAs) of breast screening of average-risk women identified in a published systematic review. We reviewed what comparators were used to estimate the cost-effectiveness ratio for each simulated strategy. In particular, we sought to determine how many CEAs used a comparator with an interval of three years or more against which to estimate the incremental cost-effectiveness ratio (ICER) of biennial screening.

RESULTS
Of the 26 studies, only six clearly reported ICERs correctly. There were were only eight studies that included comparator strategies with intervals of three years or more. Of these eight studies, there are two studies, both from the early 1990s, that provide ICERs clearly supportive of biennial screening as cost-effective.

DISCUSSION
It has long been recognised that the ICER not the average cost-effectiveness ratio is the appropriate measure of cost-effectiveness. Furthermore, it is also known that the reliable estimation of ICERs requires the comparison of as many screening strategies as practicable. This review shows that many CEAs of breast screening have not presented adequate evidence that biennial screening is cost-effective because they do not present evidence of the incremental cost-effectiveness against the most relevant comparator of triennial screening. While our results do not imply biennial breast screening is not cost-effective, they do demonstrate that the body of simulation evidence supporting biennial mammography as cost-effective is much smaller than initially apparent. This critique of the existing CEA evidence is relevant to the broader debate regarding the clinical effectiveness of breast screening. Furthermore, the issues raised here also apply to the more recent CEA literature on screening high-risk women, in which similar modelling issues can be found.

Controversial issues in screening

202 - Poster Presentation

Addressing the Trend in the Abnormal Call Rate in Breast Cancer Screening

AD Domingo[1], GD Doyle[2], HB Bryant[1], EN Nicholson[1], CP Politis[1]
[1]Canadian Partnership Against Cancer, TORONTO, Canada
[2]Eastern Health, ST. JOHN'S, Canada

Background: The Canadian Partnership Against Cancer (the Partnership) is working to address factors associated with the increased abnormal call rate (ACR) for screening mammography through evidence-based quality improvement at the national level. Between 2007-2012, the national ACR rose by 23% and the positive predictive value decreased by 19%, while the invasive cancer detection rate (CDR) was stable. The national target for ACR (<10% initial screens; <5% subsequent screens) was also not met. This suggests the increase in the ACR contributed to an increase in false-positives presenting implications for patient wellbeing and health system resources. In collaboration with jurisdictional partners across the country, the Partnership is advancing efforts to develop an evidence-based national action plan to address the ACR.
Methods: An evidence synthesis was conducted to better understand the factors associated with the increased ACR. Areas examined include: ACR and mammography technology use over time; differences in quality assurance practices; and differences in radiologist training and characteristics. Subsequent phases of work will involve an environmental scan on ACR target setting and a national workshop to share key findings and initiate the development of a national action plan to address the ACR.
Results: Factors that may decrease the ACR without compromising CDR include: implementation of digital breast tomosynthesis in screening practice; targeted double reading of only potential recalls; consensus at double reading; comparison with two or more prior mammograms; batch reading of mammograms; and fellowship training in breast imaging.
Conclusions: Areas that merit further consideration in the design of breast screening programs include: synthesized digital mammography; performance feedback; reading volume; and mammographic compression. Development of an evidence-based national action plan on the ACR will contribute to a reduction in false-positives with implications for improved patient wellbeing and health system resource savings through a reduction of diagnostic tests.

Controversial issues in screening

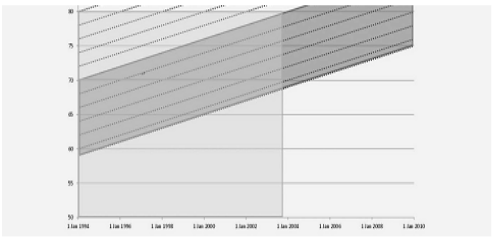
212 - Oral Presentation

What not to do, when estimating overdiagnosis in breast cancer screening

SHN Njor[1], EP Paci[2], MR Rebolj[3]
[1]Randers Regional Hospital, RANDERS, Denmark
[2]Former: ISPO Cancer Prevention and Research Institute, FLORENCE, Italy
[3]Queen Mary University of London, LONDON, United Kingdom

Background
Overdiagnosis estimates have varied substantially, causing confusion. The discussion has been complicated by the fact that populations and designs have varied substantially between studies. To help assess the impact of study designs on the estimates, we compared them on a single population.
Methods
An age-cohort study from Funen, Denmark, suggested little (~1%) overdiagnosis. It followed previously screened women for 14 years after end-of-screening. With the same data, we recreated the designs from five high-estimate, highly cited original studies from various countries. These age-period studies estimated overdiagnosis to be 25–54%.
Results
The reanalysis of the publically available Funen data resulted in overdiagnosis estimates remarkably similar to those from the original high-estimate age-period studies, 21–55%. In additional analyses, undertaken to elucidate the effect of the individual components of the study designs, overdiagnosis estimates were more than halved after the most likely changes in the background risk were accounted for, and decreased additionally when never-screened birth cohorts were excluded from the analysis (figure 1).
Conclusions
The same data give both low and high estimates of overdiagnosis, it all depends on the study design. The popular age-period analyses of breast cancer overdiagnosis that suggested very high frequencies of overdiagnosis all rested on multiple unmet assumptions, without adequately controlling for the background risk and including non-informative selections of birth cohorts. Overdiagnosis estimates should in the future be requested to adequately control for the background risk and include an informative selection of the studied population to achieve valid and comparable estimates of overdiagnosis.

Picture 1:



Comparing the age-period and birth cohort-based study designs for estimating overdiagnosis in breast cancer screening. Examples based on studies by Jørgensen et al. (light grey square) and Njor et al (dark grey rectangle) for Funen County.

Controversial issues in screening

224 - Oral Presentation

Breast cancer overdiagnosis rates and other unobservable outcomes in population subgroups: estimates from simulation modelling

Nickson[1], Procopio[1], Valentzis[1], Petrie[2], Mann[3], Brennan[4], Saxby[2], Carr[5], Canfell[6]
[1]Cancer Council NSW / University of Melbourne, CARLTON, Australia
[2]Monash University, MELBOURNE, Australia
[3]Royal Melbourne Hospital, MELBOURNE, Australia
[4]University of Sydney, SYDNEY, Australia
[5]Baker Institute, MELBOURNE, Australia
[6]Cancer Council NSW, SYDNEY, Australia

Background
Population breast cancer screening reduces breast cancer mortality and treatment intensity through earlier detection of cancers that would have become clinically detectable within a woman's lifetime. However, screening also confers some harms, including overdiagnosis and its subsequent treatment. Overdiagnosis rates are difficult to estimate. Detailed population simulation modelling provides an opportunity to estimate overdiagnosis and its presentation in different population subgroups.
Methods
Policy1-Breast is a continuous-time, stochastic, micro-simulation model of breast cancer diagnosis, screening and treatment in Australia. Attributes and behaviours are assigned to individual women, including breast cancer risk and growth, mammographic density, screening behaviour, screening test accuracy and mortality. The Policy1-Breast model design enables inference about which screen-detected cancers were overdiagnosed and how these manifest in different sub-groups of simulated women and for different screening strategies. We present some results to demonstrate this capability.
Results
For women age-eligible (50-69) for the Australian program during 2009-2018, selected outcomes are shown in Figure 1, according to population quintiles of mammographic density at age 50. In addition to confirming observed outcomes according to mammographic density (e.g. cancer rates, rates of interval cancers, program sensitivity), modelling of unobservable phenomenon suggests that women with higher mammographic density currently have lower rates of overdiagnosis, shorter lead time gained through screen-detection, and a higher proportion of interval cancers that were ≥5mm at the prior screen. Results for alternative screening strategies will also be presented.
Conclusion
The Policy1-Breast model enables estimation of some usually unobservable aspects of breast cancer screening and its impact on different population subgroups.

Picture 1:

Estimated outcomes for women aged 50-69 during 2009-2018, according to mammographic density at age 50

Population quintile of mammographic density at age 50	Invasive cancers per 10,000 women			Program sensitivity (whole period)	% of interval cancers ≥5mm at prior screen	Overdiagnosed cancers		Median lead time (years) (screen-detected cancers)
	All diagnoses	Screen-detected cancers	Interval cancers			% of all invasive cancers	% of screen-detected cancers	
Q1	193	107	20	84%	60%	8%	14%	4.6
Q2	221	118	26	82%	58%	7%	14%	4.5
Q3	252	126	33	79%	62%	7%	13%	4.7
Q4	290	137	41	77%	69%	6%	12%	4.2
Q5	311	127	57	69%	76%	5%	12%	3.7
All	254	123	36	78%	67%	6%	13%	4.3

Caption 1: Estimated outcomes for women aged 50-69 during 2009-2018, according to mammographic density at age 50

Controversial issues in screening

234 - Poster Presentation

Characteristics of adenomas influencing the sensitivity of fecal immunochemical test results: A systematic review

Todorovic[1], Jahn[2], Mladenovic[2], Sroczynski[2], Rochau[2], Siebert[2]
[1]Medical Faculty, University of Nis; UMIT, NIŠ, Serbia
[2]UMIT - University for Health Sciences, Medical Informatics and Technology, HALL IN TIROL, Austria

Background: Colorectal cancer (CRC) is the third most common cancer worldwide. Fecal immunochemical tests (FIT) are widely used and recommended for CRC screening. However, the adenoma detection rate of FIT is rather limited. Therefore, we aimed to systematically investigate and summarize all adenomas characteristics influencing FIT sensitivity and leading to false-negative results.
Methods: We conducted a systematic literature search in PubMed to identify studies on FIT accuracy and the impact of anatomical, morphological and histological characteristics of adenomas. We limited our search to articles published in English language from 2010 until 2018 and providing quantitative information on FIT sensitivity. Standardized evidence tables were used to extract study characteristics including study design, population size/characteristics, number of false-positive and false-negative FIT results and FIT sensitivity in regard to different adenoma characteristics. The review was conducted according to PRISMA guidelines.
Results: Of 479 identified articles, 59 were given full text assessment and nine of them were included in our systematic review. Study designs varied with five prospective and four retrospective screening studies. Four studies investigated adenoma localization only, three studies localization and morphology. One study compared FIT sensitivity for serrated and conventional adenomas and one study compared localization, morphology and histopathology with FIT sensitivity. The largest and smallest statistically significant proximal vs. distal FIT sensitivity difference were 19.7% (18.3% vs 38.0%) and 10.2% (24.1% vs 34.3%), respectively. Flat adenomas (according to the Paris classification) have significantly lower FIT sensitivity. The largest statistically significant FIT sensitivity difference between serrated and conventional adenoma was 18.3% (6.2% vs. 24.5%) whereby in case of high-grade dysplasia vs low-grade dysplasia the difference was 30.1% (57.1% vs 27.0%).
Conclusion: Our systematic review results suggest that proximal localization in colon, flat/depressed morphology, lower-grade of dysplasia and serrated type are associated with low FIT sensitivity and higher rate of false-negative results.

Controversial issues in screening

265 - Poster Presentation

Assessment of Harms, Benefits and Cost-effectiveness of Prostate Cancer Screening from Age 50: A Micro-Simulation Study

AM Getaneh, EAM Heijnsdijk, J De. Koning
Erasmus Medical center, ROTTERDAM, The Netherlands

Background: Prostate cancer screening usually incurs a high risk of overdiagnosis and overtreatment. An organised and age-targeted screening strategy may reduce the associated harms while retaining or enhancing the benefits.
Methods: Using a micro-simulation analysis (MISCAN) model, we assessed the harms, benefits and cost-effectiveness of 230 prostate-specific antigen (PSA) screening strategies. Screening strategies were varied by screening start age (50 at the earliest), stop age and intervals.
Results: Screening with 3-year intervals at ages 55 to 64 resulted in an incremental cost-effectiveness ratio (ICER) of €19,733 per QALY, which is closest to a willingness-to-pay threshold of €20,000 per QALY and regarded as the optimum strategy. This strategy predicted a 27% prostate cancer mortality reduction and 28 life years gained per 1,000 men; 36% of screen-detected men were overdiagnosed. In most of the sensitivity analyses, the optimal screening strategy remained the same.
Conclusions: PSA screening beyond age 64 is less cost-effective and associated with a higher risk of overdiagnosis. Similarly, starting screening before age 55 is not favoured from the cost-effectiveness perspective.

Controversial issues in screening

280 - Oral Presentation

The influence of DCIS detection on interval cancers in breast cancer screening

E.A.M. Heijnsdijk, H.A. Geuzinge, J. Fracheboud, H.J. De Koning
Erasmus MC, University Medical Center, ROTTERDAM, The Netherlands

Background: Ductal carcinoma in situ (DCIS) may or may not progress to invasive breast cancer. In the UK it was found that detecting more DCIS at screening resulted in less interval cancers in the three years after the screen. The aim of this study was to evaluate if this result could be reproduced in a country with the more commonly used 2-year screening interval.
Methods: Results of screened women age 50-74 at 158 different screening units in the period 2004-2012 in the Netherlands were used. DCIS detection rates at screening and interval cancer rates following the screens (with a maximum of 2.5 years) per unit and the Pearson correlation between DCIS detection rates and interval cancer rates were calculated. In addition, microsimulation modeling was used to simulate units with various screening sensitivities, leading to various DCIS detection rates and interval cancers in the subsequent screening interval in the period 2012-2020.
Results: In the Dutch data the average DCIS detection rate was 1.04 per 1000 screens and the corresponding interval cancer rate 2.09 per 1000 screens. The Pearson correlation coefficient was a non-significant -0.14. About 7.7 DCIS should be detected to prevent one interval cancer. The modeling results were comparable: 8.3 DCIS should be detected to prevent one interval cancer
Conclusion: A high detection of DCIS may lead to a small reduction in interval cancers in the subsequent 2-year screen interval.

Impact of screening policies and strategies

2 - Poster Presentation

Cervical Cancer Screening results for 10 years in Kazakhstan

Bolatbekova, Kaidarova, Zhylkaidarova
Kazakh Institute of Oncology and Radiology, ALMATY, Kazakhstan

Background. Cervical cancer (CC) is the second most common cancer in women worldwide with an annual registration of more than 528,000 new cases and 266,000 deaths.
Most of the cases of CC occur in developing countries. Screening programs in developed countries have reduced morbidity and mortality from CC by more than twice. CC is one of the most common cancers in women in the Kazakhstan, occupying the second leading place among women cancer. In 2017, the standardized incidence of CC was 17.9 per 100,000, while the mortality was 6.2 per 100,000. Cervical Screening program in Kazakhstan has been using Pap test since 2008 which is free for women aged 30-70 years every 4 years. Despite the introduction of cytological screening, the mortality remains stably high.
Aim. The purpose of this study is to analyze the effectiveness of CC screening in Kazakhstan
Methods. Coverage analysis, the number of screened women, the level of pre-cancer detection and cervical cancer during screening have been obtained from specific reports (form №- 025, №- 08) for 2008-2017.
Results. The number of screened women totaled at 4,869,444. The coverage for 10 years has decreased by 23%, from 72.9% in 2008 to 49.9% in 2017, with the highest coverage in 2012. Decrease in coverage is associated with reduced funding. For 10 years 1765 new cases of CC were registered, the increase in detection was due to early stages of CC. The analysis of the screening results showed a marked increase in the detection of CC with an increase of 37%. The percentage of registered cases of HSIL increased from 0.136% to 0.673%.
Conclusion. Despite sufficient coverage and relative success in detecting the initial stages of CC, the mortality rate remains high. Thus, it is necessary to improve the effectiveness of CC screening through the introduction of HPV-screening

Impact of screening policies and strategies

6 - Poster Presentation

Cancer screening guidelines and policy-making in Japan

CH Hamashima
Teikyo University, TOKYO, Japan

Background: Cancer deaths have remained a heavy burden in Japan, thus cancer screening has been anticipated to be a practical strategy for reducing mortality from cancers. In Japan, screenings for gastric, colorectal, lung, breast, and cervical cancers have been conducted. The Basic Plan to Promote Cancer Control Program published in 2006 stated that evidence-based cancer screening is required. At the conception of national cancer screening programs, there were no cancer screening assessments.
Methods: The history of the development of cancer screening guidelines and the establishment of related policies are revisited to gain important insights for further development and improvement.
Results: From 1998 to 2001, Hisamichi formed committees for the assessment of cancer screening and published three reports. These reports were the cornerstone in assessing primary studies of cancer screening in Japan which served as a stimulus for the development of cancer screening guidelines. Since 2003, research groups funded by the National Cancer Center have developed cancer screening guidelines based on established methods in reference to international standards. Screening guidelines for the following cancers have been published: gastric, colorectal, lung, prostate, cervical, and breast cancers. Recommendations for screening are made following an assessment of the balance of benefits and harms. The recommendation has been divided for population-based screening and opportunistic screening. New screening techniques with insufficient evidence have been suggested to further undergo research. The national committee has continued to appraise their evidence for cancer screening based on established guidelines and has discussed implementation problems. The screening methods for breast and gastric cancers have been revised based on cancer screening guidelines.
Conclusions: Cancer screening guidelines have increasingly contributed to the promotion of evidence-based cancer screening for national programs in Japan. To provide appropriate cancer screening evidence, additional studies to further improve the methodology for guideline development are warranted.

Impact of screening policies and strategies

17 - Poster Presentation

The Participation on the population based Colorectal Cancer Screening Programme in the Basque Country (Spain) decreases mortality

Il Idigoras, IP Portillo, IB Bilbao
Osakidetza, BILBAO, Spain

Title of the article: The Participation on the population based Colorectal Cancer Screening Programme in the Basque Country (Spain) decreases mortality
Objectives: The aims of this study were to determine the main features of Colorectal Cancer (CRC), survival rate and related factors for different types of identified CRCs in the population eligible for screening in the Colorectal Cancer Screening Programme (BCSP).
Design: The CRCs in the susceptible population to be screened between 2009 and 2014 were identified and classified into four groups: a) never-screened (diagnosed before first screening invitation and non-participants), b) screening-detected, c) interval cancer via faecal immunochemical test (FIT) (diagnosed between screening rounds after a negative FIT) IC_FIT and d) interval cancer colonoscopy (diagnosed before the colonoscopy surveillance recommended after the screening colonoscopy) IC_COL. Patient demographics and epidemiological characteristics, tumour characteristics and survival were compared between the four groups.
Results: 5,909 people were diagnosed with a CRC. The median follow-up of survival was 4.6 years (range 0-9 years). The study highlights a significant difference (p 0.0001) in 5-year survival in the screening-detected group compared to those not screened (90.1% vs 66.7%). Although Interval Cancers are adverse events, the 5-year survival rate is significantly higher for participants with respect to non-participants ($p<0.0001$) (76.3% vs 60.5%), this being the group with the lowest survival rate.
Conclusions: The significant 23.1% greater 5-year survival of the participants in the BCSP, suggests that incidence and mortality rates of CRC will decrease in the near future for participants in screening programmes. A high participation rate is essential to achieve health benefits, regardless of the type of participation.

Impact of screening policies and strategies

25 - Oral Presentation

INTERVAL CANCERS AFTER A NEGATIVE FAECAL IMMUNOCHEMICAL TEST IN THE FIRST SCREENING ROUND IN THE NETHERLANDS FOR TWO CUT-OFF LEVELS

E Toes-Zoutendijk[1], AI Kooyker[1], E Dekker[2], MCW Spaander[1], AWJ Opstal-van Winden[1], C Ramakers[1], M Buskermolen[1], AJ van Vuuren[1], EJ Kuipers[1], FJ van Kemenade[1], MF Velthuysen[1], MGJ Thomeer[1], H van Veldhuizen[1], M van Ballegooijen[1], ID Nagtegaal[3], HJ Koning[1], van Leerdam[4], I Lansdorp-Vogelaar[1]
[1]Erasmus MC university medical center, ROTTERDAM, The Netherlands
[2]Academic Medical Center, AMSTERDAM, The Netherlands
[3]Radboud University Medical Center, NIJMEGEN, The Netherlands
[4]Antoni van Leeuwenhoek - Netherlands Cancer Institute, AMSTERDAM, The Netherlands

Introduction: This study evaluated the interval cancer incidence after the first screening round in the national organised colorectal cancer (CRC) screening programme in the Netherlands using a faecal immunochemical test (FIT) in relation to FIT cut-off.
Methods: Screening participants with a negative FIT result in the first screening round in 2014 were included in the study. Main outcome measures were cumulative incidence of interval cancer after negative FIT and CRC sensitivity of FIT at a low (15 µg Hb/g faeces) and higher (47 µg Hb/g faeces) cut-off.
Results: Among the 485,112 participants with a negative FIT in 2014, 544 interval cancers were detected: 126 interval cancers among 111,800 FIT negatives at the low cut-off and 418 interval cancers among 373,312 FIT negatives at the higher cut-off. The age-adjusted two year cumulative incidence of an interval cancer after negative FIT did not differ significantly for the two cut-offs. The age-adjusted two year cumulative incidence of an interval cancer after negative FIT with a higher cut-off (13.8 per 10,000 persons) did not differ significantly from the lower cut-off (9.5 per 10,000 persons) (rate ratio of 0.68; 95%CI: 0.42-1.12). Age-adjusted CRC sensitivity of FIT was 90.5% at the low cut-off and 82.9% at the high cut-off, with no significant difference (rate ratio of 1.09, 95%CI: 0.91-1.30). The sensitivity of 87.4% among men was significantly higher than the sensitivity of 82.6% among women (p <0.001).
Conclusions: The incidence of interval CRC after a negative FIT is low. This supports the high sensitivity of FIT for CRC, also when using a relatively high FIT cut-off. The small but non-significant difference between the cut-offs is reassuring for all organised CRC screening programmes using higher FIT cut-offs aiming for an optimal balance between true and false positives or reduced colonoscopy demand.

Impact of screening policies and strategies

27 - Poster Presentation

Association between age factors and strategies for promoting participation in gastric and colorectal cancer screenings

CH Hamashima[1], HS Sano[2]
[1]Teikyo University, TOKYO, Japan
[2]Siga University, HIKONE, Japan

Objective: Despite the long history of cancer screening in Japan, the participation rates in gastric and colorectal cancer screenings have not increased. Although strategies for improving the participation rates have been proposed, the differences in these effects among age groups are unclear. The Japanese government conducted a national survey for all municipalities to investigate the implementation of promotion strategies for increasing participation in cancer screening in 2010. We investigated the association between age factors and strategies for promoting participation in cancer screening based on this national survey.
Methods: Multiple regression analysis with generalized linear model was performed using the participation rates in gastric and colorectal cancer screenings as dependent variables, and the following strategies for promoting participation as independent variables: 1) personal invitation letters, 2) household invitation letters, 3) home visits by community nurses, 4) screenings in medical offices, and 5) free cancer screening programs.
Results: 1,639 municipalities for gastric cancer screening and 1,666 municipalities for colorectal cancer screening were selected for the analysis. In gastric and colorectal cancer screenings, the participation rates of individuals aged 60-69 years were higher than those of other age groups. Personal and household invitation letters were effective promotion strategies for all age groups, which encouraged even older people to participate in gastric and colorectal cancer screenings. Screening in medical offices and free screenings were not effective in all age groups. The home visit was effective, but its adoption was limited to small municipalities.
Conclusions: Although personal and household invitation letters are effective strategies for promoting participation in cancer screening for all age groups, these strategies equally encourage older people to participate in gastric and colorectal cancer screenings. If the resource is limited to send invitation letters, priority should be considered as individuals aged their 50s and 60s for gastric and colorectal cancer screening.

Impact of screening policies and strategies

31 - Oral Presentation

Performance of Fecal Immunochemical Test in cancer screening -colonoscopy outcome in FIT positives and negatives

Ribbing Wilén, Blom, Hultcrantz
Karolinska Institutet, STOCKHOLM, Sweden

Background: Fecal Immunochemical Test (FIT) is used in colorectal cancer (CRC) screening, but evaluations of multiple sample strategies in colonoscopy screening cohorts are rare.
The aim of this study was to assess accuracy of FIT for advanced neoplasia with two fecal samples in a colonoscopy screening cohort.
Methods: The study comprised 1155 participants of the colonoscopy arm in SCREESCO (Screening of Swedish Colons), a randomized controlled study on CRC screening of 60-year-olds from the Swedish average-risk population. Participants provided two FIT samples prior to colonoscopy. First sample, mean of two, and highest of two samples were assessed. Colonoscopy findings [CRC, Advanced adenoma (AA), Advanced neoplasia (AN; CRC+AA) and adenoma characteristics] were evaluated in uni- and multivariable analysis in relation to FIT positivity [at ≥10µg Hemoglobin (Hb)/g].
Results: Of 1155 invited, 806 (416 women, 390 men) participated. CRC, AA and non-Advanced adenoma was found in 1 (0.1%), 80 (9.9%) and 145 (18%). Sensitivity and specificity for AN was 20%/93%, 25%/92% and 26%/89% for first, mean of two and highest of two samples respectively at cut off level 10µg/g, corresponding to 60-65 participants with missed AN. FIT positivity in participants with adenoma was associated pedunculated shape (p=0.007) and high-risk dysplasia (p=0.009).
Conclusion: In an average-risk colonoscopy screening cohort of 60-year-olds, sensitivity for AN was modest using two samples at cut off 10µg/g for a positive test. FIT predominantly detected adenomas with pedunculated shape and high-risk dysplasia, and participants with flat or broad based adenomas may thus be missed in screening.

Picture 1:

Table 1. Sensitivity and specificity for advanced neoplasia at different Fecal Immunochemical Test (FIT) cut off levels and number of samples in 806 screening participants.

Test, cut off µg/g		Positivity (95% CI)	True positive	False positive	True negative	False negative	Sensitivity (95% CI)	Specificity (95% CI)
≥1 of 2†	10	12.7 (10.4-15.0)	21	81	644	60	25.9 (16.8-36.9)	88.8 (86.3-91.0)
	20	7.2 (5.4-9.0)	19	39	686	62	23.5 (14.8-34.2)	94.6 (92.7-96.1)
	40	3.7 (2.4-5.0)	13	17	708	68	16.0 (8.80-25.9)	97.7 (96.3-98.6)
	60	2.5 (1.4-3.6)	10	10	715	71	12.3 (6.10-21.5)	98.6 (97.5-99.3)
	80	2.2 (1.2-3.3)	9	9	716	72	11.1 (5.20-20.0)	98.8 (97.7-99.4)
Mean‡	10	9.6 (7.6-11.7)	20	57	662	61	24.7 (15.8-35.5)	92.1 (89.9-93.9)
	20	4.6 (3.2-6.1)	14	23	696	67	17.3 (9.80-27.3)	96.8 (95.2-98.0)
	40	2.6 (1.5-3.7)	11	10	709	70	13.6 (7.00-23.0)	98.6 (97.5-99.3)
	60	2.1 (1.1-3.1)	8	9	710	73	9.90 (4.40-18.5)	98.7 (97.6-99.4)
	80	1.8 (0.8-2.7)	6	8	711	75	7.40 (2.80-15.4)	98.9 (97.8-99.5)
First§	10	8.6 (6.6-10.5)	16	53	672	65	19.8 (11.7-30.1)	92.7 (90.5-94.5)
	20	4.2 (2.8-5.6)	12	22	703	69	14.8 (7.90-24.4)	97.0 (95.4-98.1)
	40	2.4 (1.3-3.4)	8	11	714	73	9.90 (4.40-18.5)	98.5 (97.3-99.2)
	60	1.6 (0.7-2.5)	6	7	718	75	7.40 (2.80-15.4)	99.0 (98.0-99.6)
	80	1.6 (0.7-2.5)	6	7	718	75	7.40 (2.80-15.4)	99.0 (98.0-99.6)

Advanced neoplasia= adenocarcinoma or advanced adenoma (=adenoma ≥10mm or ≥3 <10mm or adenomas with villous growth or high grade dysplasia).

†) At least one of two samples above or equal to cut off.

‡) Mean of two samples above cut off. 6 participants were excluded as they sent only one sample.

§) First of two samples. In 48 participants both tests are from the same date, therefore a random sample was chosen as the first FIT.

Caption 1: Table 2. Sensitivity and specificity for advanced neoplasia at different Fecal Immunochemical Test (FIT) cut off levels and number of samples in 806 s

Impact of screening policies and strategies

32 - Poster Presentation

Strategies to increase the quality of screening mammography: Systematic evaluation and feedback

Posso[1], Martínez[2], Rodríguez[2], Alcántara[2], Ejarque[2], Arranz[2], Sivilla[2], Hernández[2], Castells[2], Macià[2]
[1]IMIM (Hospital del Mar Medical Research Institute), Barcelona, Spain., BARCELONA, Spain
[2]IMIM (Hospital del Mar Medical Research Institute), BARCELONA, Spain

Background
Several evaluation methods for assessing the quality of mammograms as well as systems for mammography classification are available. In Europe and Australia, the 'perfect, good, moderately good, and inadequate' PGMI system is widely used. We have adapted to digital mammography, and implemented to our Screening Unit, a systematic evaluation using the PGMI system. The results observed through 2015 to 2017 are reported here.
Methods
We performed an evaluation every six months. In each evaluation, 100 digital mammograms were randomly selected, after excluding the mammograms of women with breast prostheses or limited mobility. Three breast radiologists independently assessed mammograms and were blind to radiographer. For each breast and projection, cranial-caudal (CC) and oblique-medium-lateral (OML), the radiologists evaluated sharpness, extraneous objects, skin folds, clear and complete visualization of the entire breast, nipple profile, and symmetry. An atlas containing images and definitions adapted to digital mammography was elaborated to facilitate the assessment.
Results
We observed a steady improvement of the quality of the mammograms over the period 2015-2017, and no major differences were observed according to radiographer. The proportion of OML perfect projections increased from 3% (4/120) in 2015 to 43% (43/100) in 2017. Similarly, CC perfect projections varied from 6% (7/120) in 2015 to 30% (30/100) in 2017. The errors more frequently identified were those related with the inframammary angle, the position of pectoral muscle, the external glandular tissue, the shadow of the pectoral muscle, the skin folds, and the nipple profile. After each evaluation, a feedback session with the conjunction of radiologists and radiographers was carried out to discuss cases and propose improvement strategies.
Conclusions
A systematic evaluation and feedback have allowed us to considerably increase the proportion of perfect mammograms, always keeping the percentage of inadequate mammograms below 3%.

Impact of screening policies and strategies

33 - Oral Presentation

Opportunities to extend and improve the effectiveness of the Dutch colorectal cancer screening program in 2020

M. Buskermolen[1], SK Naber[2], AI Kooyker[2], E. Toes-Zoutendijk[2], AWJ Opstal-van Winden[2], VMCW Spaander[2], EJ Kuipers[2], H van Veldhuizen[2], CRB Ramakers[2], E Dekker[3], AJ van Vuuren[2], FJ van Kemenade[2], MF van Velthuysen[2], MGJ Thomeer[2], M van Ballegooijen[2], M van Leerdam[4], I Nagtegaal[5], HJ de Koning[2], I Lansdorp-Vogelaar[1]
[1]Erasmus Medical Center, ROTTERDAM, The Netherlands
[2]Erasmus MC, ROTTERDAM, The Netherlands
[3]Amsterdam University Medical Centre, AMSTERDAM, The Netherlands
[4]Nederlands Kanker Instituut, AMSTERDAM, The Netherlands
[5]Radboud UMC, NIJMEGEN, The Netherlands

Background: In 2019, the Dutch colorectal cancer screening program, which offers FIT every 2 years at a cut-off of 47 mg/g faeces to the population, will be fully implemented. Currently colonoscopy capacity and demand are in balance, which allows evaluation whether extension of the program could further improve (cost-)effectiveness.
Methods: We used microsimulation modelling to simulate the 2014 Dutch population under the current screening program and 3 alternative strategies from 2020 onwards: using a lower cut-off (40, 30, 20, 15, 10 mg/g), lower start age (51) or shorter screening interval (1 year). In addition, we simulated combinations of these strategies. Primary outcomes were QALYs gained, number of colonoscopies required and cost-effectiveness.
Results: Continuing the current program resulted in 57 QALYs gained and 279 colonoscopies per 1000 individuals. All cut-offs resulted in additional QALY gained (up to 20), and all would still cost less than €20,000/QALY gained (Table 1). For instance, lowering the cut-off to 30 mg/g would gain 9 additional QALYs requiring 82 extra colonoscopies. Lower start age and shorter screening interval also increased QALYs gained (5 and 16 QALYs respectively), but required relatively more resources for these gains. Combining all extensions yielded 99 QALYs gained and cost less than €20,000/QALY gained. However, this strategy tripled required colonoscopies.
Conclusion: To extend the Dutch screening program, first lowering the cut-off is the preferred strategy. In case of sufficient colonoscopy capacity, a combination of program extensions is most effective and would still be cost-effective.

Tabel 1. Required colonoscopies, QALYs gained and cost for the current Dutch colorectal cancer screen program and alternative strategies to extend the program per 1000 individuals.

Strategy			Colonoscopies				
Cut-off	Start age	Screen interval (year)	Total	Diagnostic	Surveil-lance	QALY's Gained	Cost (*1000 €)
47*	55	2y	279	160	119	57	25.7
40	55	2y	312	178	134	61	25.1
47	51	2y	319	173	147	62	39.6
30	55	2y	361	206	154	66	26.1
20	55	2y	419	240	179	72	28.9
47	55	1y	405	238	167	73	72.2
15	55	2y	458	265	193	75	31.6
10	55	2y	484	279	205	77	33.1
10	51	1y	740	422	318	99	109.6

*Reference: current Dutch colorectal cancer screening program strategy

Picture 1:

Impact of screening policies and strategies

35 - Poster Presentation

Variation in colorectal cancer stage and mortality across large community-based populations: the PORTAL colorectal cancer cohort.

JLS Schneider[1], HSP Feigelson[2], VPQ Quinn[3], CM McMullen[4], PAP Pawloski[5], JDP Powers[2], ATS Sterrett[2], DA Arterburn[6], DAC Corley[1]
[1]Kaiser Permanente Northern California, OAKLAND, United States of America
[2]Kaiser Permanente Colorado, DENVER, United States of America
[3]Kaiser Permanente Southern California, PASADENA, United States of America
[4]Kaiser Permanente Northwest, PORTLAND, United States of America
[5]HealthPartners Institute, BLOOMINGTON, United States of America
[6]Kaiser Permanente Washington, SEATTLE, United States of America

Background
Colorectal cancer (CRC) incidence and mortality can be markedly reduced by effective screening and/or treatment. However, the influence of health care systems on disparities among insured patients is largely unexplored.
Methods
The current study evaluated insured patients diagnosed with CRC between 2010-2014 across six diverse US health care systems in the PCORI PORTAL CRC cohort. Using hazard ratios as estimates of relative risk, we contrasted CRC stage, CRC mortality, and all-cause mortality, and the influences of demographics, stage, comorbidities and treatment between health systems.
Results
Among 16,211 insured patients with CRC, there were substantial and significant differences between health care systems in CRC stage at diagnosis, CRC-specific mortality, and all-cause mortality. The unadjusted risk of CRC-mortality varied from 27% lower to 21% higher than the reference system (HR 0.73, 95% CI 0.66-0.80 – HR 1.21, 95% CI 1.05-1.40; $p<0.01$ across plans). Significant differences persisted after adjustment for demographis, bmi, and comorbidities ($p<0.01$ across systems); however, adjustment for stage eliminated significant differences ($p=0.24$ across systems). Hazard ratios were not substantially further influenced by adjustment for duration of membership, treatment, year of diagnosis, or insurance type. All-cause mortality among patients with CRC differed approximately 30% between health care systems (HRs range 0.89-1.17; $p<0.01$); adjustment for age alone eliminated significant differences(p-value=0.48).
Conclusion
In a large, multi-center US cohort study of insured adults, substantial differences in CRC survival between health care systems were largely explained by stage at diagnosis, not by demographics, comorbidity or treatment. Given stage is strongly related to early detection, this suggests that variation in CRC screening systems alone represents a likely major modifiable systems-level factor for reducing patient disparities in CRC survival.

Impact of screening policies and strategies

41 - Poster Presentation

Direct notification of cervical cytology results to women improves follow-up in cervical cancer screening - A cluster-randomised trial

BKK Kjær Kristiansen
Randers Regional Hospital, RANDERS, Denmark

Up to half of all women do not receive follow-up as recommended after cervical cytology testing and are thus at increased risk of dysplasia progression. Women from lower social positions are at increased risk of not receiving follow-up. Sample takers, often general practitioners, convey results to women, but communication problems constitute a challenge. We aimed to investigate the effect of direct notification of cervical cytology results on follow-up rates.

In a 1:1 cluster-randomised controlled trial, we assessed if having the pathology department convey cervical cytology results directly to the investigated women improved timely follow-up, compared with conveying the results via the general practitioner as usual. All women with a cervical cytology performed in a general practice in the Central Denmark Region (2013–2014) and receiving follow-up recommendation were included (*n*=11,833).

The proportion of women without timely follow-up was lower in the group with direct notifications than in the control group of women receiving usual care, regardless of age, educational status, cohabitation status and ethnicity. Among the women with the most severe cervical cytology diagnoses who are recommended gynaecological follow-up within 3months, the percentage without timely follow-up was 15.1% in the intervention group and 19.5% in the control group (prevalence difference: −0.04 (95%CI: −0.07; −0.02)). Improved timely follow-up was also observed for women with a recommendation to have follow-up performed at 3 and 12months.

Cervical cytology results conveyed directly by letter to women increased the proportion of women with timely follow-up without raising inequality in follow-up measured by social position.

Impact of screening policies and strategies

44 - Poster Presentation

Suboptimal quality of follow-up care in the Flemish cervical cancer screening program and an intervention to improve it.

Kellen[1], Martens[1], Haelens[2]
[1]Centre for Cancer Detection, Flanders, Belgium, BRUGES, Belgium
[2]Belgian Cancer Registry, BRUSSELS, Belgium

Background: Cervical cancer screening detects pre-malignant lesions and reduces mortality from cervical cancer. However, delayed or incomplete follow-up after an abnormal cervical cytology result compromises the benefit of participating in the screening program.
Methods: In 2013, an organized screening program, promoting one cervical smear every 3 years for women aged between 25 and 64 years, was set up in Flanders, Belgium. The screening program uses a centralized invitation procedure; all invitation letters are sent out by the Centre for Cancer Detection. All cervical cytology results, histological diagnoses from cervical biopsies as well as all other pathology specimens are recorded by the Belgian cancer registry. Women with a recent spontaneous smear or those who had a hysterectomy are excluded to receive an invitation letter, in addition to women who actively opted out of the screening program. The screening program is funded by the Flemish government.
Results: In 2016, coverage was 62.1%. In 7.1% of the PAP smears abnormal cells were observed; 0.4% of the PAP smears were of insufficient quality. Up to 20% of all women did not receive follow-up as recommended; timely follow up varied between different cytology results. Among women with the most severe cervical cytology diagnoses (HSIL), the percentage with a timely follow-up was 94%. Among women who were diagnosed with ASC-US, timely follow up was 58%. The proportion of women with an unsatisfactory PAP smear result, who had a repeat smear within one year was 38.7%.
Conclusions: Women without a timely follow-up after an abnormal PAP smear result are at increased risk of dysplasia progression. Therefore, a failsafe system will be implemented. The GP's and/or gynaecologists of those women, who did not receive a timely follow-up, will be contacted by the Centre for Cancer Detection. After one year, the intervention will be evaluated.

Impact of screening policies and strategies

49 - Oral Presentation

Is it possible to modify public health policy in cancer screening field with Citizen's and professional's conferences : the french experience ?

Sandrine De Montgolfier
IRIS Institut de Recherche Interdiscipli, BOBIGNY CEDEX, France

This reflexion comes back with a dual perspective, both academic and operational, to the 2016 scientific and citizen consultation on breast cancer screening and the public health actions being developed.
In view of controversies around breast cancer screening, the Ministry of Health asked the French National Cancer Institute to organize this consultation to clarify the benefits and limitations of breast cancer screening, health objectives, organizing and tackling the health inequalities of this program. It has combined the setting up of an independent and multidisciplinary steering committee, a conference of citizens and professionals. It relied on the hearing of experts representing the trends of the controversy, on a technical and prospective report and on the analysis of nearly 500 online contributions. At the end of this process, the policy committee produced a report.
In the end, two scenarios were presented, leading to a complete overhaul of the current screening process. As a result of this report, the Ministry announced the action plan for the renovation of organized breast cancer screening in 12 measures in April 2017.
The discussion focuses on the consultation methodology as a tool for health democracy and on the levels of arbitration that led to the action plan. The objective is to reflect on the possible interactions between consultation and decision-making and to propose benchmarks for the development and improvement of this kind of citizen consultation in the field of cancer screening.

Impact of screening policies and strategies

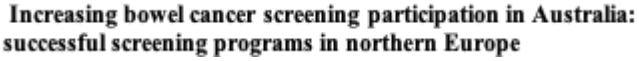
51 - Poster Presentation

Increasing bowel cancer screening participation in Australia: learning from successful screening programs in northern Europe

Flander[1], Dekker[2], Paauw-Fikkert[3], Andersen[4], Steele[5], Malila[6], van der Vlugt[2], Larsen[4], M de Klerk[2], B.J. Knotterus[2], Bertels[2], Spaander[7], Fransen[2], Dillon[8], Ait Ouakrim[1], Jenkins[1]
[1]University of Melbourne, MELBOURNE, Australia
[2]Amsterdam University Medical Centers, AMSTERDAM, The Netherlands
[3]RIVM, BILTHOVEN, The Netherlands
[4]Randers Regional Hospital, RANDERS, Denmark
[5]University of Dundee, DUNDEE, United Kingdom
[6]Finnish Cancer Registry, HELSINKI, Finland
[7]University Medical Centre, ROTTERDAM, The Netherlands
[8]Aalto University, AALTO, Finland

Background: Colorectal cancer (CRC) is the second most commonly diagnosed and deadliest cancer in Australia, and a leader in global CRC ranking. After successful feasibility trials, the National Bowel Cancer Screening Program (NBCSP) began in 2006; by 2020, all Australians from age 50 to 74 will receive biennial iFOBT. However, only 27% of those approached for the first time by the Program between 2015 and 2016 returned the kit. Of all 3.1 million kits sent, only 41% were returned. Participation rates in comparable European bowel cancer screening programs suggest that participation increases of 10-20% are possible for the NBCSP. Our aim was to identify practices and features of national bowel cancer screening programs in other countries with similar screening programs and high screening participation, to identify potential interventions for optimising Australian colorectal cancer screening.
Methods: Programs reporting at least 50% screening participation using postal invitation, delivery and free postal return of iFOBT/FIT home kit were identified from EU cancer screening reports. Research visits focused on participant and practitioner engagement in the screening pathway.
Results: Bowel cancer screening programs in Netherlands, Denmark, Scotland and Finland reported over 50% screening participation rates. We found characteristics that may contribute to high participation in screening: widespread trust in government institutions that deliver services; relatively small populations within relatively small geographic areas; relatively high literacy and narrow socioeconomic gradients; program engagement with primary care services; focused screening participation research including hard-to-reach groups; and national registration systems for population cancer screening research.
Conclusions: Some screening program features have potential to increase Australian screening participation.

Picture 1:



Impact of screening policies and strategies

55 - Poster Presentation

COMPARISON OF FIT-BASED COLORECTAL CANCER SCREENING PROGRAMMES

E Toes-Zoutendijk[1], I Portillo[2], S Hoeck[3], I de Brabander[4], P Perrin[5], C Dubois[6], van Leerdam[7], I Lansdorp-Vogelaar[1], M Bardou[8]
[1]Erasmus MC university medical center, ROTTERDAM, The Netherlands
[2]The Basque Health Service, BILBAO, Spain
[3]University of Antwerp, ANTWERP, Belgium
[4]Belgian Cancer Registry, BRUSSELS, Belgium
[5]Association pour le déspistage du Cancer Colorectal en Alsace (ADECA), COLMAR, France
[6]Centre PYRADEC, PAU, France
[7]Antoni van Leeuwenhoek - Netherlands Cancer Institute, AMSTERDAM, The Netherlands
[8]Dijon-Bourgogne University Hospital, DIJON, France

Background This study compared four faecal immunochemical testing (FIT) based screening programmes for colorectal cancer (CRC) in Flanders, France, Basque country and the Netherlands with the aim of identifying factors that could be used to further optimize existing FIT programmes.
Methods Background information and data on performance indicators were collected and compared for the four CRC screening programmes.
Results Invitation approach differed most strikingly between the four programmes: In France only an invitation letter is send by mail, while the sample kit needs to be collected at general practitioner (GP). In the other programmes, an invitation letter including the sample kit is send by mail. Additionally, Basque country and the Netherlands also send a pre-invitation letter prior to the invitation. Participation rates vary substantially with method of invitation with the highest participation rates in the Netherlands (73.0%) and Basque country (72.4%), followed by Flanders (54.5%) and France (28.6%). Basque country (92.8%) and France (88.4%), the two programmes with most active involvement of GPs in referral for colonoscopy, also had the highest participation rate with colonoscopy following a positive FIT test.
Conclusions Large differences in screening participation were observed between programmes in line with the invitation method used. This finding suggests that changes to the design of the programme, such as including the sample kit with the invitation, might increase participation. The high participation to colonoscopy in Basque country and France might indicate that in programmes with active involvement of GPs individuals are more likely to undergo a colonoscopy.

Impact of screening policies and strategies

56 - Poster Presentation

QUALITY MONITORING OF A FIT-BASED COLORECTAL CANCER SCREENING PROGRAM

E Toes-Zoutendijk[1], JMG Bonfrer[2], C Ramakers[1], M Thelen[3], MCW Spaander[1], E Dekker[4], MP van der Meulen[1], M Buskermolen[1], AJ van Vuuren[1], EJ Kuipers[1], FJ van Kemenade[1], MF Velthuysen[1], MGJ Thomeer[1], H van Veldhuizen[1], M van Ballegooijen[1], HJ Koning[1], van Leerdam[2], I Lansdorp-Vogelaar[1]
[1]Erasmus MC university medical center, ROTTERDAM, The Netherlands
[2]Antoni van Leeuwenhoek - Netherlands Cancer Institute, AMSTERDAM, The Netherlands
[3]Amphia Hospital, BREDA, The Netherlands
[4]Academic Medical Center, AMSTERDAM, The Netherlands

Background Quality assessment is crucial for consistent program performance of colorectal cancer (CRC) screening programs using fecal immunochemical test for hemoglobin (FIT). However, literature on the consistency of FIT performance in laboratory medicine was lacking. This study examined the consistency of FIT in testing positive or detecting advanced neoplasia (AN) for different specimen collection devices, lot reagents and laboratories.
Methods All participants with a FIT sample with a cut-off concentration of 47 µg Hb/g feces in the Dutch CRC screening program in 2014 and 2015 were included in the analyses. Multivariable logistic regression analyses were performed to estimate the odds ratios of collection devices, reagents and laboratories, on testing positive or detecting AN and positive predictive value (PPV).
Results 87,519 (6.4%) of the 1,371,169 participants tested positive. Positivity rates and detection rates of AN differed between collection devices and reagents (all $P<0.01$). In contrast, PPV were not found to vary between collection devices, reagents or laboratories (all $P>0.05$). Positivity rates showed a small difference for laboratories ($P=0.004$), but not for detection rates of AN. Size of the population impacted by the deviating positivity rates was small (0.1% of the total tested population).
ConclusionsVariations were observed in positivity and detection rates between collection devices and reagents, but there was no detected variation in PPV. While the overall population-impact of these variations on the screened population is expected to be modest, there is room for improvement.

Impact of screening policies and strategies

58 - Poster Presentation

Unit costs attributable to breast cancer in specialized medical care in Finland

Heinävaara[1], Lehtinen[1], Sarkeala[1], Karlsson[2], Tukiainen[2], Anttila[1]
[1]Finnish Cancer Registry, HELSINKI, Finland
[2]Auria Biobank, TURKU, Finland

Background: Costs of cancer care affect greatly on cost-effectiveness of screening. With unique long-term data, we estimated 10-year average costs of breast cancer (BC) by stage and age.
Methods: We gathered aggregate data from specialized medical care in South Western Finland. Data included 4,185 women diagnosed with BC (C50, D05) in 2004–2013. All women were followed after diagnosis for events of interest until death or end of follow-up in 2013. Events of interest, i.e., visits, operations, treatments and medications were defined based on National breast cancer care guidelines. Data were extracted partly from unstructured data using text mining and external verifications of correctness.
Numbers of women, events of interest, deaths, and follow-up times were available stratified by stage of cancer, age at diagnosis, and time interval since diagnosis (12 months after diagnosis, 12 months before death, and time in-between). For each event, data were combined with regional unit costs in 2017. Average costs for 10-year period were then extrapolated by applying stage- and age-specific survival rates and recurrence probabilities of BC.
Results: An average 10-year unit cost of women diagnosed with BC was 28,700€. The average 10-year unit costs varied by stage from 16,800€ for carcinoma *in situ* to 47,300€ for metastasized BC. Unit cost varied also by age from 41,300€ for those diagnosed at young age to 19,000€ for at those old age.
Conclusions: Average 10-year unit costs of BC vary remarkably by stage and age. For BC patients with very good survival, these costs may underestimate true long-term costs, particularly for localized BC. National care guidelines are followed nationwide, and thus cost estimates are plausible to the whole country. These and time-interval specific costs will be used in estimating cost-effectiveness of the Finnish breast cancer screening program in the EU-TOPIA project.

Impact of screening policies and strategies

60 - Poster Presentation

Impact on survival from cervical cancer diagnosed age 20 to 30yrs of not screening women aged 20-24

A Castanon, P.D. Sasieni
King's College London, LONDON, United Kingdom

Background: From 2009 onwards, women aged 20-24 in England we no longer invited for cervical cancer (CaCx) screening. We previously estimated that in order to prevent one stage 1B or worse cervical cancer at under age 30yrs one would need to screen 11,000 women from age 20yrs. Here we update this estimate following evidence that the change in policy increased diagnosis of stage I CaCx at age 25 by 44% and estimate 5-year survival from cancers diagnosed age 20-29.
Methods: We use data from the National Cancer Registration Service on CaCX diagnosed ages 20 to 29.9 in England from January 2006 to December 2016 by FIGO stage. Survival by age of screening invitation and cancer diagnosis was estimated using Kaplan Meier.
Results: The decision not to offer screening age 20-24 led to a substantial increase in diagnoses of CaCx at age 25-29 so that now one would need to screen 7,000 women at ages 20-24 to prevent one stage 1B or worse cancer. Survival from stage 1A CaCx was 99.8% (95%CI: 99.3-99.9%) and did not vary by when women were invited for screening, similarly no differences were seen in survival from stage 2+ cervical cancer. Differences in 5-year survival were seen among those diagnosed with stage 1B CaCx. Survival was 80.6% (95%CI: 69.3-88.12%) among those diagnosed under age 25; it was 90.2% (95%CI: 87.5-92.3%) among those invited from age 20 and 93.3%(95%CI: 90.1%-95.5%)
Conclusion: Inviting women from age 25 increased diagnosis of CaCX but did not result in more deaths. Survival from stage 1A cancer is much better than previously thought. A non-significant 3% increase in survival from stage 1B cancer was observed.

Impact of screening policies and strategies

63 - Poster Presentation

Testing email content to encourage physicians to access an audit and feedback tool: a factorial randomized experiment.

Vaisson[1], Witteman[1], Chipenda-Dansokho[1], Saragosa[2], Bouck[2], Bravo[3], Desveaux[2], Llovet[3], Presseau[4], Taljaard[4], Umar[3], Grimshaw[4], Tinmouth[3], Ivers[2]
[1]Office of Education and Professional Development, Université Laval, QUÉBEC, Canada
[2]Women's College Hospital, TORONTO, Canada
[3]Cancer Care Ontario, Prevention & Cancer Control, TORONTO, Canada
[4]Ottawa Hospital Research Institute, Clinical Epidemiology Program, OTTAWA, Canada

Background
In Ontario, Canada, an online audit and feedback tool providing detailed information about patients who are overdue for cancer screening to primary care physicians is underused.
Methods
Between May-September 2017, a pragmatic 2x2x2 factorial experiment was conducted to examine the effect of messages operationalizing three behaviour change techniques on use of the audit and feedback tool and cancer screening rates: Anticipated Regret, Material Incentive, and Problem Solving. Outcomes were assessed using routinely collected administrative data. A qualitative process evaluation explored how and why the email(s) did or did not support cancer screening.
Results
5449 primary care physicians were randomly allocated to one of 8 email versions. Less than half of physicians opened the emails and less than 10% of them clicked through the email. Messages with problem-solving content were associated with a 12.9% relative reduction in accessing the tool (Risk Ratio, RR=0.8708, 95%Confidence Interval, 95%CI: 0.791-0.958, *p-value*=0.005), but a 0.3% increase in cervical cancer screening (RR=1.003, 95%CI: 1.001-1.006, *p-value*=0.003). If true, this would represent 7568 more patients getting screened. No other significant effects were observed.
Conclusion
For audit and feedback to work, recipients must engage with the data; for emails to prompt this activity, recipients must open and review the email content. This large factorial experiment demonstrated that small changes in the content of such emails may influence clinical behaviours. Future research should focus on making strategies to facilitate cancer screening more user-centred.

Impact of screening policies and strategies

64 - Poster Presentation

INCREASING PHYSICIAN ADENOMA DETECTION RATE IS ASSOCIATED WITH A REDUCED RISK OF POST-COLONOSCOPY COLORECTAL CANCER

DA Corley[1], CD Jensen[1], JK Lee[1], TR Levin[1], CA Doubeni[2], AG Zauber[3], JE Schottinger[4], NR Ghai[4], WK Zhao[1], N Udaltsova[1], BH Fireman[1], CP Quesenberry[1]
[1]Kaiser Permanente Northern California, OAKLAND, United States of America
[2]University of Pennsylvania, PHILADELPHIA, United States of America
[3]Memorial Sloan Kettering Cancer Center, NEW YORK, United States of America
[4]Kaiser Permanente Southern California, PASADENA, United States of America

Background: Physician adenoma detection rate (ADR) is inversely associated with post-colonoscopy colorectal cancer (PCCRC). However, no available, reproducible training interventions have been demonstrated to increase physician ADRs and decrease risk of PCCRC.
Methods: In a large multi-center healthcare setting, we evaluated whether a 30-minute interactive online training on polyp identification, clearing/washing techniques, and colonoscopy quality, combined with feedback on personal-level ADR, could improve physician ADRs and decrease risk of PCCRC (colorectal cancer diagnosed >6 months after a colonoscopy without cancer). The training was created using novel behavioral change techniques developed through in-depth study of potential ADR drivers, and was completed by 86 endoscopists in 2014. ADRs (from screening colonoscopies) were calculated for the baseline year (2013) and the 2-year post-intervention period (2015-2016). Physician-level ADR improvement was defined separately as 1) mean change and 2) reaching or maintaining an ADR ≥34% (the median ADR from screening examinations calculated from the whole data set). Cox regression was used to evaluate the association between reaching or maintaining the post-intervention ADR at ≥34% (vs. below) and risk of PCCRC, adjusted for patient age and sex.
Results: Endoscopist ADRs increased post-intervention by 5.9 percentage points (18.7% relative increase), from 31.5% to 37.4% ($p<0.01$). Following 99,920 post-intervention colonoscopy examinations negative for colorectal cancer, through 2017, 47 PCCRCs were diagnosed. Compared to patients of endoscopists with post-intervention ADRs below 34%, patients of endoscopists with ADRs ≥34% had a 45% lower adjusted risk of PCCRC (adjusted hazard ratio: 0.55; 95% confidence interval: 0.31,0.98).
Conclusion: A simple interactive online training combined with ADR feedback was associated with a 5.9 percentage point increase in physician ADR (18.7% relative increase) post-intervention, and higher ADRs post-intervention were associated with a reduction in PCCRC risk. This method may provide a practical approach for improving physician ADRs and patient outcomes in different settings.

Impact of screening policies and strategies

65 - Poster Presentation

HPV-prevalence in elderly women in Denmark

Lynge
University of Copenhagen, NYKØBING FALSTER, Denmark

BACKGROUND

The age-specific pattern of cervical cancer incidence is at present bipolar in many countries with a first peak around age 35, and a second peak after age 65. This has led to questioning whether the upper age limit for cervical screening should be increased. An analysis by birth cohort of cervical cancer incidence data from the Nordic countries showed, however, a unipolar pattern within each birth cohort. Therefore, the present second peak is more likely to derive from previous incomplete screening of older birth cohorts than from a new cancer risk in old age.

METHOD
On this basis, all Danish women born before 1948 were offered a one-time HPV-screening. To our knowledge, this is the first nationwide cervical screening of elderly women.

RESULTS
Three main messages can be concluded from the findings:

1) We did not see a rebound in HPV-prevalence after menopause, as it has been suggested based on previous estimates from younger samples;
2) HPV-prevalence decreased with increasing age, and the presently high incidence of cervical cancer in old age was not reflected in a correspondingly high HPV-prevalence;
3) HPV-prevalence pattern in post-1945 born women did not deviate from the general declining pattern after age 35.

CONCLUSION
Based on the HPV-prevalence data a need for a general increase in the upper age limit for cervical screening is not indicated. We are presently analyzing histology data from screen-positive women.

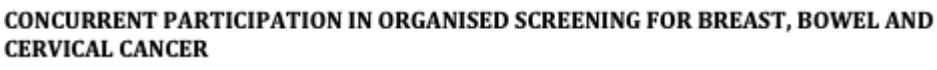
Impact of screening policies and strategies

68 - Oral Presentation

Concurrent participation in organised screening for breast, bowel and cervical cancer

M Rebolj[1], D Parmar[2], R Maroni[2], S.W. Duffy[2]
[1]King's College London, UK, LONDON, United Kingdom
[2]Queen Mary University of London, LONDON, United Kingdom

Background.
Among English women around age 60, >75% participate in cervical, 75% in breast, and 55% in bowel screening. We aimed to determine whether the same women attend all three screening programmes, i.e. whether a high participation in each programme translates into a high concurrent participation in all three programmes combined.
Methods.
We used data on 3060 controls aged 60-65 years from an on-going English case-control study of breast screening. Women were considered to be concurrently screened if they had at least one cervical screening test in the last 6 years, one breast screening test in the last 4 years, and one bowel screening test in the last 3 years before 2010/11, when they were last known to be alive. Additionally, we used national GP practice data, where we compared the characteristics of practices that achieved higher-than-average coverage in all three screening programmes and those that achieved lower-than-average coverage rates.
Results.
Of the 3060 women, 1086 (35%) were screened for all three cancers, 1142 (37%) for two and 526 (17%) for a single cancer, while 306 (10%) women remained completely unscreened. Under an assumption of randomness, fewer (27%) would be expected to participate in all three programmes (P<0.001) and fewer (3%) to participate in none (P<0.001). GP practice data suggested that concurrent high participation is related to low deprivation and low unemployment, frequent contact and satisfaction with health services, and absence of unhealthy lifestyles such as smoking.
Discussion.
These data show that the targeted population is less well protected from all three cancers combined than the participation rates from the individual screening programmes could suggest. Participation in only some of the recommended programmes, with non-random clustering, indicates that self-selection for screening may be a more complex issue than it appears from studying single programmes.

Picture 1: 

Impact of screening policies and strategies

72 - Oral Presentation

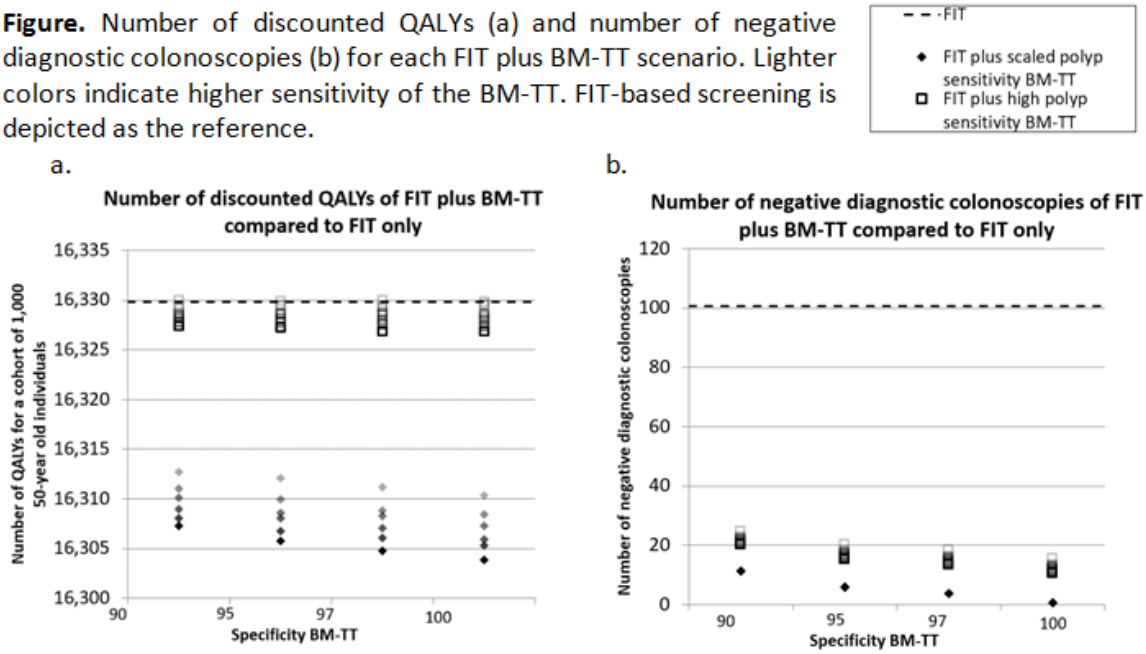
Can a biomarker triage test reduce colonoscopy burden in fecal immunochemical test screening?

MJE Greuter[1], B Carvalho[2], M de Wit[2], E Dekker[3], GA Meijer[2], M van Engeland[4], VMH Coupé[1]
[1]Amsterdam UMC - location VUmc, AMSTERDAM, The Netherlands
[2]Netherlands Cancer Institute, AMSTERDAM, The Netherlands
[3]Amsterdam UMC - locatie AMC, AMSTERDAM, The Netherlands
[4]GROW - School for Oncology and Developmental Biology, MAASTRICHT, The Netherlands

Background: In the Dutch fecal immunochemical test (FIT)-based colorectal cancer (CRC) screening program, no advanced neoplasia is detected in 50% of FIT-positive colonoscopies. We assessed the potential of a hypothetical biomarker triage test (BM-TT) in FIT-screening to reduce this colonoscopy burden.
Methods: In a FIT plus BM-TT strategy, only individuals with both a positive FIT and BM-TT are referred to colonoscopy. Using the ASCCA model, we simulated 24 scenarios in which a BM-TT was added to FIT-screening. Scenarios differed in BM-TT specificity (range 90%-100%), late CRC sensitivity (range 80%-100%) and early CRC and polyp sensitivity (using FIT test characteristics as a reference, BM-TT sensitivity changed with the same ratio as for late CRC). We also included 28 scenarios in which polyp sensitivity of the BM-TT was substantially increased. The comparator was the Dutch screening program. Outcomes included CRC burden, quality-adjusted lifeyears and colonoscopy demand.
Results: Depending on biomarker test characteristics, adding a BM-TT to FIT-screening reduced the number of negative diagnostic colonoscopies with 89%-100% at the cost of an increase in CRC mortality of 27%-41% compared to FIT-screening only. Figures were 75%-89% and 0%-4.4% when a BM-TT with high polyp sensitivity was added to FIT-screening.
Conclusions: Adding a BM-TT to FIT-screening could considerably reduce colonoscopy burden. Yet, it also substantially lowers screening effectiveness except when the BM-TT has ≥60% polyp sensitivity. However, depending on test costs, a biomarker test with such improved polyp sensitivity compared to FIT may have more impact as a primary screening test.

Picture 1:

Figure. Number of discounted QALYs (a) and number of negative diagnostic colonoscopies (b) for each FIT plus BM-TT scenario. Lighter colors indicate higher sensitivity of the BM-TT. FIT-based screening is depicted as the reference.



Caption 1: Figure. Number of discounted QALYs (a) and number of negative diagnostic colonoscopies (b) for each FIT plus BM-TT scenario.

Impact of screening policies and strategies

74 - Poster Presentation

Development of a tool to measure the importance of barriers to implementing breast cancer screening policies in terms of impact on effectiveness and equity

Priaulx[1], Csanádi[2], de Kok[3], Heinävaara[4], Ivanuš[5], Novak Mlakar[5], Senore[6], Széles[2], Veerus[7], de Koning[3], McKee[1]
[1]London School of Hygiene and Tropical Medicine, LONDON, United Kingdom
[2]Syreon Research Institute, BUDAPEST, Hungary
[3]Erasmus MC, ROTTERDAM, The Netherlands
[4]Finnish Cancer Registry, HELSINKI, Finland
[5]Institute of Oncology, LJUBLJANA, Slovenia
[6]SSD Epidemiology and Screening-CPO, TURIN, Italy
[7]Tervise Arengu Instituut, TALLINN, Estonia

Background
We have previously used the Barriers to Effective Screening Tool (BEST) to identify the most common barriers to effective breast, cervical and colorectal cancer screening programmes in thirty-one European countries. We report a further refinement to enable screening programme organisers, researchers and policy-makers to undertake a structured self-assessment of the importance of these barriers and prioritise the most important, considering both overall effectiveness and equity.
Methods
We added two rating scales from one (not at all important) to five (very important) to assess the impact of existing barriers in components of screening systems (knowledge generation, identifying eligible population, maximising informed participation, successful operation of a programme, adequate follow-up and ensuring effective treatment) on overall effectiveness and equity of the cancer screening programme. Respondents in six countries participating in the EU-TOPIA project (Towards improved screening for breast,cervical and colorectal cancer in all of Europe) then prioritised the top three barriers in their countries to mitigate these impacts for breast cancer screening.
Results
The most important barriers to overall effectiveness impact on different components of screening systems. Opportunistic screening outside the programme is important (scoring three or over) in four countries. The most important barriers to achieving equity relate mainly to participation. Priorities for overcoming barriers vary by country as, for example, establishing or updating guidelines, protocols and processes is only a priority in some countries.
Conclusions
The updated BEST tool allows those that manage programmes to evaluate barriers to effective screening at all stages in the cancer screening process and prioritise those that are more important in achieving both effectiveness and equity. This exercise demonstrates the need for country-specific strategies to overcoming a range of different barriers. The findings are being used in further work identifying ways to overcome barriers, including stakeholder analyses and barrier quantification to input into models.

Impact of screening policies and strategies

75 - Oral Presentation

Impact of the New German Screening Policy for Cervical Cancer on the Benefit-Harm Balance - A Decision-Analysis

Sroczynski[1], Hillemanns[2], Siebert[1]
[1]UMIT - University for Health Sciences, Medical Informatics and Technology, HALL I.T., Austria
[2]Hanover Medical School, University of Hanover, HANOVER, Germany

Introduction/Objectives
In Germany, cervical cancer screening is moving from opportunistic annual Papanicolaou (Pap) cytology for women as of age 20 years to organized screening with 3-yearly HPV-Pap co-testing for women as of age 35 years and annual Pap cytology for women between age 20 and 34. Our aim was to systematically evaluate the benefit-harm balance of new cervical cancer primary screening policy for the German context.
Methods
A Markov-state-transition model calibrated to the German epidemiological and clinical context of the disease was used to evaluate different screening strategies that differ by primary screening test (Pap cytology, HPV-testing), screening interval, age, and specific follow-up algorithms. German clinical and epidemiological data, as well as test accuracy data from international meta-analyses were incorporated. Predicted outcomes were reduction in cervical cancer incidence, and -mortality, total cases of positive test results, colposcopies, conizations, overtreatment (defined as conization with histological diagnosis <CIN3). Comprehensive sensitivity analyses were performed.
Results
Compared with current opportunistic annual Pap screening the new screening policy including 3-yearly HPV-Pap co-testing as of age 35 years would result in similar benefits in terms of reduction in cervical cancer incidence and mortality. However, the model predicted substantial relative risk reductions (RRR) in total positive test results (RRR: 25%), total cases of colposcopies (RRR: 52%), and conizations (RRR: 8%). The new screening policy including 3-yearly HPV-Pap co-testing as of age 35 years would reduce overtreatment by 4%, relatively. Risk-adapted screening with increased intervals for women vaccinated against oncogenic HPV types would additionally reduce overdiagnosis and overtreatment.
Conclusions
Based on our benefit-harm analysis, the new German screening policy for cervical cancer screening including HPV-Pap co-testing in women as of age 35 years reduces overtreatment, likely without loss in benefits. Risk-adapted screening strategies based on women’s screening history and vaccination status should be considered in future policy adaptations.

Impact of screening policies and strategies

78 - Oral Presentation

Introduction to Cancer Screening in 5 continents (CanScreen5) - A new initiative from IARC Basu P, Lucas E, Sauvaget C, Muwonge R, Herrero R, Sankaranarayanan R IARC Early Detection & Prevention Section

Basu, Lucas, Sauvaget, Muwonge, Herrero, Sankaranarayanan
International Agency for Research On Cancer, LYON, France

Background
Newly launched CanScreen5 project of IARC aims to collect information on the characteristics and performance of cancer screening programmes across the globe in a harmonized manner and disseminate the information for improved programme management and informed policy-making. Training of program managers to collect good quality data, use the same to estimate performance indicators and take corrective actions based on the estimates is also a key objective.
Methods
The CanScreen5 is a freely accessible website designed to collect, analyze and disseminate information on cancer screening programmes and activities in different countries with the core objective of motivating and supporting countries to collect and utilize cancer screening data in a consistent manner and regularly through an effective information system. The platform provides the requisite data collection tools, the standardized methodology for estimating the performance indicators and the facility to compare the indicators with national and international standards. An e-learning platform will be integrated.
Results
The synthesized data from 28 European Union Member States (collected by IARC to prepare the second report on Cancer screening in the European Union- 2017) is uploaded. The data are presented: for a given cancer type, a selected country or through analysis tools (interactive graphs and maps).

Conclusion
CanScreen5 (http://canscreen5.iarc.fr) website is a publicly global repository of information on cancer screening programmes. We will invite data providers from countries to collaborate, submit and share data for their respected screening programmes. We will build networks with other organizations working towards the common goal of improving cancer screening quality.

Picture 1:

Caption 1: Figure: CanScreen5 platform screenshot

Impact of screening policies and strategies

80 - Poster Presentation

Changing incidence and stage distribution of prostate cancer in a Lithuanian population - evidence from national screening programme

Patasius[1], Ulys[1], Adomaitis[2], Smailyte[1]
[1]National Cancer Institute, VILNIUS, Lithuania
[2]Vilnius University, VILNIUS, Lithuania

Background: In 2006 Lithuania has started Early Prostate Cancer Detection Programme. To our knowledge, Lithuania is the only country in the world with a running nation-wide prostate specific antigene (PSA)-based prostate cancer screening programme. Aim of this study was to examine the impact of screening introduction on trends in prostate cancer incidence and stage of distribution in Lithuania.
Methods: The study was based on all new prostate cancer cases identified in Lithuanian Cancer Registry during 1998–2016. Information about screening services provided was derived from National Health Insurance Fund database. Age-standardized incidence rates (adjusted to the European Standard Population) were calculated. Joinpoint regression was used to estimate the annual percentage change in the trends. Changes in overall incidence and changes by stage (localized, regional and distant of disease were examined. In the screening period differences in stage distribution in screened and unscreened mens were evaluated. The Chi-square test used to test associations between study groups. A p-value 0.05 was considered statistically significant.
Results: Over study period, total number of 48 818 new prostate cancer cases were identified. Age-standardized incidence rose from 51.9/100 000 in 1998 to 279.3/100 000 in 2007 (+20.3%) and then decreased thereafter by 3.8% annually. Incidence of localized disease rose by 38.2% per year until 2007 reaching rate 284.6/100 000. In the screening period 78.1% of all cases were diagnosed via screening programme. Localized disease was diagnosed in 32.5% and 49.1% of prostate cancer patients in pre-screening and screening periods respectively ($p<0.0001$). During screening period, proportion of localized disease was higher in screened population (53.5% screened vs. 33.8% unscreened, $p<0.0001$).
Conclusions: An immense rise in the incidence of prostate cancer was observed in Lithuania following the implementation of PSA-based prostate screening programme. The adoption of PSA screening caused a stage migration toward localized disease at diagnosis.

Impact of screening policies and strategies

82 - Oral Presentation

NordScreen - a platform for presenting cervical cancer screening indicators in the Nordic countries

V-M Partanen[1], A Anttila[1], S Heinävaara[1], M Pankakoski[1], T Sarkeala[1], J Dillner[2], S Lönnberg[1]
[1]FINNISH CANCER REGISTRY, HELSINKI, Finland
[2]Karolinska Institutet, STOCKHOLM, Sweden

BackgroundQuality assurance and improvement of cancer screening programmes require up-to-date monitoring systems and evidence-based indicators. National quality reports exist but the definition and calculation of indicators varies which makes comparison between countries difficult. The NordScreen project facilitates comparison of cancer screening across countries and support quality improvement. It has developed a publicly available web-based application to access standardized indicators of cervical cancer screening, based on up-to-date Nordic cancer screening register data.

Methods
The screening data originates from population-based screening registries in each of the Nordic countries and Estonia. The test data are available on individual level linked to personal ID number. Through a network of Nordic and Baltic screening managers, population-based individual screening data from each country was converted to standard format locally and aggregated by an R program script for use by the NordScreen online platform. Comparability between countries is enhanced by the uniform data structure and standardized calculations.
ResultsThe NordScreen platform (nordscreen.org) contains indicators on cervical screening test coverage, test distribution and average number of tests per tested woman. The indicators are based on over 30 million screening tests from 4 Nordic countries and Estonia. In 2014, the test coverage within a follow-up time of 5.5 years in age group 30-64 was between 78-84% in Iceland, Norway and Sweden whereas 69% in Finland. The application allows users to define indicator specifications interactively.
ConclusionsNordScreen is a pilot model for cross-country comparison of cancer screening. The aim is to stimulate collaborative research and quality improvement in screening through freely available, interactive, and regularly updated quality indicators. The project currently includes data on cervical cancer screening. The platform can be extended to new countries with screening registries that contain individual level data. Screening programmes for breast cancer and colorectal cancer will also be included in coming phases.

Impact of screening policies and strategies

86 - Poster Presentation

Disability-adjusted life years averted and quality-adjusted life years gained: model analysis for breast cancer screening

MD Davidovic[1], Heijnsdijk[2], Zielonke[2], Lansdorp-Vogelaar[2]
[1]Faculty of Medicine University of Belgrade, BELGRADE, Serbia and Montenegro
[2]Erasmus MC, ROTTERDAM, The Netherlands

Background:
Breast cancer screening has proven to significantly reduce breast cancer mortality. To quantify the impact of breast cancer screening on the quality of life, disability-adjusted life years (DALYs) averted or quality-adjusted life years (QALYs) gained can be used. We assessed whether the use of DALYs averted or QALYs gained will lead to different cost-effective screening strategies.
Methods:
Using the microsimulation model MISCAN, we simulated different breast cancer screening strategies varying in starting age (starting at 45, 47, and 50 years), stopping age (stopping at 69, 72, and 74 years), and frequency (annual, biennial, and combination of both). In total, we defined 16 different breast cancer screening strategies including non-screened as a reference strategy.
Results:
Breast cancer screening averted between 234 and 324 DALYs and gained between 124 and 172 QALYs per 1000 women. Annual screening from age 45 to 50 years followed by biennial screening from age 50 to 74 resulted in the optimal strategy in both DALY and QALY analyzes, producing an incremental cost-effectiveness of €8,195 per DALY averted and €4,729 per QALY gained.
Conclusion:
Using the DALYs averted instead of QALYs gained to assess the effects on quality of life from breast cancer screening yields slight differences in cost-effectiveness. However, using DALYs averted or QALYs gained resulted in the same strategies on the efficiency frontier; therefore both tools can be used to determine the optimal screening strategy.

Impact of screening policies and strategies

93 - Poster Presentation

Trends in screening breast MRI rates in US women 2006-2016

KJ Wernli[1], KA Callaway[2], LM Henderson[3], K Kerlikowske[4], JM Lee[5], D Ross-Degnan[2], JK Wallace[2], JF Wharam[2], F Zhang[2], NK Stout[2]
[1]Kaiser Permanente Washington Health Research Institute, SEATTLE, United States of America
[2]Harvard Pilgrim Health Care Institute, BOSTON, United States of America
[3]University of North Carolina, Chapel Hill, CHAPEL HILL, United States of America
[4]University of California, San Francisco, SAN FRANCISCO, United States of America
[5]University of Washington, SEATTLE, United States of America

Background: Breast magnetic resonance imaging (MRI) in addition to screening mammography is recommended for US women at increased breast cancer risk (e.g., BRCA+, lifetime risk >20%). Current trends of utilization are unknown. We present trends in screening breast MRI from 2006-2016 in the US.
Methods: Using medical care claims, we studied breast MRI use in women aged 20-64 years enrolled for ≥1 year in a large nationally-representative US commercial insurer. We developed a claims-based algorithm using procedure and diagnosis codes to distinguish screening breast MRIs. Using age-standardized rates (per 10,000 women), we applied autoregressive time series models to evaluate trends in screening breast MRI use overall and among women with diagnosed BRCA mutation, family history of breast cancer, or personal history of breast cancer.
Results: Among all women aged 20-64, screening breast MRI use was rare but increased 2.6-fold from 7/10,000 in 2006 to 18/10,000 women in 2016 ($p<0.01$). The highest rates and largest increase over time were observed among BRCA+ women from 312/10,000 in 2006 to 1,465/10,000 women in 2016 ($p<0.01$). Use among women with a family history of breast cancer increased at a slower rate from 93/10,000 in 2006 to 157/10,000 women in 2016 ($p=0.18$). Among women with personal history of breast cancer, screening MRI remained stable ($p=0.8$) with an average annual rate over 800/10,000 women.
Conclusions: Use of screening breast MRI has increased among US women over the past decade. A large proportion of this increase is consistent with current guidelines to screen BRCA+ women. However, many women, for whom the benefits of screening MRI are uncertain, such as those a lower breast cancer risk or with a personal history of breast cancer, are also participating. Further research should also assess downstream patterns of care including both benefits and harms associated with use of screening breast MRI.

Trends in screening breast MRI rates in US women 2006-2016

Picture 1:

Impact of screening policies and strategies

100 - Oral Presentation

Evaluating the impact and cost-effectiveness of a mass-media campaign for improving participation in a colorectal cancer screening program in Australia

Worthington[1], Lew[1], Feletto[1], Broun[2], Durkin[2], Wakefield[2], Grogan[3], Harper[2], Canfell[1]
[1]Cancer Council NSW, WOOLLOOMOOLOO, Australia
[2]Cancer Council Victoria, MELBOURNE, Australia
[3]Cancer Council Australia, SYDNEY, Australia

Background: From 2020, the Australian National Bowel Cancer Screening Program (NBCSP) will supply free biennial immunochemical faecal occult blood test (iFOBT) screening to all people aged 50-74 years after a phased rollout from 2006-2019. The NBCSP participation rate in 2015-2016 was 40.9% nationally. In 2017, a mass-media campaign targeting improved NBCSP participation in an Australian region (Victoria) was held, and preliminary investigation indicated it led to an averaged 1.38-fold increase in iFOBT kit return rates for nine weeks. We aimed to predict the long-term impact on lives saved and cost-effectiveness of this mass-media campaign and assess a hypothetical extended campaign assuming similar effectiveness.
Methods: The cost-effectiveness and health benefits of the NBCSP with the campaign vs no campaign were estimated for Victoria using *Policy1-Bowel*, a comprehensive microsimulation model of colorectal cancer in Australia. Costs considered in the analysis include AUD$1.06 million campaign costs, iFOBT testing and colonoscopy costs, and CRC treatment costs. A hypothetical extension with three campaigns annually for four years was evaluated.
Results: The 9-week campaign was estimated to prevent 222 CRC cases and save 121 lives over the lifetime of the target cohort eligible for screening in Victoria at the time of the campaign. It was found to be highly cost-effective (cost-effectiveness ratio [CER]: AUD$1,850/life-year saved [LYS] compared with no campaign) vs an indicative willingness-to-pay threshold of AUD$30,000/LYS in Australia. A 4-year campaign would prevent approximately 1,990 CRC cases and 1,070 deaths, and have a highly favourable CER (AUD$5,500/LYS) in Victoria vs no campaign. If the 4-year campaign were conducted nationally in Australia, an estimated total of 4,250 additional deaths could be prevented.
Conclusions: Mass-media campaigns to encourage screening participation can be highly cost-effective and maximise the potential impact of an iFOBT screening program. This could inform decision making for investments in screening awareness initiatives.

Impact of screening policies and strategies

102 - Poster Presentation

Rising colorectal cancer incidence rates in younger Australians: impact of starting screening from a younger age

Lew[1], Yu[1], Feletto[1], Worthington[1], St John[2], Macrae[3], Mahady[4], He[1], Grogan[5], Ee[6], Greuter[7], Coupé[7], Caruana[1], Canfell[1]
[1]Cancer Council NSW, WOOLLOOMOOLOO, Australia
[2]Cancer Council Victoria, MELBOURNE, Australia
[3]University of Melbourne, MELBOURNE, Australia
[4]Monash University, MELBOURNE, Australia
[5]Cancer Council Australia, SYDNEY, Australia
[6]Sir Charles Gairdner Hospital, NEDLANDS, Australia
[7]VU Medical Center, AMSTERDAM, The Netherlands

Background: Australia's National Bowel Cancer Screening Program (NBCSP) will provide 2-yearly immunochemical faecal occult blood test (iFOBT) screening for average-risk Australians aged 50-74 years from 2020. Current evidence suggests the best investment to improve NBCSP-related outcomes is to maximise NBCSP participation in 50-74 year-olds. In line with international evidence, a recent Australian study found increasing colorectal cancer (CRC) incidence in people aged under 50 years. CRC incidence rates of people born in 1978-1982 and 1988-1992 were 1.55 and 3.03 times higher than people born in 1943-1947, respectively. This study aims to evaluate the benefits, harms and cost-effectiveness of lowering the NBCSP start age for cohorts with higher CRC incidence rates.
Methods: A microsimulation model, *Policy1-Bowel*, was used to simulate the NBCSP starting at 40 or 45 and ceasing at 74 years compared with screening at 50-74 years, at 40%, 60% or 100% screening participation, for two cohorts with 1.5-fold and 3.0-fold increased CRC incidence from the currently observed rates.
Results: The number of prevented CRC cases and deaths by lowering the screening start age increased in cohorts with higher CRC incidence. The number of colonoscopy assessments to follow-up positive iFOBT results and provide surveillance also increased in cohorts with higher incidence. Lowering screening start age to 45 years was found to be cost-effective given the indicative willingness-to-pay threshold of $30,000/life-year saved (LYS). It was associated with an incremental cost-effectiveness ratio of AU$8,800-17,400/LYS, depending on participation assumptions, for the cohort with 1.5-fold increase in CRC incidence and could potentially be cost-saving for the 3.0-fold increase cohort.
Conclusions: A younger starting age of screening could be considered for people born in 1988-92 or later, once they reach their forties. This implies that starting screening earlier in the NBCSP would be cost-effective and could be incorporated into the program from about 2025 onwards.

Impact of screening policies and strategies

107 - Poster Presentation

Health care resources used for investigation and treatment of abnormalities in cervical cancer screening

Fogh Jørgensen[1], Andersen[1], Rebolj[2], Njor[1]
[1]Randers Regional Hospital, RANDERS, Denmark
[2]Kings College, LONDON, United Kingdom

Background:
Normal operation of cancer screening is often hampered by unavailability of diagnostic services to investigate screen-detected abnormalities. Hence, we set up an extensive register-based project to systematically map the use of all diagnostic and treatment services in the three Danish cancer screening programmes. We are starting with cervical screening, where some 400,000 screening tests are taken per year and 9% are recommended for clinical follow-up. These examinations can potentially go on for several months or even years.
Method:
This nationwide study including data from primary practice, hospitals, pathology departments and privately practicing specialists, will follow >100,000 women with screen-detected abnormalities in 2012-2014 until final diagnosis, resolution, or end of 2018. We will determine the total number of tests and treatments from different healthcare providers, and their timing. Variations in the resource use will be assessed to determine how often and how a patient's care deviates from the recommendations and whether this is associated with patient or provider characteristics.
Results:
We have just obtained the necessary data and preliminary results on inadequate screening samples show that only 54% of women are re-tested within 4 months as recommended. About 8% had either no follow-up or follow-up later than 24 months after the primary screening. We will report these patterns in full for all women with non-negative tests at the conference.
Conclusion: Systematic evaluations like this are rare not only in Danish cancer screening research, but in all countries with population-based screening. This study will provide a framework for continued monitoring of the necessary resources, which can be easily adapted to changes (e.g. HPV testing instead of cytology in cervical screening). Our study can also address inconsistencies in the management of abnormal screening results, to ensure that the quality of the follow-up program after screening can be uniformly high throughout the country.

Impact of screening policies and strategies

113 - Poster Presentation

Impact of Structure and Process on Effectiveness of Population-based Screening for Colorectal Cancer with Fecal Immunochemical Test (FIT)

Jen[1], Hsu[1], Yen[2], Chen[1]
[1]Institute of Epidemiology and Preventive Medicine, National Taiwan University, TAIPEI, Taiwan
[2]School of Oral Hygiene, College of Oral Medicine, Taipei Medical University, TAIPEI, Taiwan

Background
Population-based service screening program for colorectal cancer (CRC) has been involved with the issues of structure and process pertaining to coverage rate, referral process, and waiting time (WT) for confirmatory diagnosis. Evaluating their impacts on the reduction of advanced staged CRC is of great interest but computationally intractable. We therefore propose the consolidated Coxian phase-type (CPH) model in conjunction with Queue process for such purposes.
Data and Methods
We used data on population-based screening program for CRC with biennial fecal immunochemical test (FIT) in Taiwan. A total of 5,417,699 eligible population aged 50-69 years covering 56.6% population attending at least one FIT. The positive rate were 6.9% in the first round and 6.2% in subsequent screen. Among them, 59% and 67.5% underwent confirmatory examination.
The reciprocal relationships between coverage rate, positive rate, compliance rate with colonoscopy, and WT have been first quantified by using Queue process and Hurdle CPH model. These parameters were further embedded into the CPH Markov model on multi-state natural history of CRC.

Results
Given the parameters of the coverage rate, compliance rate, and transition parameters on disease natural history estimated from Taiwanese empirical data, the effectiveness of reducing 20% (95%CI: 19%-22%) advanced CRC was projected. The effectiveness was reduced to 8% (95%CI: 6%-10%) with 3% positive rate and 18% (95%CI: 17%-20%) with three-yearly screening program. The corresponding figures for low (20%) and high (80%) coverage rate were quantitatively estimated as 8% (95%CI: 6%-10%) and 30% (95%CI: 29%-32%). The corresponding figures for (low) 20% and high (80%) compliance rate were also estimated as 7% (95%CI: 6%-92%) and 26% (95%CI: 25%-28%), respectively.
Conclusion
Evaluating the impacts of structure and process of screening on the effectiveness of population-based screening program provides an insight into how to improve the quality assurance program in order to achieve the expected benefit.

Chen-Yang Hsu[1]

Picture 1:

Impact of screening policies and strategies

114 - Poster Presentation

New strategy for colorectal cancer screening in Finland

Sarkeala, Heinävaara, Jäntti, Pitkäniemi, Anttila, Malila
Finnish Cancer registry, HELSINKI, Finland

New strategy for colorectal cancer screening in Finland
Authors: Tytti Sarkeala, Sirpa Heinävaara, Maija Jäntti, Janne Pitkäniemi, Ahti Anttila, Nea Malila
Institution: Finnish Cancer Registry, Helsinki, Finland
ABSTRACT

Background: European Commission recommends colorectal cancer (CRC) screening as a public health policy. In Finland, CRC screening was introduced as a randomized, biennial program for men and women aged 60-69 years in 2004. Performance estimates of this gFOBT-based program were comparable to those of corresponding European programs. The interim results indicated, however, no difference in CRC mortality between the screening and control arms. By sex, there was a non-significant increase in CRC mortality in women (33 %) and a decrease in men (12 %). These results and the improved analytical capacity of faecal occult blood tests induce a need to find a new screening strategy in Finland.
Methods: The new CRC screening pilot starts in voluntary municipalities in 2019. In 2022, the program will be incorporated in the Act of Screening. The program will be implemented gradually to the whole country over 2019-2030. Men and women aged 60-74 years will be invited to biennial FIT- screening. A questionnaire concerning CRC risk factors will be incorporated in the invitation letter.
There will be a special focus on the gender-specific cutoffs for test positivity based on the performance of other European CRC screening programs. Special attention will be paid also to the adequacy of colonoscopy resources.
Results: The program will be monitored annually. Detection of high-grade adenomas and CRCs, and death from CRC and other causes will be compared between age groups, genders and various risk profiles during the implementation phase. Effectiveness will be evaluated ten years after the launch of the national program.
Conclusion: Finland will introduce a nationwide FIT-based CRC screening program, which is effective in reducing CRC mortality of both genders.

Impact of screening policies and strategies

115 - Oral Presentation

Development and validation of microsimulation models for predicting colorectal cancer screening benefits in Europe

A Gini[1], M Buskermolen[2], C Senore[3], A Anttila[4], D Novak Mlakar[5], P Veerus[6], E.E.L. Jansen[2], N Zielonke[2], S Heinävaara[4], N Segnan[3], H. J. de Koning[2], I Lansdorp-Vogelaar[2]
[1]Erasmus MC, Rotterdam, The Netherlands, ROTTERDAM, The Netherlands
[2]Erasmus MC, ROTTERDAM, The Netherlands
[3]Città della Salute e della Scienza University Hospital, CPO, TURIN, Italy
[4]Finnish Cancer Registry, HELSINKI, Finland
[5]National Institute for Public Health, LJUBLJANA, Slovenia
[6]National Institute for Health Development, TALLINN, Estonia

Background: With the objective of assisting European countries in improving their colorectal cancer (CRC) screening programmes, the EU-TOPIA consortium has developed a web-based tool for screening evaluation. In this abstract, we describe the development and validation of four decision models that form the basis for this tool.
Methods: We quantified Microsimulation Screening Analysis-Colon (MISCAN-Colon) model versions for Italy, Slovenia, Finland, and Estonia using data from National Health Institutions (internal validation). Subsequently, these models were validated against the best available evidence for the effectiveness of screening from their region (external validation), when available: the Screening for COlon REctum [SCORE] trial and the Florentine fecal immunochemical test (FIT) screening study for Italy; the Norwegian Colorectal Cancer Prevention [NORCCAP] trial and the guaiac fecal occult blood test (gFOBT) Finnish population-based study for Estonia and Finland.
Results: Our models reproduced age-specific CRC incidence rates and stage distributions in the pre-screening period (Table 1, internal validation). Moreover, the Italian model replicated CRC mortality reductions observed in Italy (SCORE trial and Florentine FIT study). Both Estonian and Finnish models replicated CRC mortality reductions observed in the NORCCAP Trial and in the Finnish gFOBT study (Table 1, external validation). CRC mortality reductions were predicted slightly larger than those observed (except for NORCCAP trial), but consistently within the corresponding 95% confidence intervals.
Conclusions: Our findings corroborate the MISCAN-Colon model reliability, which can represent an additional tool for policymakers and researchers, aimed to support decision making, as well as quality assurance efforts, on CRC screening in Europe.

Picture 1:

Table 1. Model simulated and observed colorectal cancer incidence rates, stage distributions, and reductions in colorectal cancer mortality due to screening¥ in a selected number of European countries (Italy, Slovenia, Finland, and Estonia).

	Italy		Slovenia		Finland		Estonia	
	Observed (95%CI)	Simulated	Observed (95%CI)	Simulated	Observed (95%CI)	Simulated	Observed (95%CI)	Simulated
Internal validation, CRC incidence rates								
Period*	1998-2002		2004-2008		1999-2003		2010-2014	
Age, 40-44	14 (13-16)	15	13 (10-15)	14	10 (9-12)	9	10 (8-14)	10
45-49	30 (28-32)	29	26 (22-30)	26	17 (16-19)	17	22 (18-27)	20
50-54	55 (53-57)	53	53 (48-58)	51	31 (29-34)	29	34 (29-39)	36
55-59	90 (87-93)	89	93 (86-101)	90	53 (50-57)	48	69 (61-77)	69
60-64	137 (133-141)	139	149 (138-159)	145	87 (82-92)	86	111 (101-122)	111
65-69	195 (190-200)	194	222 (209-235)	219	127 (120-133)	127	170 (156-185)	180
70-74	258 (252-264)	264	281 (266-297)	290	173 (165-181)	168	249 (232-267)	232
75-79	313 (306-320)	321	330 (311-350)	357	229 (219-239)	220	324 (302-347)	311
80-84	361 (350-372)	359	354 (329-380)	370	265 (251-279)	264	382 (354-412)	392
85-100	345 (335-356)	379	316 (284-349)	358	295 (278-312)	289	320 (289-353)	405
CRC stage distribution, %*								
Stage, ª I	18 (17.1-19)	18.7	12.5 (11.7-13.3)	12.7	43 (42-44)ª	43.6	42 (41-43)ª	42.9
II	28.5 (27.4-29.7)	27.6	32.9 (31.7-34.1)	31.6				
III	31.3 (30.2-32.5)	31.3	34.1 (32.9-35.3)	34.6	23.5 (22.6-24.4)ª	23.5	30 (29.1-30.9)ª	29.3
IV	22.1 (21-23.2)	22.4	20.5 (19.5-21.5)	21.1	33.5 (32.5-34.5)ª	32.8	28 (27.1-28.9)ª	27.8
External validation, FS evidence	**SCORE trial**		**Not available**		**NORCCAP trial**		**NORCCAP trial**	
Country and period	Italy, 1995-2008		-	-	Norway, 1999-2011		Norway, 1999-2011	
CRC mortality reduction (RR)	0.78 (0.56-1.08)	0.70	-	-	0.73 (0.56-0.94)	0.77	0.73 (0.56-0.94)	0.78
Stool-test evidence (Test)	**Ventura et al (FIT)**		**Not available**		**Pianism et al (gFOBT)**		**Pitkäniemi et al (gFOBT)**	
Country and period	Italy, 1993-2008		-	-	Finland, 2004-2012		Finland, 2004-2012	
CRC mortality reduction (RR)	0.59 (0.37-0.93)	0.51	-	-	1.04 (0.84-1.28)	0.92	1.04 (0.84-1.28)	0.92

¥ Reductions in CRC mortality due to screening were retrieved looking for each country the best published evidences in the corresponding European region (Finland and Estonia, Northern; Italy, Southern; and Slovenia, Eastern Europe).* Pre-screening period was used and CRC stage distribution was rescaled to take in account the presence of unknown stages, data from cancer registry in pre-screening period was used (except for Italy, we used data from IMPATTO-COLON study, regions with no screening during 2000-2005; and for Estonia, we used cancer registry data for the period 1995-2008); ª Finland and Estonia used a different CRC staging (Localized, Regional, and Distant). Hence, models were normalized using the UICC TNM staging system assuming for Finland and Estonia: localized CRCs equals to stage I + II; regional as stage III, and distant as stage IV; CRC indicates colorectal cancer; FS, flexible-sigmoidoscopy; FIT, fecal immunochemical test; gFOBT, guaiac fecal occult blood test; RR, Relative Risk; SCORE, Screening for colon rectum; and NORCCAP, Norwegian Colorectal Cancer Prevention.

Impact of screening policies and strategies

121 - Poster Presentation

Bayesian meta-analysis and causal model for evaluation of novel cancer screening strategies

Yen[1], Hsu[2], Peng[2], Jen[2]
[1]Taipei Medical University, TAIPEI, Taiwan
[2]College of Public Health, National Taiwan University, TAIPEI, Taiwan

Background
The effectiveness of a screening program is ideally demonstrated through randomized controlled trials. However, clinical trial evidence may not be available for those areas where the screening program is widespread in the general public. In the era of service screening, the performance will be affected by a variety of aspects, including the characteristics of target population, inter-screening interval, study design, attendance rate, factors related to the quality of screening (sensitivity, specificity, and over-detection), and treatment and therapeutic components. We aim to develop a Bayesian network framework by linking together a cascade of causal relationships as a whole with Bayesian Network Markov Chain Monte Carlo (MCMC) method underpinning.
Methods
We borrowed information from previous randomized controlled trial for mammography to examine the impact of attendance rate and quality assurance indicators, (proportional incidence rate and over-detection) on advanced stage of breast cancer and breast cancer death.
Results
Nine scenarios of attendance rate and sensitivity on low, medium, and high sensitivity groups gave the estimated effectiveness in terms of the reduction of advanced breast cancer and breast cancer death. The best scenario (90% attendance rate and 95% sensitivity) yielded 0.67 (95% CI: 0.58-0.76) and 0.67 (95% CI: 0.58-0.76) of RR for advanced breast cancer and breast cancer death, indicating 33% (95% CI: 20-43%) reduction in both adverse events, whereas the poor scenario (30% attendance rate and 55% sensitivity) gave 0.98 (95% CI: 0.83-1.16) and 0.87 (95% CI: 0.77-0.98), indicating only 2% reduction in advanced breast cancer and 13% reduction in breast cancer mortality.
Conclusion
The established Bayesian network causal model is anticipated to build the guideline of the standard on average for countries started to launch their service screening, such as Asian counties, and also to provide an insight into the personalized screening strategies for different risks of being susceptible to cancers.

Impact of screening policies and strategies

125 - Poster Presentation

The benefits and drawbacks of implementing a direct FIT kit for subsequent clients for bowel cancer screening; the experience from BowelScreen, the Irish National Bowel Screening Programme

Fahy, Fitzpatrick, Coffey, O'Donoghue, Mooney
National Screening Service, DUBLIN, Ireland

Background
BowelScreen, The National Bowel Screening Programme in Ireland, offers free colorectal screening to men and women aged 60-69 years through a home Faecal Immunochemical Test (FIT) kit. To improve on the 40.2% uptake in Round One (2012-2015), an intervention during Round Two saw FIT kits sent directly to previously screened (subsequent) clients rather than the “Usual-Invite” method, whereby clients contact the programme by telephone before receiving a FIT kit.

Results of this intervention showed that uptake was significantly higher amongst FIT-Direct compared with Usual-Invite clients (91.6% vs 85.1%, $p<0.0001$). Consequently in July 2017 FIT-Direct was fully implemented for subsequent clients participating in BowelScreen. Despite the improved uptake it was noted that the unsatisfactory FIT rate has increased and is approaching the programme standard of ≤3%. The aim of this study was to compare unsatisfactory rates before and after full FIT-Direct implementation.

Methods
Unsatisfactory FIT Rates and their corresponding 95% confidence intervals (CI) for periods before and after full FIT-Direct implementation were estimated. Rates were compared using rate ratios. A z-test of the null hypothesis that the unsatisfactory FIT rates before and after FIT-Direct implementation were equal was computed.

Results
The unsatisfactory FIT rate for subsequent clients before full implementation was 1.03% (95% CI: 0.83%-1.27%) compared with 2.38% (95% CI: 2.17%-2.61%) for subsequent clients after full implementation. This gives an unsatisfactory FIT rate 2.31 times higher with FIT-Direct (95% CI: 1.84-2.92, $p<0.0001$).

Conclusions
The FIT-Direct intervention had an overall positive effect on uptake with client convenience likely to be important. However our study shows evidence that the FIT unsatisfactory rate is significantly higher after compared with before full FIT-Direct implementation. This rise in the unsatisfactory rate is of concern and needs close monitoring to ensure it does not rise above the BowelScreen 3% standard.

Impact of screening policies and strategies

140 - Poster Presentation

STAGING OF SCREEN AND NON-RESPONDERS' DETECTED CANCERS IN SLOVENIAN COLORECTAL CANCER SCREENING PROGRAMME AS INCENTIVE FOR GENERAL PRACTITIONERS' INVITATION ACTIVITIES

Novak Mlakar[1], Kofol Bric[1], Škrjanec[1], Krajc[2]
[1]National Institute of Public Health, LJUBLJANA, Slovenia
[2]Institute of Oncology Ljubljana, LJUBLJANA, Slovenia

Background. In the second organizational round of the Slovenian national colorectal cancer screening programme the incidence and characteristics of screening cancers were analysed and compared with cancers in non-responders. For better involvement of general practitioners in the invitation process national evidence of screening benefits is needed.
Methods. The analysis included the population of Slovenian residents aged between 50 to 69 years, invited for screening between April 2011 and December 2012. The persons were monitored until the next foreseen invitation, in average for 2 years. The data were obtained from screening programme information system and the Cancer Registry.
Results. Among 502,488 persons invited for screening 493 cancers were detected after positive screening test and 395 in non-responders. Among the persons with positive test result, the cancer was significantly more often detected in men ($p = 0.009$) and in persons aged 60+ years ($p < 0.001$). In the comparison between screen detected cancers and non-responders' cancers, there was no difference according to gender or age groups. Among the non-responder cancer patients, there were more persons with less than 10 years of schooling, compared to screen detected cancer patients, where there were more persons with 10 years of schooling or more ($p = 0.001$). In screen detected cancers more cases were in stage I ($p < 0.001$), whereas more non-responder cancer cases were in stage II ($p = 0.016$) and IV ($p < 0.001$).
Conclusions. Cancers among non-responders in the screening programme are detected at higher stages when treatment options are limited and patient survival is lower. Based on the unfavourable results of cancers staging among non-responders general practitioners are encouraged to use the algorithm for the additional invitation activities for non-responders in the screening.

National Institute of Public Health

Picture 1:

Impact of screening policies and strategies

141 - Oral Presentation

Impact of Mammographic Features on Inter-screening Interval of Breast Cancer Screening

Chiu[1], Yen[2], Chuang[3], Wu[4], Chen[2], Fann[5], Tabar[6]
[1]College of Management, Chang Gung University, TAO-YUAN, Taiwan
[2]School of Oral Hygiene, Taipei Medical University, TAIPEI, Taiwan
[3]Institute of Epidemiology and Preventive Medicine, National Taiwan University, TAIPEI, Taiwan
[4]Department of Radiation Sciences, Oncology, Umeå University, UMEÅ, Sweden
[5]College of Healthcare Management, Kainan University, TAOYUAN, Taiwan
[6]Department of Mammography, Falun Central Hospital, FALUN, Sweden

Background The optimal interval-screening interval for cancer screening varies with disease natural history and sensitivity, which implies that the impact of inter-screening interval may also varied with mammography features. We aimed to estimate mean sojourn time (MST) with adjustment for sensitivity by mammographic features with emphasis on 1-14 mm tumour and then assess how they affect the impacts of different inter-screening intervals.

Methods The Swedish screening cohort in two periods (1977-1985 and 1996-2010) was conducted by collecting screening detection modes and mammographic features based on 1-14mm invasive tumor size. The sensitivity-adjusted three-state Markov exponential regression model incorporating mammographic appearances was employed to estimate MST using Bayesian Monte Carlo Markov Chain (MCMC). The impact of interval-screening interval by mammographic features was evaluate based on the percentage of interval cancer against background incidence (1-I/E ratio).

Results The longer MST was revealed on powdery and crushed stone-like calcifications (4.26 years) and stellate masses (3.76 years), but shorter MST on circular masses (2.65 years). The percentage of interval cancer against background incidence for biennial and triennial program were 21% and 29% for powdery and crushed stone-like calcifications and 32% and 43% for the circular type.

Conclusion Our study revealed the sensitivity-adjusted MST for small breast tumour were different by mammographic appearance. Different impacts of inter-screening interval in the light of mammographic features provide an insight into the optimal surveillance schedule by these mammographic features.

Impact of screening policies and strategies

145 - Oral Presentation

Bayesian round-based regression for the evaluation of organized service screening

Hsu[1], Yen[2], Ku[1], Aarts[3], Broeders[3], Duffy[4], Chen[1]
[1]National Taiwan University, TAIPEI, Taiwan
[2]Taipei Medical University, TAIPEI, Taiwan
[3]Radboud Institute for Health Sciences, NIJMEGEN, The Netherlands
[4]Queen Mary University of London, LONDON, United Kingdom

Introduction
While service mammography screening has been adopted as a major strategy for breast cancer prevention, the assessment along the evolution of policies is hampered by the lacking of control group. We aimed to develop a Bayesian round-based regression for the estimation of disease natural history along with measurement error parameter using tabular information on service screening.
Methods
The breast cancer screening in Nijmegen started from 1975. A forty-year follow-up data on breast cancer screening consisted of women aged 50-69 years spanned between the year 1975 to 2012 was used to illustrate the proposed method. The period was grouped into four periods: 1) pilot period (1975-1988), 2) early period for nationwide programme (1989-2000), 3) nationwide programme period (2001-2006) and 4) digital mammography period (2007-2012). With a three state progressive Markov model underpinning, a Bayesian round-based regression was developed to estimate the joint effect of two rate dominating the evolution of breast cancer, incidence rate and progression rate along with the sensitivity in the four periods.
Results
During the study period, a total of 24,394 women attended the screening programme with 961 screening detected and 417 interval breast cancers identified. The estimated incidence rate increasing from 240 per 100,000 in period 1 (1975-1988) to 350 per 100,000 in the fourth period (2007-2012), while the corresponding annual progression rate decreasing from 0.29 (95% CI: 0.23-0.37) to 0.22 (95% CI: 0.17-0.27). The estimated duration of early detection for the four periods was ranged between 3.4 (95% CI: 2.7-4.3, 1975-1988) and 4.6 (95% CI: 3.7-5.9, 2007-2012). The estimated sensitivity for the four periods was ranged between 70.2% (57.7-81.9%, 2001-2006), and 79.0%(70.7-86.7%, 2007-2012).
Conclusions
The proposed Bayesian round-based regression model provides a feasible and flexible framework to update the prior information with empirical evidence derived from a defined time period and area.

Impact of screening policies and strategies

154 - Poster Presentation

Results from a pragmatic randomized controlled trial of an endoscopist audit and feedback report for colonoscopy

Tinmouth[1], Sutradhar[2], Li[2], Patel[1], Baxter[3], Paszat[2], Rabeneck[4]
[1]Sunnybrook Research Institute, TORONTO, Canada
[2]Institute for Clinical Evaluative Sciences, TORONTO, Canada
[3]St. Michael's Hospital, TORONTO, Canada
[4]Cancer Care Ontario, TORONTO, Canada

Background: High quality colonoscopy is critical to organized colorectal cancer screening programs. There is considerable variation in colonoscopy quality, much attributable to endoscopist performance. Audit and feedback (A/F) can be used to improve physician performance. We conducted a pragmatic randomized controlled trial to determine if A/F for colonoscopy compared to no A/F improves performance among practicing endoscopists.
Methods: A/F reports for endoscopists in Ontario, Canada in 2014 were generated centrally using health administrative data. All endoscopists (n=833) were randomly assigned to receive (intervention group, n=417) or not to receive (control group, n=416) an A/F report in October 2015. We measured colonoscopy performance in both groups over two 12 month periods: pre-report and post-report. The primary outcome was polypectomy rate (PR). Secondary outcomes were cecal intubation rate, bowel preparation and 'recent normal findings'. Primary and secondary outcomes were compared between the two groups using rate ratios (RR) estimated using Poisson regression under a difference-in-differences framework for all endoscopists and for 'poor performers'.
Results: Primary and secondary outcomes improved among all endoscopists from the pre- to the post-report periods without a significant difference between the intervention and control groups. Among 'poor performers', there was improvement in PR from the pre- to the post-report periods with significantly greater improvement in the intervention versus control group (RR, intervention vs control: 1.34 vs 1.11, p=0.02). There was no significant improvement in the other outcomes among 'poor performers' [Table 1].
Conclusion: A/F reports for colonoscopy improved endoscopist performance among those who were poor performers at baseline.

Picture 1: https:\\www.eventure-online.com/parthen-uploads/122/53700/add_1_505594_1abef51e-804a-4136-a5f4-0845c526759f.jpeg

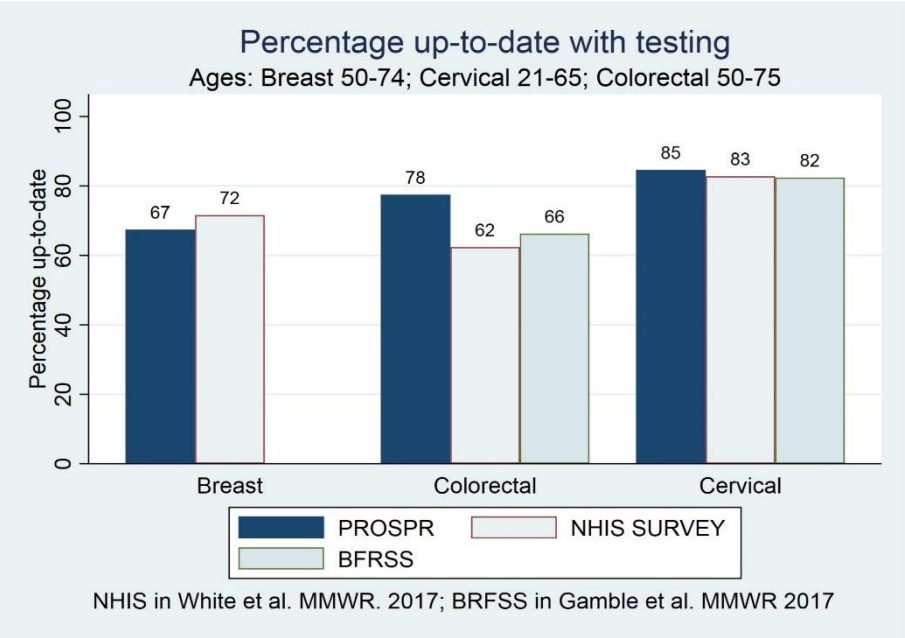
Impact of screening policies and strategies

155 - Oral Presentation

Evaluating screening participation, follow-up and outcomes for breast, cervical and colorectal cancer in the PROSPR consortium

WE Barlow[1], E Beaber[2], B Geller[3], A Kamineni[4], Y Zheng[5], J Haas[6], C Chao[7], C Rutter[4], A Zauber[8], B Sprague[9], E Halm[10], D Weaver[9], J Chubak[4], VP Doria-Rose[11], S Kobrin[11], T Onega[12], V Quinn[7], M Schapira[13], A Tosteson[12], M Thornquist[2], D Corley[14], C Skinner[10], M Schnall[13], K Armstrong[13], C Wheeler[15], M Silverberg[14], B Balasubramanian[10], C Doubeni[13], D McLerran[2], J Tiro[10]
[1]Cancer Research and Biostatistics, SEATTLE, United States of America
[2]Fred Hutchinson Cancer Research Center, SEATTLE, United States of America
[3]University of Vermont and State Agricultural College, BURLINGTON, United States of America
[4]Kaiser Permanente Washington Health Research Institute, SEATTLE, United States of America
[5]Fred Hutch, SEATTLE, United States of America
[6]Brigham and Women's Hospital, BOSTON, United States of America
[7]Kaiser Permanente Sothern California, LOS ANGELES, United States of America
[8]Memorial Sloan-Kettering Cancer Center, NEW YORK, NY, United States of America
[9]University of Vermont, BURLINGTON, VT, United States of America
[10]University of Texas Southwestern, DALLAS, TX, United States of America
[11]National Cancer Institute, BETHESDA, MD, United States of America
[12]Dartmouth Medical School, HANOVER, NH, United States of America
[13]University of Pennsylvania, PHILADELPHIA, PA, United States of America
[14]Kaiser Permanente Northern California, OAKLAND, CA, United States of America
[15]University of New Mexico, ALBUQUERQUE, NM, United States of America

Background: Cancer screening is a complex process encompassing risk assessment, the initial screening examination, diagnostic follow-up procedures, and treatment of cancer precursors or early cancers. Metrics that enable comparisons across different screening targets are needed. We present population-based screening metrics for breast, cervical, and colorectal cancers for nine sites participating in the PROSPR consortium.
Methods: We describe how selected metrics map to a trans-organ conceptual model of the screening process. For each cancer type, we calculated calendar year 2013 metrics for the screen-eligible target population (breast: ages 40-74; cervical: ages 21-65; colorectal: ages 50-75). Metrics for screening participation, timely diagnostic evaluation, and diagnosed cancers in the screened and total populations are presented for the total eligible population and stratified by age group and site.
Results: The cancer type with the population most up-to-date for testing was cervical cancer (85%), then colorectal cancer (78%), followed by breast cancer (64%). Breast cancer had the highest percentage of positive screens (10.2%) and of completing timely follow-up (96.8%), while cervical and colorectal cancer had similar percentages for both metrics (~4.5% positive screen and ~74% receiving timely follow-up). Cancer rates per screen were highest for breast screening (5.66 per 1,000 screened), followed by colorectal screening (1.56 per 1,000 screened) and cervical screening (0.17 per 1,000 screened).
Conclusions: Comprehensive assessment of metrics by the PROSPR consortium enabled systematic identification of screening process steps in need of improvement. We encourage widespread use of these metrics to facilitate comparison across cancer types and healthcare settings.



Picture 1:
Caption 1: Comparing percentage of population up to date on testing

Impact of screening policies and strategies

158 - Poster Presentation

The estimated impact of reducing the masking effect of mammographic density in breast cancer screening programs

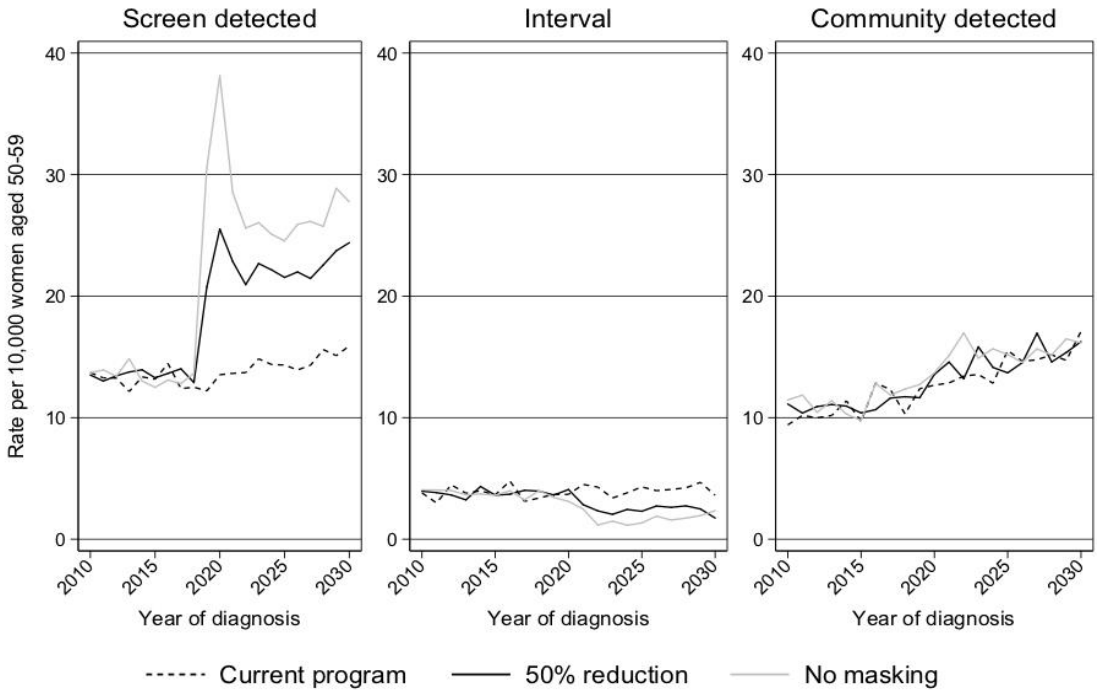
Procopio[1], Valentzis[1], Petrie[2], Mann[3], Canfell[4], Brennan[5], Saxby[2], Carr[6], Nickson[1]
[1]Cancer Council NSW / University of Melbourne, CARLTON, Australia
[2]Monash University, MELBOURNE, Australia
[3]Royal Melbourne Hospital, MELBOURNE, Australia
[4]Cancer Council NSW, SYDNEY, Australia
[5]University of Sydney, SYDNEY, Australia
[6]Baker Institute, MELBOURNE, Australia

Background
Mammographic density (MD) is a strong risk factor for breast cancer and it reduces mammographic screening test sensitivity by masking or camouflaging cancerous lesions. Simulation modelling of breast cancer screening incorporating detailed MD modelling enables a better understanding of the dual role of MD in the performance of screening and the likely impact of alternative screening protocols and/or tests.

Methods
Policy1-Breast is a continuous-time, stochastic, multiple-cohort micro-simulation clinical and health economics model of breast cancer diagnosis, screening and treatment in Australian (current screening participation 55%).Its detailed MD sub-model reproduces life-course MD and associated breast cancer risk and masking effects. We estimate the impact of hypothetical screening tests with reduced MD-masking effects, comparing projected population-level cancer outcomes for current and alternative scenarios.

Results
For women aged 50-59, a 50% reduction in MD-related masking would, in its first 10 years of implementation, increase screen-detected invasive cancer rates by 52% and decrease interval cancer rates by 40% (Figure). For a screening test where MD has no masking effect (so that sensitivity matches observed sensitivity for very low-MD women), screen-detected cancer rates would increase by 80% and interval cancer rates decrease by 60%. Results for other age groups and MD sub-groups will be shown.

Conclusion
Reducing MD-related masking is expected to markedly reduce interval cancer rates while increasing screen-detected cancers, partly due to an increase in overdiagnosed cancers in women with high MD. This analysis demonstrates how Policy1-Breast can help evaluate the costs, benefits and harms of current and alternative breast cancer screening protocols.



Picture 1:
Caption 1: Rates of screen detected, interval, and community detected cancers for the three scenarios considered (showing women aged 50-59)

Impact of screening policies and strategies

160 - Poster Presentation

Cost-effectiveness of breast cancer screening with MRI in women with familial risk

HA Geuzinge, EAM Heijnsdijk, MMA Tilanus-Linthorst, HJ de Koning
Erasmus MC, ROTTERDAM, The Netherlands

Background: The optimal screening strategy for women with a family history of breast cancer without a proven gene mutation is unknown. Recently, a randomized controlled trial evaluated whether these women should be screened with mammography and clinical breast examination (CBE), or with MRI, mammography and CBE. The cost-effectiveness of these screening strategies is unknown.
Methods: We evaluated data of the FaMRIsc trial, a randomized controlled trial. A total of 1355 women aged 30-55 years with a cumulative lifetime breast cancer risk of >20% without a *BRCA1/2* mutation were randomized in two arms. In the MRI-arm, women received annual MRI, CBE and biennial mammography. In the Mx-arm, women received annual mammography and CBE. Data of this trial will be used to adjust a microsimulation model (MISCAN) in order to simulate the cost-effectiveness of additional MRI screening. We will estimate life years, quality-adjusted life years and direct medical costs on a life time horizon for each screening strategy. Incremental cost-effectiveness ratios will be calculated to compare screening strategies.
Results: Between 2011 and 2017, 41 cancers were detected in the MRI-arm and 14 cancers in the Mx-arm. Those detected in the MRI-arm were on average in an earlier stage than those in the Mx-arm, resulting in lower average costs per detected cancer. Specificity was lower in the MRI-arm compared to the Mx-arm (83.8% versus 91.0%, $p<0.001$) and sensitivity differed hardly (95.1% versus 92.9%, $p=1$). Preliminary results showed higher costs associated with the MRI-arm compared to the Mx-arm, due to higher detection, higher costs for the MRI itself and by more false positive screening results.
Conclusions: Screening with MRI results in higher cancer detection, more false positive results and higher costs, compared to mammography screening.

Impact of screening policies and strategies

162 - Poster Presentation

WAY WOMEN'S HEALTH. An App to encourage and sustain women in the adoption of healthy lifestyles. Project funded by the Italian Ministry of Health (CCM2016)

Dotti[1], Jaramillo[1], Castagno[1], Di Stefano[1], Piccinelli[1], Mantellini[2], D'Angelo[2], Masala[2], Gorini[2], Parodi[3], Pezzana[3], Valenza[4], Menzano[5], Giordano[1]
[1]Città della salute e della scienza, TURIN, Italy
[2]Institute for the study, prevention and oncology network - ISPRO, FLORENCE, Italy
[3]Asl Città di Torino, TORINO, Italy
[4]Azienda Sanitaria Provinciale, PALERMO, Italy
[5]Ministero della Salute, ROMA, Italy

Introduction: Unhealthy diet, physical inactivity, and smoking are key risk factors for cancer and other NCDs. Encouraging people to adopt healthy lifestyles is a challenge for health systems. In this scenario, cancer screening procedures may represent an ideal setting: for the large amount of people participating, the possibility for it to be a moment to consider lifestyles and health correlations, for its periodic invitations.
Nudge theory, the idea to gently induce people towards an option, provides theoretical framework. Studies shown how instruments based on it can influence behaviours such as stop smoking, be physically active and eat well.
New ICT, such as App and websites are widespread among populations. They can offer a plethora of tools (fitness trackers, messaging, information) that represent a efficient and cost-saving way to offer interventions to wide populations.
Methods: Nine cervical and breast cancer screening centres in Turin, Florence and Palermo are involved in the study. Women will be encouraged through a nudge approach, to download and use the App that will address smoking, physical inactivity and unhealthy diet. Users individual habits will be screened through a triage. Women will be subsequently allowed to access dedicated areas, provided with specific tools to facilitate the adoption of healthy lifestyles: agendas to monitor changes and results, tips, recipes, exercises, mindfulness instruments, local resources. Periodical notifications will be sent to encourage instrument use and compliance with recommendations.
For non-web users, a similar path has been developed (paper materials and counselling sessions).
Results: After being pretested the App reached its final version. It will be tested between February and April 2019. Preliminary impact will be presented.
Conclusions: The introduction of ICT in health care settings represents an important challenge we have to engage to find alternative, cost effective and possibly user-friendly instrument that ca be spread in the population.

Impact of screening policies and strategies

165 - Poster Presentation

The impact of FIT accuracy on effectiveness and cost-effectiveness of colorectal cancer screening in Austria

Jahn[1], Sroczynski[1], Bundo[1], Mühlberger[1], Puntscher[1], Todorovic[2], Oberaigner[1], Fischer[3], Schiller-Frühwirth[3], Hackl[4], Ferlitsch[5], Siebert[1], Austrian CRC Model Group[6]
[1]UMIT - University for Health Sciences, Medical Informatics and Technology, HALL IN TIROL, Austria
[2]Institute of Public Health, Medical Decision Making, Health Technology, HALL IN TIROL, Austria
[3]Main Association of Austrian Social Security Institutions, VIENNA, Austria
[4]Statistics Austria, VIENNA, Austria
[5]Medical University of Vienna, Department of Internal Medicine, VIENNA, Austria
[6]Austrian CRC Model Group, HALL, Austria

Purpose: Organized population-based screening for colorectal cancer (CRC) is increasingly implemented in Europe. Our study evaluates long-term effectiveness and cost effectiveness of CRC-screening strategies compared to no screening for women and men with average CRC risk in Austria. The impact of immunochemical fecal occult blood test (FIT) accuracy was investigated.
Methods: We developed, calibrated and validated a decision-analytic state-transition cohort (Markov) model for colorectal adenoma and cancer with a lifelong time horizon and four screening strategies: 1) No-Screen: no screening, 2) FIT-Screen: FIT (age 40-75years, annually), 3) gFOBT-Screen: guaiac-based fecal occult blood test (age 40-75years, annually), and 4) COL-Screen: colonoscopy (age 50-70years, 10-yearly). The following outcomes where assessed: life-years gained (LYG), CRC-related deaths avoided, CRC cases avoided, costs and discounted incremental cost-effectiveness ratios (ICER). We adopted the perspective of the statutory health care system and a 3% annual discount rate. Comprehensive sensitivity analyses were performed including sensitivity of FIT. An interdisciplinary expert panel guided the project.
Results: No-Screen and gFOBT-Screen were dominated. Most effective strategies were FIT-Screen and COL-Screen. Moving from COL-Screen to FIT-Screen has an ICER of around 15,000 EUR/LYG. When the sensitivity of each annual FIT was reduced by 60%, the ICER increases to 58,000 EUR/LYG. COL-Screen becomes dominant when FIT sensitivity is further reduced.
Discussion: Sensitivity of FIT is a sensitive model parameter for cost-effectiveness outcomes. Undetected lesions associated with less bleeding may in practice decrease overall sensitivity for fecal occult blood tests of certain persons over time. Therefore, the current model assumption of independent test accuracies of consecutive annual fecal blood tests conditional on the disease needs to be further investigated.
Conclusion: Organized CRC-screening programs with annual FIT or 10”yearly colonoscopy are effective and cost effective. Sensitivity of FIT has a high impact on cost effectiveness but detailed effects of dependent consecutive FIT require further research.

Impact of screening policies and strategies

173 - Poster Presentation

Tumour subtypes and breast cancer survival by screening status.

K.M. o' Brien[1], T. Mooney[2], P. Fitzpatrick[3], L. Sharp[4]
[1]National Cancer Registry Ireland, CORK, Ireland
[2]National Screening Service, DUBLIN, Ireland
[3]University College Dublin, DUBLIN, Ireland
[4]Newcastle University, NEWCASTLE UPON TYNE, United Kingdom

Purpose:
For women with a breast cancer diagnosis in Ireland in the period 2006-2011, we examined whether demographic and tumour characteristics (including subtype) differed by screening status; women with breast cancer diagnosed via mammography screening, women with interval breast cancer, lapsed attenders and non-participants of the screening programme. In addition, we explored whether there were survival differences by screening status, taking into account lead time bias.
Methods:
Data from National Cancer Registry Ireland and the national breast screening programme BreastCheck were used to identify the population. We used multinomial logistic regression to test the association of covariates with screening status. For survival analysis, we corrected the survival time for screen-detected cases for lead time bias. We examined Kaplan-Meier curves and also used Cox regression to investigate differences in survival by screening status.
Results:
Subtype (HER2 over-expressing, triple negative), stage (III/IV), grade (poor), having comorbidities, area of deprivation, smoking status and age were associated with having interval cancer or being a non-participant of the screening programme in the multivariable model.
After correcting for lead time bias, and adjusting for variables associated with screening status, there was no evidence that risk of breast cancer death for women with screen-detected cancer was different from women with interval cancer (HR = 0.76, 95%CI 0.56 -1.03) non-participants (HR = 1.07, 95%CI 0.84 - 1.37) and lapsed attenders (HR = 0.97, 95%CI 0.65 - 1.45).
Conclusions:
Screening status was strongly associated with subtype and this association persisted after adjustment for covariates including tumour stage and grade. After correcting for lead-time bias, there was no evidence a difference in the relative hazard of death from breast cancer by screening status in the adjusted analysis. Different stage distribution by screening status accounted for almost all of the survival differences between these groups.

Impact of screening policies and strategies

177 - Oral Presentation

SUCCESS; A smoking cessation strategy in cervical screening participants

KM van Asselt[1], M.B. Mansour[1], M Crone[2], H.C. van Weert[1], NH Chavannes[2]
[1]Amsterdam UMC locatie AMC, AMSTERDAM, The Netherlands
[2]LUMC, LEIDEN, The Netherlands

Background:
In current practice, screening focuses on detection of cancer or detection of pre-cancer manifestations, but does not address health behavior. The direct health benefits of screening programs can be extended by seizing the opportunity for effective smoking cessation in a highly motivated group, as people who attend screening programs have demonstrated to be motivated to improve their health. Involvement of general practitioners (GPs) in screening for cervical cancer is more intense than in other population based screening programs. Therefore it is possible to take advantage of the logistics which are already established within the general practice. In this trial we will investigate the effect of a smoking cessation strategy offered to smokers in the cervical cancer screening program.
Methods
We designed a cluster randomized trial of 66 Dutch GP practices with an intervention and control arm. Screening participants (women aged 30-60) who visit the GP a smear test will be asked to participate. The strategy in the intervention arm consists of: 1) Providing information about the relationship between smoking and the development of cancer, and 2) stop advice and offering smokers cessation support.
Results
The effect study will show whether this strategy increases the percentage of women who make a stop attempt. The process evaluation will show whether the strategy is acceptable and feasible for screening participants and care providers, and which factors play a role in the successful implementation of the strategy.
Discussion
The study protocol will be presented at the congress. The trial started in September 2018 in Dutch GP practices.

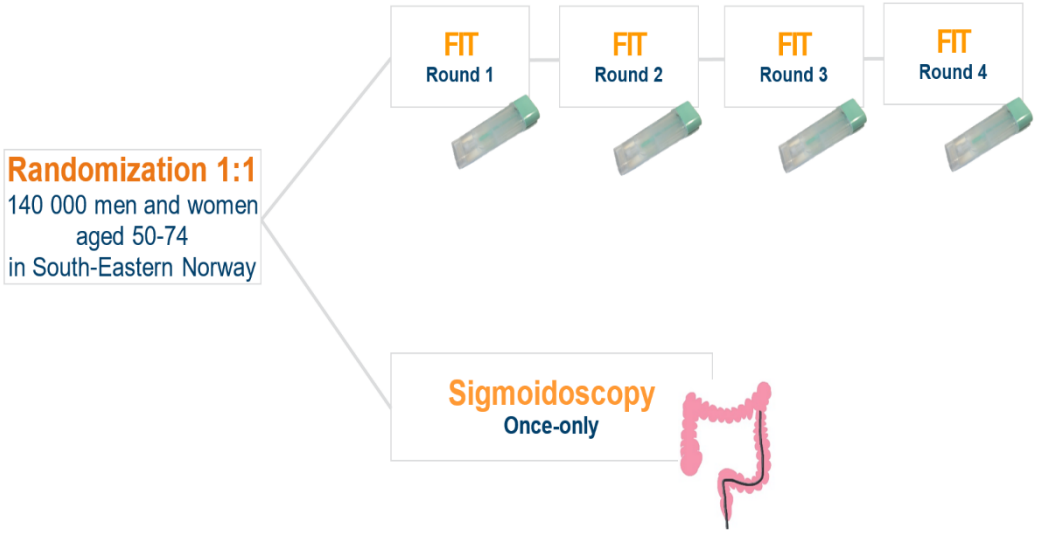
Impact of screening policies and strategies

181 - Poster Presentation

Sigmoidoscopy versus faecal occult blood testing for colorectal cancer screening: Design of The Bowel Cancer Screening in Norway (BCSN) trial

Berstad, Randel, Schult, Knudsen, Natvig, Jørgensen, Botteri, Hoff, Holme
Cancer Registry of Norway, OSLO, Norway

Background: Screening for colorectal cancer (CRC) with sigmoidoscopy or faecal occult blood testing (FIT) reduces CRC mortality. However, the effectiveness of the two methods has never been compared in randomized trials.
Methods: In 2012, Norwegian health authorities launched a screening pilot project to inform decision makers of feasibility and effectiveness of the two methods. The project was designed as a comparative effectiveness trial. 140,000 men and women aged 50-74 years living in South-Eastern Norway were identified through the Norwegian Population Registry and randomized (1:1) to once-only sigmoidoscopy or four rounds of biennial FIT (Figure). The primary endpoint of the trial is CRC mortality after 10 years of follow-up. Auxiliary studies have evaluated potential harmful effects of screening on lifestyle and mental health.
Results: In December 2018, the last participant was invited to the trial, and inclusion will be finalized during the winter of 2019. The fourth round of FIT is expected to be completed in 2023. The study will generate important knowledge concerning effectiveness and feasibility of the two CRC screening methods. The auxiliary studies found no considerable harmful effects on lifestyle or mental health during one year following the first screening examination.
Conclusions: The BCSN pilot project has provided valuable experience and infrastructure for implementation of a national CRC screening programme.



Picture 1:
Caption 1: The design of the Bowel Cancer Screening in Norway (BCSN) trial, a comparative effectiveness trial comparing sigmoidoscopy and biennial immunochemical

Impact of screening policies and strategies

182 - Poster Presentation

Mammography screening of breast cancer survivors, what is the best follow-up programme?

SHN Njor, MB Larsen
Randers Regional Hospital, RANDERS, Denmark

Background
Several reviews have found that there is a better survival among breast cancer recurrences detected at mammography than among recurrences detected clinically, they though all state that further evidence is needed, since the better survival is biased by length and lead time bias. Based on this a 2016 review concluded that “organized screening programs should reassess their guidelines on surveillance mammography and consider including breast cancer survivors.” and in Denmark the guidelines for follow-up of breast cancer survivors were changed, so that survivors shortly after their breast cancer diagnosis are only followed by mammography screening instead of being followed by clinical examination and mammography screening.

Methods
This study aims at evaluating whether mammography screening can be used alone as follow-up of breast cancer survivors or is better used alongside clinical examinations.
We estimated the proportion of screen-detected cancers and interval cancers that are detected at screening i.e. estimated the odds of having the breast cancer detected at screening given that you have breast cancer.

Results
Among breast cancer survivors who have not had a clinical examination 0-15 months before mammography screening, 58% of recurrences are detected as interval cancers, where as only 18% of recurrences are being detected as interval cancers among breast cancer survivors who have had a clinical examination 0-15 months before the screening.

Conclusions
It might to be better to follow breast cancer survivors with both mammography screening and clinical examination. This should be further investigated in e.g. a Randomized controlled trial offering 2-3 types of follow-up to breast cancer survivors.

Impact of screening policies and strategies

183 - Poster Presentation

Cervical Cancer Screening Initiation by HPV Vaccination Status in Four U.S. Health Care Systems

Aruna Kamineni[1], Silver[2], Garcia[3], Chao[4], Winer[5], Silverberg[6], Chubak[1], Tiro[7], Wheeler[8], Mao[5], Corley[6], Doria-Rose[2], Feldman[9], Beaber[3]
[1]Kaiser Permanente Washington, SEATTLE, United States of America
[2]National Cancer Institute, ROCKVILLE, United States of America
[3]Fred Hutchinson Cancer Research Center, SEATTLE, United States of America
[4]Kaiser Permanente Southern California, PASADENA, United States of America
[5]University of Washington, SEATTLE, United States of America
[6]Kaiser Permanente Northern California, OAKLAND, United States of America
[7]University of Texas Southwestern Medical Center, DALLAS, United States of America
[8]University of New Mexico Comprehensive Cancer Center, ALBUQUERQUE, United States of America
[9]Brigham and Women's Hospital, BOSTON, United States of America

Although cervical cancer screening guidelines remain agnostic to human papillomavirus (HPV) vaccination status, 2012 United States (U.S.) consensus guidelines recommended delaying screening initiation from age 18 until 21 years for all women. We examined the association between vaccination status and subsequent screening initiation in geographically and ethnically diverse U.S. populations during a period of changing screening entry recommendations.

After excluding women with screening prior to their 18th or 21st birthdays, we identified two age cohorts - 9,498 women who turned 18 years old and 87,371 women who turned 21 years old - between January 1, 2010 and December 31, 2014 across four health care systems within the Population-Based Research Optimizing Screening through Personalized Regimens (PROSPR I) consortium. Vaccination status prior to the date of first screen was ascertained. We estimated median times to screening from age 18 or 21 and 95% confidence intervals (CIs) using the Kaplan-Meier method. Hazard ratios (HR) and 95% CIs were estimated from multivariable Cox proportional hazards models.

Median time to screening initiation was shorter for vaccinated women compared to unvaccinated women (age 18 cohort: 47.8 vs. 48.5 months; age 21 cohort: 17.4 vs. 32.1 months). After adjustment for race/ethnicity, number of primary care provider visits, body mass index, and health care system, HRs (95% CIs) for screening initiation among vaccinated women relative to unvaccinated women were 1.35 (1.15-1.60) for the age 18 cohort and 1.35 (1.32-1.38) for the age 21 cohort.

Pooling across multiple health care settings during the beginning of de-implementation of screening prior to age 21 in the U.S., vaccinated women were more likely to screen and less likely to delay screening initiation compared to unvaccinated women irrespective of the age of screening initiation guideline. These findings suggest that efforts to improve screening and catch-up vaccination for these unvaccinated young women are warranted.

Impact of screening policies and strategies

184 - Oral Presentation

15 years of organised cervical cancer screening in Slovenia: the past and the future

Ivanus, Primic Zakelj, Florjancic, Jerman
Institute of Oncology Ljubljana, LJUBLJANA, Slovenia

Background: Organised, population-based cervical cancer screening was implemented in Slovenia in 2003 with conventional cytology in three-year screening intervals for women aged 20–64 years. Due to new evidence and technology development, as well as due to entering of HPV-vaccinated cohorts into the screening programme, the screening policy might change in the future.
Methods: Data from National Cervical Cancer Screening Registry ZORA are regularly used for monitoring of the screening, diagnostics and treatment of cervical lesions in Slovenia. All cervical cytology results in Slovenia are recorded in the ZORA registry since 2003, all cervical histopathological reports and all hysterectomies since 2004, and all HPV test results (both triage and test of cure) since 2010. Bethesda classification is used for cervical cytology reporting since 2011 and World Health Organisation classification for histology since 2015. ZORA registry has daily online synchronisation with the Central Population Registry of the Republic of Slovenia and the Registry of Spatial Units and it exchanges data yearly with the Cancer Registry of Republic of Slovenia.
Results: After 15 years of the implementation of organised cervical screening in Slovenia time trends of selected key process-indicators will be presented, such as population coverage by a screening test and proportion of women with screening results that need further diagnostics. Evaluation of the impact of the screening programme on the cervical cancer burden in Slovenia, such as the decrease of cervical cancer incidence and mortality, will be presented, as well as the results of the audit of new cervical cancer cases.
Conclusions: Despite the good results of the organised cervical cancer screening program in Slovenia, a change will be considered in the national screening policy in the future, including liquid-based technology, primary HPV screening, HPV-self-sampling of non-responders together with risk-based assessment and management of women.

Impact of screening policies and strategies

186 - Poster Presentation

Breast cancer screening in Singapore: a modelling study

SC Chootipongchaivat
Erasmus MC, ROTTERDAM, The Netherlands

Background
Breast cancer is one of the leading causes of cancer-related death among women in Singapore. Since 2002, the Singaporean government has implemented a nationwide breast cancer screening program. The aim of this study is to evaluate the performance and cost-effectiveness of the current program in which women are screened annually from the age 40-49 years and biennially from 50-69 years and alternative screening scenarios.
Method
National data on breast cancer incidence, mortality, treatment, screening and costs were obtained from the National Registry Of Diseases Office (NRDO), BreastScreen Singapore (BSS) and Singapore's National Statistical Office (SingStat). Screening policies were evaluated for a population of individuals born between 1910-1970. The outcomes of various screening scenarios were evaluated, such as breast cancer deaths averted, number of mammograms and false positives, costs and life years gained.
Results
At current attendance level, the screening policy had modest effects in terms of breast cancer deaths averted and life years gained. When assuming full adherence to the recommended screening policy, benefits increased substantially. However, more false positives were found when the number of mammograms increases.
Conclusion
This study found that the current screening practice could be further optimized. Results from this study should be carefully interpreted as each country has its own features. One characteristic of Singapore is that its population is very dynamic in terms of migration, adding one additional layer of complexity to our modelling study. Furthermore, registration of data has improved over time, resulting in good quality data for recent years but less reliable data for earlier years.

Impact of screening policies and strategies

190 - Poster Presentation

Elimination of cervical cancer in Canada: The role of HPV immunization uptake and primary HPV screening

Baines, Nicholson, Smith, Memon, Fitzgerald, Bryant
Canadian Partnership Against Cancer, TORONTO, Canada

Background: The Canadian Partnership Against Cancer (the Partnership) has endorsed the global pledge to eliminate cervical cancer. Two complementary strategies are necessary to reduce mortality from cervical cancer in Canada: increasing HPV immunization uptake and implementing primary HPV screening programs. To better understand the role of these strategies in the elimination of cervical cancer, the effect of HPV immunization uptake on health and screening outcomes was examined, and stakeholders were engaged to identify considerations for the implementation of HPV testing.
Methods: The OncoSim microsimulation model was used to assess the impact of increasing HPV immunization uptake in Canada from the current rate of 67% to a target rate of 90% in a cohort of Canadian women. Outcomes included cervical cancer incidence, cervical cancer mortality, number of colposcopies and number of cervical biopsies. The Partnership's Pan-Canadian Cervical Cancer Screening Network (PCCSN) was engaged to inform the development of a report on the implementation of primary HPV testing.
Results: The OncoSim model projects that increasing HPV immunization uptake from 67% to 90% would result in a 23% reduction in incidence and mortality, a 23% reduction in the number of colposcopies and a 36% reduction in the number of cervical biopsies in a cohort of Canadian women. The National Guidance Document on HPV Testing for Primary Screening of Cervical Cancer, developed by the PCCSN, provides a comprehensive list of key considerations in the development of business proposals for HPV testing for primary cervical cancer screening, including economic and laboratory considerations, stakeholder engagement, and quality management.
Conclusions: HPV immunization has the potential to reduce incidence and mortality from cervical cancer and reduce the number of screening follow-up procedures. Given the robust evidence in favour of primary HPV screening, focused efforts to prepare for implementation are needed to progress towards the elimination of cervical cancer.

Impact of screening policies and strategies

191 - Oral Presentation

The second round of the dutch colorectal screening program: impact of an increased fit-cut off level

A.I. Kooyker[1], Toes-Zoutendijk[1], Opstal-van Winden[1], Spaander[1], Dekker[2], Buskermolen[1], Van Vuuren[1], Kuipers[1], Van Kemenade[1], Velthuysen[1], Nagtegaal[3], Ramakers[1], De Koning[1], Monique Van Leerdam[4], Lansdorp-Vogelaar[1]
[1]Erasmus Medical Center, AMSTERDAM, The Netherlands
[2]Amsterdam University Medical Center, AMSTERDAM, The Netherlands
[3]Radboud Medical Center, NIJMEGEN, The Netherlands
[4]Netherlands Cancer Institute, AMSTERDAM, The Netherlands

Background: In this study we present the results of the second round of the Dutch fecal immunochemical test (FIT) based colorectal cancer (CRC0 screening program and evaluate the impact of the increased FIT cut-off level halfway the first round
Design:Data were collected from the national screening database, ScreenIT. Primary outcomes were participation rate, positivity rate, positive predictive value (PPV) for advanced neoplasia (AN) and detection rate of AN. Outcomes were compared between previous participants and non-participants and between participants tested in the first round (2014) with a low (15 µg Hb/g feces) or high (47 µg Hb/g feces) FIT cut-off. All participants in 2016 were screened with a 47 µg Hb/g feces FIT cut-off level.

Results: A total of 459,754 individuals were invited for the second round of the Dutch CRC screening program of whom 75.9% participated. Participation was 93.4% among previous participants and 21.0% among previous non-participants. After age-adjustment, individuals tested with a high cut-off compared to a low cut-off in the first round had a significantly higher positivity rate (4.4% vs. 3.4%, Standardized Rate Ratio (SRR): 0.78, 95%CI: 0.68 – 0.89) and detection rate of AN (15.3 vs. 10.4 (SRR: 0.68, 95%CI: 0.53 – 0.88) per 1,000 participants).

Conclusion: Participation in the second round of the Dutch CRC screening program was high . The detection rate in the second round was higher when tested with a high cut-off in the first round. This suggests that a substantial part of the missed findings due to the increased FIT cut-off was detected in the subsequent round.

Impact of screening policies and strategies

192 - Oral Presentation

A Centralized Mailed Program with Stepped Support and Adherence to Colorectal Cancer Screening over 9 Years: A Randomized Controlled Trial

BB Green[1], ML Anderson[1], AJ Cook[1], J Chubak[1], S Fuller[1], RT Meenan[2], SW Vernon[3]
[1]Kaiser Permanente Washington, SEATTLE, United States of America
[2]Kaiser Permanente Northwest, PORTLAND, United States of America
[3]University of Texas, HOUSTON, United States of America

Background:
Higher long-term adherence to CRC screening would decrease CRC morbidity and mortality. No prior trials testing interventions to increase screening adherence have evaluated outcomes beyond 3 years.
Systems of Support to Increase Colorectal Cancer Screening (SOS) is a randomized controlled trial comparing a centralized mailed fecal test and stepped support program to usual care. The primary outcome is time in compliance with CRC guidelines.
Methods:
SOS was implemented in a healthcare organization in Washington State. Between 2008 and 2009, 4653 individuals aged 50-74 were randomized to receive in years 1 and 2: Usual care (Arm 1) or stepped intensity interventions: Mailed fecal tests with a colonoscopy option (Arm 2); mailings plus brief telephone assistance (Arm 3); or mailings and assistance plus navigation (Arm 4). In years 3–9, Arm 1 continued to receive UC. Arms 2-4 participants were randomized to continued or stopped interventions.
We compared time in compliance with CRC screening over 9 years in Arm 1 (UC) versus Arms 2-4 (Intervention). Screening tests contributed time based on national guidelines for screening intervals (fecal tests annually, sigmoidoscopy 5-years, colonoscopy 10-years).
Results:
All participants contributed data, but were censored at disenrollment, death, age 76, or CRC diagnosis. Compared with UC, Intervention participants had 20% more adjusted covered time over 9 years 57.5% vs.69.1%, incidence rate ratio, 1.20; *P* <.001. Fecal testing accounted for almost all additional covered-time. CRC screening increased over time in both UC and Intervention, with annual rates significantly higher in Intervention.
We will present comparative 9-year results, percent with no screening, differences by subgroup characteristics, and diagnostic yield (adenoma detection, CRC).
Conclusion:
In a healthcare organization with clinic-based activities to increase CRC screening, a centralized program led to increased CRC screening adherence over 9 years. Long-term screening adherence and its impact on CRC outcomes will be presented.

Impact of screening policies and strategies

193 - Poster Presentation

Risk of interval invasive breast cancer and predicted reductions with the addition of breast ultrasound

McGahan, DeVries, Andrew Coldman, Sam
BC Cancer, VANCOUVER, Canada

Background
Breast density is of interest in mammography screening as it is associated with risk of interval breast cancer. In the United States women with BIRADS density C or D and negative mammograms are often advised to have supplementary screening, commonly with breast ultrasound. This practice is not supported by accredited guidelines. We estimate the effect on interval cancer rates of adding ultrasound to mammography.
Method
Data was extracted on women in British Columbia between 2011 and 2015 who had at least one mammogram on which density was recorded (BIRADS) and was used to estimate the risk of interval breast cancer via Poisson regression with age (40-49, 50-59, 60-74), BIRADS density (A, B, C, D) and interval (<18, 18-30, 30-42 months) as factors. The relative reduction of 37% in interval cancer observed in the first round of the J-Start randomized trial, which compared biennial ultrasound + mammography to mammography alone, was applied to the modeled rates to predict reductions in interval cancer.
Results
There were 388,756 women who contributed 622,136 screening intervals in the estimation of rates for British Columbia and the findings are summarized in the attached table along with predicted reductions in interval cancer. Generally, predicted reductions in interval breast cancer were modest and exceeded 1 per 1,000 for only those with the highest density.
Conclusion
Women screened with the highest density receiving supplementary breast ultrasound were predicted to have reduced rates of interval cancer, but the magnitude of any associated long-term benefit remain unclear.

Table; Risk of invasive interval breast cancer for biennial mammography screening and predicted reductions in interval cancer with supplementary ultrasound by age and density.

Age	Density on Preceding Screen	Biennial Rate of Invasive Breast Cancer per 1,000	Predicted Reduction in Interval Rate per 1,000
40-49	A	0.82 (0.65-1.02)	0.30
	B	1.12 (0.94-1.34))	0.41
	C	2.0 (1.68-2.40)	0.74
	D	2.72 (2.16-3.38)	1.00
50-59	A	0.91 (0.73-1.13)	0.34
	B	1.25 (1.05-1.48)	0.46
	C	2.24 (1.91-2.64)	0.83
	D	3.04 (2.44-3.79)	1.12
60-74	A	1.40 (1.13-1.67)	0.52
	B	1.91 (1.60-2.23)	0.71
	C	3.43 (2.94-3.95)	1.27
	D	4.65 (3.79-5.83)	1.72

Picture 1:

Impact of screening policies and strategies

194 - Oral Presentation

Impacts of Fecal Immunochemical Test Screening on Mortality from Site-Specific Colorectal Cancer

Chiu[1], Jen[2], Wang[3], Hsu[2], Chen[4], Hsu[1], Lee[1], Wu[1], Wu[3], Chou[3], Chen[2]
[1]National Taiwan University Hospital, TAIPEI, Taiwan
[2]College of Public Health, National Taiwan University, TAIPEI, Taiwan
[3]Health Promotion Administration, TAIPEI, Taiwan
[4]Taipei Medical University, TAIPEI, Taiwan

Background: While fecal immunochemical testing (FIT) is well recognized for population-based colorectal cancer screening, the effectiveness of long-term outcomes by anatomical site, has been hardly addressed. We aimed to quantify the impact of FIT on overall and site-specific advanced stage colorectal cancer incidence and mortality over the first decade of Taiwan's screening program.
Methods: The fixed cohort comprised eligible subjects invited to attend first FIT screening between 2004 and 2009. They continued with repeated screens and follow-up until 2014. FIT-positive subjects were offered colonoscopy as a confirmatory exam. The entire cohort was divided into the exposed and unexposed group for evaluation of effectiveness related to incidence of advanced stage and mortality of colorectal cancer.
Results: A total of 3,072,164 (56.6%) out of 5,417,699 eligible screenees attended at least once FIT, and 1,605,200 (52.3%) received more than two tests. Biennial FIT screening after around 10 years of follow-up conferred significant reduction of advanced stage cancer incidence and mortality [48.3 versus 76.8; 20.3 versus 41.1 (per 100,000) in the exposed and unexposed group]. The adjusted effect size of reducing both outcomes were 29% [adjusted relative risk (aRR)=0.71 (0.67-0.74)] and 35% [aRR=0.65 (0.61-0.68)] controlling for age, sex, self-selection, and increasing incidence. The effectiveness was more remarkable for distal [advanced cancer incidence aRR=0.64 (0.60-0.68); mortality aRR=0.60 (0.57-0.64)] than proximal cancers [advanced cancer incidence aRR=0.91(0.83-0.99); mortality aRR=0.78 (0.71-0.86)].
Conclusion:FIT screening was effective in reducing advanced stage of and mortality from colorectal cancer with larger benefit noted in distal colorectal cancer compared with proximal ones.

Impact of screening policies and strategies

198 - Poster Presentation

Trend in performance of mammography screening programs in Switzerland, 2010-15

J.L. Bulliard[1], M Zwahlen[2], J Fracheboud[3]
[1]Lausanne University Hospital (CHUV), LAUSANNE, Switzerland
[2]University of Bern, BERN, Switzerland
[3]Erasmus University Medical Centre, ROTTERDAM, The Netherlands

Background: Mammography screening programs have gradually been implemented in Switzerland between 1999 and 2015 in a context where opportunistic screening and screening strategy vary regionally. This context and the unusual length of the staggered implementation raises challenges for comparison of performance across programs. This study presents the largest and most comprehensive standardized evaluation of utilization, quality and effectiveness of mammography screening programs in Switzerland, and addresses issues of international relevance for comparison of performance between programs in different situations.
Methods: Anonymous screening records of each regional program were obtained, processed and pooled. National performance indicators, which largely follow the European Guidelines (EG), were computed by year (2010-2015), type of screening round (prevalent vs incident) and implementation status (programs in steady state situation vs newer programs). Sensitivity analyses were performed.
Results: By 2015, 10 organized programs covered 12 cantons and 56.5% of the Swiss female population aged 50 to 69 years. Some 480,000 screening examinations were included. Participation and reattendance rates between 2010-12 and 2013-15 decreased, mainly due to the low participation in a large new program. In the prevalent round, performance improved over time but the referral and false-positive rates (73.0 and 66.9/1000 screens, 2013-15) remained slightly higher than recommended in the EG. For the incident round, quality and effectiveness indicators were stable over time and met overall international standards. Inter-program variation was largest for participation and performance in the prevalent round, likely due to regional specificities.
Conclusion: In healthcare systems where screening programs are implemented regionally and at different times, standardized procedures are necessary to improve the quality and comparability of results, and to identify indicators whose values vary widely across programs. Criteria to define and handle outliers' values for indicators, and an approach to improve inter-program comparability in prevalent round are discussed.

Impact of screening policies and strategies

201 - Poster Presentation

Breast density and risk of screen detected and interval breast cancer in a Canadian breast screening program

McGahan, Mar, Sam, DeVries, Coldman
BC Cancer, VANCOUVER, Canada

Background
Breast density is of interest in mammography screening as it is associated with both breast cancer risk and mammographic detection. Research on breast density is most commonly presented as relative risks with control for a range of breast cancer risk factors. In order to develop information of more direct applicability for use in breast screening we present results from the British Columbia breast screening program (BCCBSP).
Method
Data was extracted on women in BCCBSP who with one or more mammogram on which density was recorded (BIRADS) between 2011 and 2015. This data was used to separately estimate the risk of screen detected and interval breast cancer via Poisson regression with age (40-49, 50-59, 60-74), density (A, B, C, D), high risk (1st degree family history yes/no) and interval (<18, 18-30, 30-42 months) as factors.
Results
There were 388,756 women with 622,136 screening intervals in the estimation of rates. The Poisson models all included main effects and some second order interactions. The modeled rates are in the attached table. Risk of screen-detected and interval breast cancer increased with age and first-degree family history. Risk of interval cancer increased with increasing density but showed a non-monotonic relationship to screen-detected risk. Density was more strongly related to interval cancer risk than either age or family history.
Conclusion
Density was a strong predictor of interval cancer risk and for those with the highest density the risk of interval cancer exceeded the rate of screen detected cancer.

Table: Risk of screen detected and interval invasive breast cancer for biennial screening by age, density and risk status.

		No First-Degree Family History of Breast Cancer		First-Degree Family History of Breast Cancer	
Age	Density on Preceding Screen	Rate of Screen Detected Invasive Breast Cancer per 1,000	Rate of Interval Invasive Breast Cancer per 1,000	Rate of Screen Detected Invasive Breast Cancer per 1,000	Rate of Interval Invasive Breast Cancer per 1,000
40-49	A	1.03 (0.67-1.50)	0.78 (0.62-0.96)	2.58 (1.65-3.71)	1.30 (1.01-1.69)
	B	1.29 (0.97-1.64))	1.06 (0.90-1.27)	3.24 (2.45-4.16)	1.76 (1.39-2.23)
	C	1.38 (1.07-1.70)	1.90 (1.59-2.28)	3.47 (2.58-4.32)	3.15 (2.49-3.90)
	D	1.8 (1.25-2.36)	2.57 (2.03-3.15)	4.51 (3.04-6.03)	4.25 (3.27-5.34)
50-59	A	1.64 (1.26-2.04)	0.86 (0.68-1.05)	3.66 (2.80-4.68)	1.42 (1.11-1.83)
	B	1.57 (1.31-1.88)	1.17 (0.97-1.38)	3.50 (2.86-4.24)	1.93 (1.58-2.38)
	C	1.69 (1.41-2.04)	2.08 (1.76-2.45)	3.77 (3.03-4.65)	3.45 (2.80-4.16)
	D	1.36 (0.86-1.97)	2.82 (2.24-3.51)	3.02 (1.90-4.50)	4.66 (3.65-5.91)
60-74	A	2.61 (2.22-3.01)	1.29 (1.04-1.55)	5.87 (5.04-6.79)	2.14 (1.70-2.63)
	B	3.48 (3.07-3.87)	1.75 (1.48-2.06)	7.82 (6.71-9.06)	2.91 (2.38-3.56)
	C	3.34 (2.80-3.97)	3.13 (2.69-3.63)	7.52 (6.29-8.94)	5.19 (4.28-6.20)
	D	2.10 (1.28-3.06)	4.24 (3.40-5.30)	4.73 (2.62-6.94)	7.02 (5.59-8.91)

Picture 1:

Impact of screening policies and strategies

204 - Oral Presentation

Comparing Disease Detection at 48-month Exit Testing in Women with Negative Cytology and Negative HPV at Baseline in the HPV FOCAL Trial

Coldman, Smith, Van Niekerk, Krajden, Gondara, Ogilvie
BC Cancer Research Centre, VANCOUVER, Canada

Background
In many populations HPV testing is replacing cytology for cervical cancer screening with increased interval length. The HPV FOCAL trial compared screening cytology at 24-month intervals to HPV testing at 48-month intervals and confirmed the superior negative predictive value of HPV testing. However, the higher frequency of cytology testing resulted in differences in screening compliance between the two arms. We compare CIN2+ detection at 48-months 48-month co-testing (cytology+HPV) by subgroup within the study arms.
Method
Results for women randomized to the control (cytology) and intervention (HPV) arms with negative screening tests at baseline were utilised. Subgroups within the control arm were constructed based upon screening attendance behaviours and cytology outcomes at 48-month testing. Exit results were extracted at 48-months for those attending screening.
Results
In the control arm 9,074 tested NILM at baseline of which 7,448 attended 24-month and exit co-testing. In the intervention arm 8,769 tested HPV negative of which 7,822 attended exit co-testing. The attached table provides results. HPV exit testing identified more disease than cytology exit testing in both arms and subgroups. Control group subjects missing screening at 24 months had the highest rates of disease at exit. At 48 months, rates of CIN2+ were 4.4/1000 (95%CI 3.2, 6.2) in women with one HPV negative test and 6.6/1000 (4.9, 8.8) in women with 2 consecutive NILM.
Conclusion
Women HPV negative at baseline had lower rates of CIN2+ disease detection at exit than women with cytology negative results at both baseline and 24 months.

Table: CIN2+ detection at 48-months by exit test result and earlier screening results in the intervention and control arms of the HPV FOCAL trial.

Arm	Baseline Result	24 – Month Result	Number Tested at Exit	Rate per 1,000 of CIN2+ Detected at 48 Month Exit Testing Co-testing (95%CI)		
				Detected by Cytology: ≥ASCUS	Detected by HPV: Positive	Detected by Cytology or HPV
Intervention	HPV Neg	N/A	7822	2.3 (1.5-3.7)	4.2 (3.0-5.5)	4.4 (3.2-6.2)
Control	NILM	Not Tested	598	14.4 (7.0-28.3)	17.3 (9.1-32.6)	19.5 (10.6-35.6)
	NILM	No CIN2+ Detected	7448	4.1 (2.9-5.8)	7.1 (5.4-9.3)	7.3 (5.5-9.5)
	NILM	NILM	7252	3.5 (2.3-5.2)	6.6 (4.9-8.8)	6.6 (4.9-8.8)
	NILM	Not NILM but no CIN2+ Detected	80	12.5 (2.2-67.5)	0 (0-45.8.0)	12.5 (2.2-67.5)

Picture 1:

Impact of screening policies and strategies

206 - Oral Presentation

Projected impact of human papillomavirus vaccination on cervical screening outcomes

F Inturrisi[1], BI Lissenberg-Witte[1], NJ Veldhuijzen[1], PJF Snijders[1], G Ronco[2], CJLM Meijer[1], J Berkhof[1]
[1]Amsterdam UMC, Vrije Universiteit Amsterdam, AMSTERDAM, The Netherlands
[2]University Hospital „Città della Salute e della Scienza di Torino„, TURIN, Italy

Background: With the introduction of human papillomavirus (HPV) vaccination as primary prevention for cervical cancer, HPV-based screening programs need optimization in the near future. Population-based data on the impact of vaccination on screening outcomes in the context of HPV-based screening are currently very limited. We predicted the impact of vaccination on the number of screen-detected HPV infections and cervical precancer (CIN3+) detected by a five-yearly HPV-based screening programme and the positive predicted value (PPV) of HPV alone and HPV with cytology testing for CIN3+ under different vaccine scenarios.
Methods: We included 21,287 women from a population-based screening trial with 14 years of follow-up (POBASCAM). We calculated cumulative incidences of screen-detected HPV infections and CIN3+ detected over screening lifetime, and positive predictive value (PPV) of a positive HPV test for CIN3+ as well as a positive HPV test combined with abnormal Pap smear. We re-estimated cumulative incidences and PPV after applying vaccine efficacy under three scenarios: bivalent vaccine, bivalent vaccine with cross-protective efficacy, and nonavalent vaccine.
Results: In total, 858 women had an HPV infection, leading to a cumulative incidence of 25.5%, which decreased to 18.9%, 15.2%, and 10.5% under the three different vaccine scenarios. Screening lifetime incidence of CIN3+ was 4.0% in absence of vaccination and decreased to 1.3%, 0.66%, and 0.18%. PPV for CIN3+ of HPV testing alone decreased from 15.8% in absence of vaccination to 10.0% and 4.5% following bivalent and nonavalent vaccination. In combination with abnormal cytology, the PPV decreased from 44.1% to 27.3% and 16.9%.
Conclusion: In the context of HPV-based screening, substantially lower cumulative incidences of screen-detected HPV infections and CIN3+ must be expected in vaccinated women compared to unvaccinated. HPV vaccination further reduces screening efficiency reflected by the PPV of HPV testing, stressing the need for a screening program with differential risk of disease.

Impact of screening policies and strategies

209 - Poster Presentation

Predicted impact of Canadian recommendations for colorectal cancer screening in those with a family history of colorectal cancer

Coldman[1], Yong[2], Fitzgerald[2], Memon[2], Iragorri[2], Flanagan[3], Nadeau[3]
[1]BC Cancer Research Centre, VANCOUVER, Canada
[2]Canadian Partnership Against Cancer, TORONTO, Canada
[3]Statistics Canada, OTTAWA, Canada

Background: Colorectal cancer (CRC) is one of the most common causes of cancer-related deaths in Canada. Most jurisdictions in Canada screen for CRC by fecal immunochemical test every two years (biennial FIT) for those between ages 50-74 years, but for individuals with a family history screening practice varies. The 2018 Canadian clinical guideline recommends screening individuals who had first degree relatives diagnosed with CRC (FH) with colonoscopy every 5-10 years, starting at age 40 years. The objective of this analysis was to predict the impact of the new guideline.
Method: OncoSim-CRC models the natural history and progression of adenomas and CRC and is calibrated to the Canadian population. Using OncoSim-CRC, we simulated a 1968 birth cohort to compare two strategies: (i) colonoscopy every 5 years for half of the FH individuals between ages 40-74 years (elevated risk), and the remaining population biennial FIT at age 50-74 years (average risk); and (ii) average risk screening strategy for everyone. We assumed 60% participation rate among those invited to average risk screening. We compared incidence and mortality of CRC, incremental cost per quality-adjusted life-year (QALY) gained and total colonoscopies between the two strategies. Cost and QALYs were discounted at 1.5%; costs are in CAD (2018).
Results: The family history-based screening strategy was more effective in preventing CRC and CRC-deaths than offering biennial FIT to everyone, regardless of their CRC family history. It was projected to prevent one-third of CRC cases and deaths (1160 fewer cases and 400 fewer CRC-deaths) in the 1968 Canadian cohort, but required more colonoscopies. We estimated that the family history-based screening strategy would cost $98 more per QALY gained.
Conclusion: Colonoscopy screening every 5 years for individuals with FDR diagnosed with CRC is likely cost-effective and could be considered in screening programs if colonoscopy capacity permits.

Impact of screening policies and strategies

210 - Poster Presentation

THE DEVELOPMENT AND USE OF AN ONLINE MONITORING AND EVALUATION TOOL FOR BREAST, COLORECTAL AND CERVICAL CANCER SCREENING PROGRAMMES

I.M.C.M. De Kok[1], Jansen[1], Gini[1], Zielonke[1], Senore[2], A. Anttila[3], Ivanuš[4], Van Ravesteyn[1], Lansdorp-Vogelaar[1], De Koning[1]
[1]Erasmus Medical Center Rotterdam, ROTTERDAM, The Netherlands
[2]CPO Piemonte, TURIN, Italy
[3]Finnish Cancer Registry, HELSINKI, Finland
[4]Institute of Oncology Ljubljana, LJUBLJANA, Slovenia

Background
The EU-TOPIA project aims to decrease the breast, colorectal and cervical cancer burden across Europe, by optimizing screening programmes. We will identify more efficient screening programmes by systematically monitoring and evaluating screening programmes in all European countries. For this purpose we will develop an online evaluation and monitoring tool.
Methods
An indicator-set to collect information on screening practices and (short-term) effects of a screening programme was developed, partly based on the set used in the EU guidelines for quality assurance of cervical cancer screening. An online monitoring tool was developed to measure these indicators. To estimate the long-term effects of different screening protocols, an online version of the microsimulation model MISCAN was developed (i.e. the evaluation tool) for the three cancer sites. This tool automatically uses data collected in the monitoring tool. Both tools are first tested in 4 exemplary countries, before they are used by delegates of all European countries.
Results
Per cancer site, we have collected data for 9 demographical/epidemiological and 12 screening indicators, for Slovenia, Italy, Finland and the Netherlands. Based on the data collected, we have for all three cancer sites developed 4 different regional MISCAN models that fitted the data well and are now incorporated in the evaluation tool. Participants in most European countries used the monitoring tool to collect data. In September 2018, delegates of all European countries worked with the evaluation tool to simulate the long-term impact of different screening programmes in their country.
Conclusions
We were able to develop two effective online tools that are used to monitor and evaluate breast, colorectal and cervical cancer screening practices and effects in all European countries. With this tool we collected a wealth of information that is necessary for the improvement of cancer screening programmes in Europe.

Impact of screening policies and strategies

214 - Poster Presentation

The OncoSim Cancer Simulation Model: Experiences and issues in the development and maintenance of an online population-based cancer planning tool for Canada

Coldman[1], Yong[2], Fitzgerald[2], Memon[2], Iragorri[2], Flanagan[3], Nadeau[3]
[1]BC Cancer Research Centre, VANCOUVER, Canada
[2]Canadian Partnership Against Cancer, TORONTO, Canada
[3]Statistics Canada, OTTAWA, Canada

Background: Simulation models are important tools for evaluating potential cancer screening strategies and interventions aimed to improve screening effectiveness. While cancer model projections could help inform screening policies, developing these complex models is resource-intensive and the results may not be timely for informing policy decisions. OncoSim is a web-based cancer simulation tool that is available for free to registered users and was developed by the Canadian Partnership Against Cancer (CPAC) and Statistics Canada. It is a natural history-based model that projects cancer rates, deaths, resources and costs in several cancers (breast, cervical, colorectal and lung cancers).
Results:
Over the last five years, OncoSim has been used for evaluating screening-related interventions in breast, cervical, colorectal and lung cancers across Canada. CPAC actively works with its partners to promote the use of OncoSim in informing policy decisions. The modeling team in Statistics Canada develops and maintains the models with input from experts in cancer screening, clinical epidemiology, health economics and oncology. In this session, we will share our experience in developing and maintaining a cancer simulation tool aimed to inform policy decisions. We will discuss governance structure to effectively elicit input from experts, strategies to engage users and promote adoption among policy makers, efforts to calibrate models using emerging real-world data and updating the models to reflect evolving screening pathways, strategies, and downstream cancer treatment costs. In addition, we will indicate our challenges in keeping the models current and useful for policy makers.
Conclusion: OncoSim has proven to be a useful model but its maintenance for use by a diverse user group continues to be challenging.

Impact of screening policies and strategies

220 - Poster Presentation

The potential of breast cancer screening in the EU

N. Zielonke, Kregting, Van Ravesteyn, Heijnsdijk, De Kok, De Koning
Erasmus MC, University Medical Center Rotterdam, ROTTERDAM, The Netherlands

Background
The European Commission strongly recommends biennial mammography screening for early detection of breast cancer in asymptomatic women aged 50 and 69, based on the evidence that breast cancer screening reduces breast cancer mortality. At present, all EU countries have some form of screening for breast cancer. Nevertheless, disparities exist in terms of the status of implementation, attendance, and the extent to which screening programmes coexist with opportunistic screening activities.
In this study we examined how many deaths could be prevented if all 28 EU-countries would screen for breast cancer according to the EU-guideline.
Methods
Assuming similar effectiveness of organised and opportunistic screening, we calculated for each country the number of breast cancer deaths which have already been prevented due to screening as well as the number of breast cancer deaths which could be additionally prevented if the total examination coverage (organized plus opportunistic) would reach 100%. The calculations are based on total examination coverage in the target age range, breast cancer mortality deaths for women aged 50-75 years old (both obtained through information provided by users of the EU-TOPIA evaluation tool and expert opinion, for the latest available year), and the maximal possible mortality reduction (based on high quality observational studies).
Results
For the 28 EU countries, more than 30.000 breast cancer deaths were already prevented per year due to recent mammography screening. If all countries would reach a 100% examination coverage, 15.000 additional breast cancer deaths could be averted annually.
Conclusions
This study illustrates that through further optimising screening coverage, the number of breast cancer deaths of European women could be further reduced significantly.

Impact of screening policies and strategies

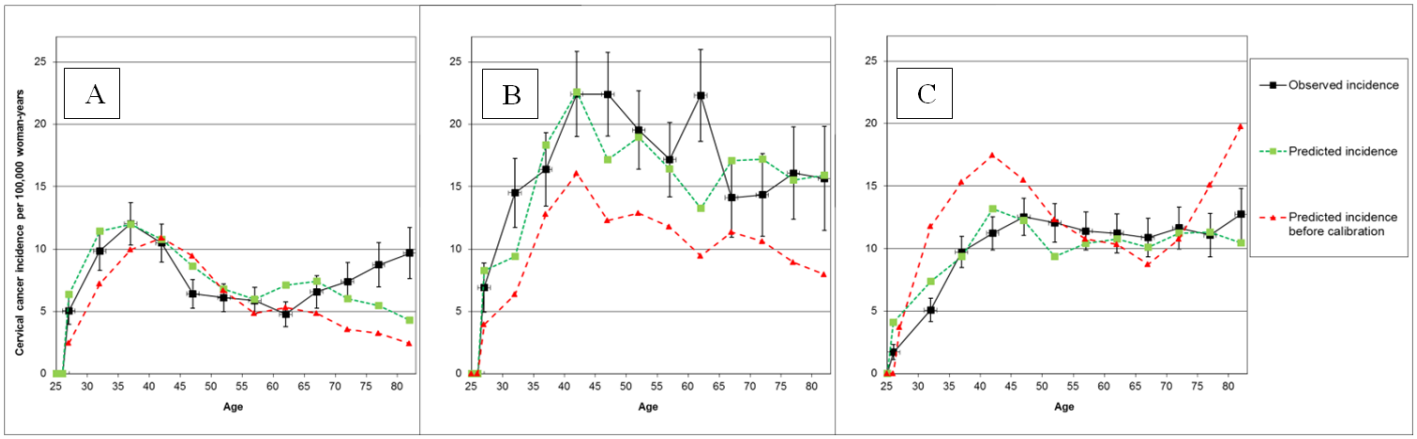
222 - Poster Presentation

THE DEVELOPMENT OF MICROSIMULATION MODELS TO PREDICT OUTCOMES OF CANCER SCREENING FOR DIFFERENT EUROPEAN COUNTRIES

E.E.L. Jansen[1], A. Gini[1], N. Zielonke[1], U Ivanuš[2], A Anttila[3], M. Csanádi[4], C. Senore[5], N. Segnan[5], P. Veerus[6], S. Heinävaara[3], N.T. van Ravesteyn[7], I. Lansdorp-Vogelaar[1], H.J. de Koning[1], I.M.C.M. de Kok[1]
[1]Erasmus MC, ROTTERDAM, The Netherlands
[2]Institute of Oncology Ljubljana, LJUBLJANA, Slovenia
[3]Finnish Cancer Registry, HELSINKI, Finland
[4]Syreon Research Institute, BUDAPEST, Hungary
[5]CPO Piemonte, City of Health and Science University Hospital, TURIN, Italy
[6]National Institute for Health Development, TALLINN, Estonia
[7]Erasmus University Medical Center, ROTTERDAM, The Netherlands

Background
The aim of the EU-TOPIA project is to improve health, by evaluating and optimizing breast, cervical, and colorectal cancer screening programmes in all European countries using region-specific microsimulation models. In this study we describe how we proceeded in developing those models.
Methods
A stepwise process was applied to develop European region-specific models. For each cancer site, we started using a well validated microsimulation screening analysis (MISCAN) model already developed for the Netherlands (Western Europe); we adjusted all observable parameters, such as demographic characteristics to the region-specific exemplary country (i.e. Italy, Finland and Slovenia for South, North and East, respectively); we calibrated a selection of parameters most likely to be different between regions; we internally validated the model by comparing various outcomes with observed data from the exemplary country. Finally, we externally validated the models using published evidence data on screening effectiveness.
Results
Before calibration, the Dutch MISCAN models did not fit the observed data of the exemplary countries well. For example, for cervical cancer, the predicted age-specific incidence was different than observed in all three regions. The calibrations mainly changed the background risk to improve the fit with the observed data (Figure 1), resulting in a satisfying fit for all three cancer sites in all European regions.
Conclusion
With the newly developed models we are able to predict screening effects for four different European regions. Using the stepwise process, more insight is gained in how parameters vary between regions and differences in screening effects can be explained more easily.

Picture 1:



Caption 1: Figure 1. The improvement of the model fit of cervical cancer incidence in Northeren (A), Eastern (B) and Southern (C) Europe

Impact of screening policies and strategies

233 - Poster Presentation

A method to model colonoscopy utilization to inform fecal immunochemical test implementation in an organized colorectal cancer screening program

Tinmouth[1], Ieraci[2], Vahid[2], Dube[2], McCurdy[2], Esensoy[2], Paszat[3], Hilsden[4]
[1]Sunnybrook Research Institute, TORONTO, Canada
[2]Cancer Care Ontario, TORONTO, Canada
[3]Institute for Clinical Evaluative Sciences, TORONTO, Canada
[4]University of Calgary, CALGARY, Canada

Purpose: The fecal immunochemical test (FIT) is better at detecting colorectal neoplasia and leads to greater participation than the guaiac fecal occult blood test (gFOBT). The implementation of FIT in Ontario, Canada may result in increased demand for colonoscopy services compared to the current gFOBT-based screening program. The objective of this project was to develop a mathematical model to predict colonoscopy utilization in order to inform FIT implementation in Ontario's organized colorectal cancer screening program.
Methods: We developed a model to project the number of colonoscopies required for each of Ontario's 14 health regions based on key parameters and assumptions: eligible screening population proportions by health region; screening participation rates; FIT positivity rate; follow-up colonoscopy compliance rate based on historical data; and surveillance colonoscopy rates derived from experience with FIT in another Canadian province (Alberta). Several scenarios were modelled to estimate the increased colonoscopy utilization that would result from FIT implementation compared to gFOBT over 2017–2021.
Results: Scenarios were modelled incorporating projected surveillance colonoscopies and varying participation from 40–60%, FIT positivity rates from 5–10%. Shortfalls in colonoscopy capacity in the 14 health regions varied depending on the scenario. In 2019, there were no shortfalls at 5% positivity for 40% and 50% participation rates while at 10% positivity and 60% participation, 13 of 14 LHINs had shortfalls.
Conclusions: We present a mathematical model that relies on key parameters to estimate the increased colonoscopy utilization anticipated with FIT. Using this model, program planners can identify target FIT positivity rates/thresholds based on the local colonoscopy resource, ensuring timely access to colonoscopy.

Impact of screening policies and strategies

236 - Poster Presentation

The PROSPR Research Network: An Initiative for Studying Cancer Screening in United States Community Settings

VP Doria-Rose[1], EF Beaber[2], ES Breslau[1], J Chubak[3], DA Corley[4], CA Doubeni[5], RT Greenlee[6], JS Haas[7], SA Honda[8], A Kamineni[3], CI Li[2], PM Marcus[1], C Neslund-Dudas[9], DP Ritzwoller[10], JE Schottinger[11], CS Skinner[12], JA Tiro[12], Y Zheng[2]
[1]National Cancer Institute, BETHESDA, United States of America
[2]Fred Hutchinson Cancer Research Center, SEATTLE, United States of America
[3]Kaiser Permanente Washington, SEATTLE, United States of America
[4]Kaiser Permanente Northern California, OAKLAND, United States of America
[5]University of Pennsylvania, PHILADELPHIA, United States of America
[6]Marshfield Clinic Research Institute, MARSHFIELD, United States of America
[7]Partners HealthCare, BOSTON, United States of America
[8]Kaiser Permanente Hawaii, HONOLULU, United States of America
[9]Henry Ford Health System, DETROIT, United States of America
[10]Kaiser Permanente Colorado, AURORA, United States of America
[11]Kaiser Permanente Southern California, PASADENA, United States of America
[12]University of Texas Southwestern, DALLAS, United States of America

BACKGROUND: Cancer screening is not a single test, but a complex process involving multiple steps including eligibility determination; screening invitation, delivery, and test interpretation; diagnostic follow-up; and treatment referral. Since screening in the United States (US) is generally delivered opportunistically rather than through an organized program, there is considerable heterogeneity in participation in and completion of the screening process across different healthcare delivery systems. Funded by the US National Cancer Institute, the Population-based Research to Optimize the Screening PRocess (PROSPR) network was designed to evaluate patient, provider, clinic, and organizational factors that affect screening processes, to address breakdowns and promote improvement.
METHODS: Three PROSPR Research Centers (one each for cervical, colorectal, and lung cancer screening) were funded in April 2018. Each center includes 3-5 data-contributing sites representing heterogeneous healthcare delivery systems and diverse patient populations. Participating sites collect data from electronic health records, administrative databases, and cancer registries, for use in research projects designed to better understand and improve delivery of screening services. Specific focus areas include organizational factors affecting the screening process, screening quality measures, and health disparities.
RESULTS: PROSPR includes over 3.7 million individuals, screened and unscreened, at 10 healthcare systems across the US. Data include approximately 1 million screening and diagnostic examinations and 3600 incident cancers annually, with longitudinal data starting in 2010 (Table).
CONCLUSIONS: PROSPR provides an opportunity to improve cancer screening by evaluating multilevel characteristics that promote successful completion of the screening process in diverse healthcare systems. We welcome opportunities to collaborate internationally.

Picture 1:

	Cervical	Colorectal	Lung
Health Systems	Partners HealthCare (Massachusetts) Kaiser Permanente Washington Parkland Health & Hospital System (Texas)	Kaiser Permanente Northern California Kaiser Permanente Southern California Kaiser Permanente Washington Parkland Health & Hospital System (Texas)	Henry Ford Health System (Michigan) Kaiser Permanente Colorado Kaiser Permanente Hawaii Marshfield Clinic (Wisconsin) University of Pennsylvania Health System
Ages included in cohort	18-89 years	50-89 years[b]	35-89 years
Cohort size[a]	440,100	2,264,600	1,010,000
Tests[a]	129,200 cytology 17,300 hrHPV DNA 7,600 colposcopies 1,000 excisional treatments	633,600 FIT/FOBT 143,600 colonoscopies 42,100 sigmoidoscopies	3,560 LDCT
Incident cancers[a]	70	2,360	1,170

PROSPR research is supported by a coordinating center based at the Fred Hutchinson Cancer Research Center, Seattle, Washington

[a] Numbers are for a single year, 2010 for cervical and colorectal and 2016 for lung.

[b] Additional data collection is planned for individuals aged 40-49 years.

Caption 1: Table. Characteristics of the 3 PROSPR II Research Centers

Impact of screening policies and strategies

242 - Poster Presentation

Cumulative risk of metastasis: a more comprehensive indicator of screening benefit than metastasis at diagnosis

Lange, Gulati, Etzioni
Fred Hutchinson Cancer Research Center, SEATTLE, United States of America

Background: One of the primary indicators of the benefit of cancer screening is a reduction in the incidence of de novo metastatic disease. However, this does not account for progressive cases that may develop after screen diagnosis; including such cases may attenuate the effect of screening inferred solely from de novo metastatic incidence. As a more comprehensive metric of impact of screening, we propose use of the cumulative probability of metastasis (CPM) that includes both de-novo and progressive cases.
Methods: We develop a simulation modeling framework that combines information on de novo stage at diagnosis from a screening trial with risk of metastasis after localized diagnosis from a treatment trial. We use this framework to project CPM in the screening and control arms of the European Randomized Study of Screening for Prostate Cancer (ERSPC). Given disease stage at diagnosis in the screening and control arms of the trial, we project the post-diagnosis incidence of metastatic progression on each arm using data on time to metastatic progression from the SPCG4 trial of primary surgery for localized prostate cancer.
Results: Difference in CPM between screening and control arms is .004 at diagnosis and .001 after 15 years of follow-up. These results are consistent in direction with empirical findings from the ERSPC that suggested a 50% reduction in hazard de novo disease versus a 30% reduction in hazard of CPM at 12 years.
Conclusion: Metastasis is a key end point that impacts both quality of life and cancer mortality. The difference in CPM under screening provides a more comprehensive picture than de novo metastasis of the burden of metastatic disease in screened and unscreened populations.

Impact of screening policies and strategies

243 - Oral Presentation

QUANTIFYING THE BENEFIT-HARM TRADEOFFS OF CERVICAL CANCER SCREENING IN THE UNITED STATES: A COMPARATIVE MODELING STUDY

J Kim[1], K Canfell[2], M van Ballegooijen[3], I de Kok[3], F Alarid[4], E Burger[1], N Campos[1], E Dowling[1], E Groene[4], J Killen[2], C Regan[1], E Sanstead[4], K Simms[2], M Smith[2], S Sy[1], S Kulasingam[4]
[1]Harvard TH Chan School of Public Health, BOSTON, United States of America
[2]Cancer Council New South Wales, SYDNEY, Australia
[3]Erasmus Medical Center, ROTTERDAM, The Netherlands
[4]University of Minnesota School of Public Health, MINNEAPOLIS, United States of America

Background. In order to inform screening guidelines in the United States, we evaluated the benefits, harms, and cost-effectiveness of cervical cancer screening strategies through comparative modeling as part of the Cancer Intervention and Surveillance Modeling Network (CISNET) consortium.
Methods. Four independent microsimulation models were calibrated to U.S. epidemiological data but varied in underlying structures and assumptions about the carcinogenic process. Screening strategies included cytology alone, HPV testing alone, and cytology plus HPV "cotesting," varying age to switch from cytology to HPV or cotesting (25, 27, 30 years), re-screening interval (3, 5 years), and management of screen-positive women (diagnostic colposcopy, surveillance). Women were screened from ages 21 to 65 years, and full adherence was assumed for all strategies. Outcomes included measures of benefits (cancer reduction, life years), harms (colposcopies, false positives), costs, and cost-effectiveness.
Results. Compared with guidelines-based cytology testing, strategies involving primary HPV testing alone were estimated to have higher effectiveness in terms of cancer reduction and life-years gained when administered every 3 years (in all models) or every 5 years (in 3 of 4 models), irrespective of switch age; results were more variable across models when life years were quality-adjusted. Accordingly, colposcopy rates and costs were generally higher with 3-year HPV testing (all models), but lower with 5-year HPV testing (in 3 of 4 models) than cytology alone. Cotesting strategies were associated with higher colposcopies and costs but similar effectiveness compared with HPV testing alone; as a result, strategies involving cotesting were not cost-effective. All models identified 5-year HPV testing as a cost-effective strategy, but the preferred switch age varied across models.
Conclusions. In this comparative base-case analysis involving four independent models, screening with HPV testing alone was found to potentially improve health, reduce harms, and/or be cost-effective compared to strategies involving cytology alone or cotesting.

Impact of screening policies and strategies

250 - Oral Presentation

IARC Handbooks of Cancer Prevention - future perspectives

Beatrice Lauby-Secretan
IARC, LYON, France

The *IARC Handbooks* is one of the core programmes of the International Agency for Research on Cancer, providing policymakers and regulatory agencies worldwide with reliable evaluations of interventions and strategies that can reduce the risk of cancer. These evaluations are a first step to support public health recommendations and cancer prevention strategies.
The Working Procedures to the *IARC Handbooks* describe the principles and procedures used in developing IARC Handbooks, including the scientific criteria that guide the evaluations. In February 2019, IARC will convene an Advisory Group to make recommendations to amend the Working Procedures to the IARC Handbooks. The objective is to reflect on recent procedural changes and scientific developments. Advisory Group Members will prepare and review preliminary documents regarding the Working Procedures to the *IARC Handbooks* and participate in a 3-day meeting. IARC issued a public call for nominations for scientists who wished to be considered for membership in the Advisory Group. IARC then selected Advisory Group members based on (a) knowledge and experience, and (b) absence of real or apparent conflicts of interests. Consideration was also given to demographic and gender diversity. Topics covered may include: transparency in the application of principles of systematic review methods; transparency in the review and use of published meta-analyses, and possibility of performing ad-hoc analyses as appropriate; use of studies investigating intermediate end-points (biomarkers); quality assessment of human experimental (RCT) and human observational data; review and use of cost-effectiveness studies; assessment of studies in high-risk individuals, including those in which risk is quantified primarily by polygenic risk scores; scientific issues specific to the primary target of the preventive intervention: individual, defined community sub-group, whole community and whole population (e.g. interventions at the regulatory or fiscal level).
The outcome of the meeting will be presented at the conference.

Impact of screening policies and strategies

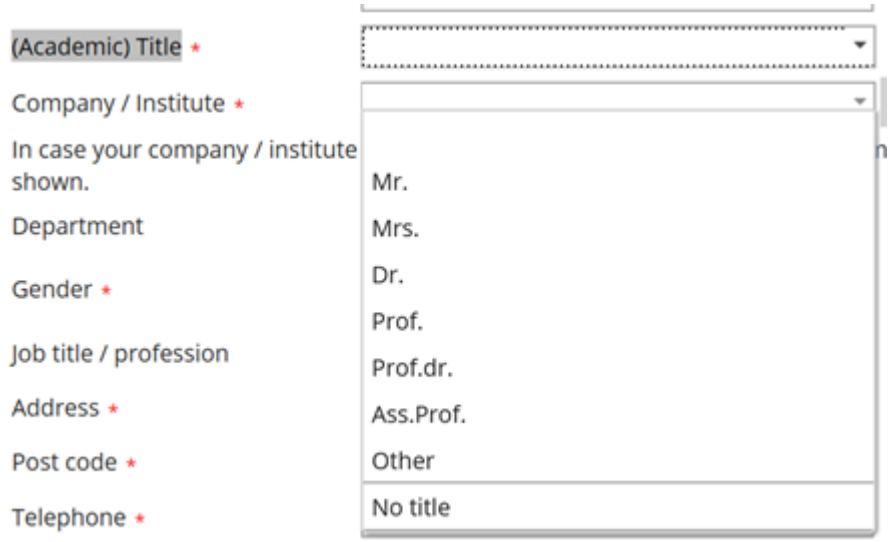
267 - Oral Presentation

Priority Setting in Scaled-up Cancer Screening in China: An Integrated Systematic Review of Economic Evaluation Evidences

Shi[1], Liu[1], Wang[1], Wang[1], Bai[1], Huang[1], Zhu[1], Li[1], Zhang[2], Feng[2], Bai[2], Li[1], Dai[1], Chen[1]
[1]National Cancer Center, BEIJING, China
[2]Chinese Academy of Medical Sciences and Peking Union Medical College, BEIJING, China

BACKGROUND
Screening efficacy and population acceptance varied among different cancers, priority setting in cancer types could be considered in scaled-up screening with limited budget. The existing economic evaluations of screening focused on single cancer type, however, evidence on parallel comparison among multiple cancers is lacking in China.
METHODS
Partially based on our previous individual systematic reviews (colorectal, breast, liver and lung cancer), evidence of economic evaluations of cancer screening in populations in mainland China (2009-2018) were systematically updated. All cost was presented in US$ and discounted to 2017 value. The ratios of incremental cost-effectiveness ratio (ICER) compared with no-screening to China's GDP per capita in 2017 were calculated.
RESULTS
A total of 44 studies were included, 23 for breast cancer, 15 for colorectal cancer, 5 for lung and 1 for liver cancer. The 'cost per cancer detected' was the mostly adopted indicator (33 studies); the individual median (p25-p75) was $7,300 ($4,107-10,652) for colorectal cancer among 27 screening strategies, $25,464 ($18,883-44,596) for breast cancer (n=24), and $189,640 ($122,427-300,741) for lung cancer (n=5). Indicator of ICER was observed in two cancer types, the median ratio of 'cost per life year saved' (LYS) to 'GDP per capita' was 0.30 (p25-p75: 0.01-0.47) for colorectal cancer (n=12) and 3.57 (0.41-5.38) for breast cancer (n=32). The same ranking but more favorable ratio of ICER/per capita GDP was observed in per 'quality-adjusted life years' (QALY) gained, with the results of 0.004 (0.002-0.005) and 2.33 (0.77-7.70) for colorectal cancer and breast cancer, respectively. Results on cost per 'disability-adjusted life years' (DALY) avoided was not reported.
CONCLUSION
The preliminary analysis suggests that colorectal cancer could be given priority in future scaled-up screening, compared to other 3 included cancers. This priority setting will be updated if this analysis is extended to more common cancers, including cervical, stomach and esophageal cancer.

Picture 1:



Impact of screening policies and strategies

269 - Poster Presentation

Modelling Natural History of Liver Cancer for Economic Analysis of Screening Interventions in China

Bai, Wang, Wang, Zhao, Chen, Dai, Qu, Shi
National Cancer Center, BEIJING, China

BACKGROUND
Modelling study for economic evaluation on liver cancer screening was limited in China. To make a comprehensive evaluation, a high-validated natural history model was needed.
METHODS
A new Markov model was built to simulate the natural history of liver cancer progression. Model structure was ascertained by review of official guidelines and other literatures at home and abroad. Model parameters such as initial distributions and transition probabilities were obtained from literatures or by assumption when data was not available. The model calibration targets included age-standardized incidence and mortality of liver cancer as well as its stage distribution, according to local data from the National Cancer Registry and other public databases in Chinese population.
RESULTS
The preliminarily constructed model on natural history of liver cancer included state of full health, HBV infection, compensated cirrhosis, decompensated cirrhosis and liver cancer. Four clinical stages were considered for cancer state, based on the TNM staging system (the AJCC 7th Edition, 2009) and local data available. The age-standardized incidence and mortality of liver cancer predicted by the model were 41.59/100 000 and 33.31/100 000; the corresponding values were 41.52/100 000 and 35.43/100 000 from the local registry, respectively. Proportion of stage-I liver cancer was predicted as 25.1% by the model (26.7% from a nationwide epidemiological survey).
CONCLUSION
A multi-target calibrated model for liver cancer in population in China was preliminarily developed, which will become a platform for future cost-effectiveness evaluation of liver cancer screening alone and HBV vaccination combined.

Impact of screening policies and strategies

275 - Poster Presentation

Estimating the public health impact of a national guideline on cervical cancer screening: an audit study of a program in Campinas, Brazil

DB Vale, TL Menin, JB Bastos, JC Teixeira, MK Bonas, LC Zeferino
Unicamp, CAMPINAS, Brazil

Background
A Brazilian guideline on cervical cancer screening was released in 2011. The objective of this study was to verify changes in screening indicators around this period.
Methods
An audit study which sample was all screening tests performed by the public health system of Campinas city from 2010 to 2016. Variables were absolute tests numbers, excess tests, intervals and results, by age. For trend analysis was used Cochran-Armitage x2 and linear regression.
Results
Were carried out 62,925 tests in 2010 and 43,523 tests in 2016, a tendency at a reduction (P=0.001). Excess tests were higher than 50% over the years, with a tendency at a reduction (P<0.001). Tests performed on women under 25 ranged from 20.2% to 15.4% (P<0.001), while in the 25-64 years age-group, it ranged from 75.1% to 80.2% (P<0.001) in the period. In 2010 the most frequent interval was annual (47.5%) and in 2016 biennial (34.7%). There was a tendency at a reduction in the proportion of tests performed at the first time and those with an annual interval (P<0.001), and also a tendency at an increase in tests with intervals equal to or greater than biannual (P<0.001). We observed a tendency at a reduction in LSIL and HSIL-CIN2 results (P=0.04 and P=0.001, respectively), and a tendency at an increase in HSIL-CIN3 result (P=0.02).
Conclusion
The proportion of cervical cancer screening tests performed out of the recommendation showed a significant reduction in the period. This indicates a tendency to align cervical cancer screening in Campinas with the standards recommended.

Individualized screening

18 - Poster Presentation

Individualized breast cancer risk prediction models in average-risk women: a systematic review and quality assessment

Posso[1], Louro[2], Román[1], Domingo[1], Castells[1], Sala[1]
[1]IMIM (Hospital del Mar Medical Research Institute), Barcelona, Spain., BARCELONA, Spain
[2]Research Network on Health Services in Chronic Diseases (REDISSEC), BARCELONA, Spain

Background: Individualized prediction models can predict whether a woman would develop breast cancer in a defined period and therefore they are key to planning risk-based screening approaches. Although these models are widely used in clinical context, organized programs do not routinely use them. Our aim was to conduct a systematic review and quality assessment of the individualized breast cancer risk models addressed to average-risk women.
Methods: We followed the methods of the Cochrane Collaboration and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement, searching in Medline, EMBASE and The Cochrane Library databases up to February 2018. We included studies published in English. We used the ISPOR-AMCP-NPC Questionnaire to assess the risk of bias of included studies. Study quality was assessed by two independent reviewers and disagreements were solved by consensus. Key study characteristics and methodological quality are described in tables and summarised in a narrative manner.
Results: We included 22 studies out of the 2974 citations initially retrieved. Seventeen studies were based on three models, the Gail, the Breast Cancer Surveillance Consortium (BCSC), and the Rosner & Colditz model, whereas five studies addressed other original models. The BCSC and the Tyrer-Cuzick model were the only ones that included genetic information. Studies addressing the Gail model reported the area under the receiver operating characteristic curve (AUROC) values that ranged from 0.56 to 0.68. Breast density, benign breast disease, and polygenetic score were predominant in the BCSC model, which achieved AUROC values of 0.64 to 0.67. A maximum AUROC value of 0.71 was reported in the only study conducted in a screening context. The quality of the studies was moderate with few limitations in the discriminative power and data inputs.
Conclusions: Individualized risk prediction models show promising results as tools for planning risk-based breast cancer screening strategies.

Individualized screening

20 - Poster Presentation

An individualized breast cancer risk prediction model to personalize mammographic screening

Roman[1], Louro[1], Posso[1], Sala[1], Quintana[2], Castells[1]
[1]Hospital del Mar Medical Research Institute (IMIM), BARCELONA, Spain
[2]Biomedical Research Institute Sant Pau (IIB Sant Pau), BARCELONA, Spain

Background: Individualized breast cancer prediction models are key for planning risk-based screening approaches. We specifically developed and validated a model to estimate the biennial absolute risk of breast cancer for women targeted for mammography screening.
Methods: We analyzed data from 121,969 women aged 50-69 years screened in two areas of the Spanish Breast Cancer Screening Program 1995-2015, followed-up until 2017. We used partly conditional Cox regression to estimate the hazard ratios (HR) associated with age, family history of breast cancer, previous benign breast disease (BBD), and previous mammographic features. We estimated the biennial absolute risk of breast cancer for each woman age 50-69 based on their personal characteristics. We used 60% of the population to develop the model, and the remaining 40% for validation. The area under the receiver operating characteristic (AUROC) was used to assess discriminatory power.
Results: The mean follow-up was 7.6 years. An increased risk was observed in women with a family history (HR=1.34), previous calcifications (HR=3.19), and previous proliferative benign breast disease (HR=2.88). The overall cumulative risk increased from 0.25% at 2-years to 5.32% at 20 years. The highest risk was found in women with a previous proliferative BBD without atypia, and proliferative BBD with atypia, with 23.3% and 35.9% absolute risk at 20 years, respectively. The Expected/Observed ratio was not significantly different from 1 for any prediction. It ranged from 0.93 (95%CI: 0.81-1.07) for 2-year to 1.05 (95%CI: 0.99-1.12) for 20-year risk estimates. The time-adjusted AUROC ranged from 57.8% to 58.3% for 2-year and 20-year estimates.
Conclusion: We developed an individual breast cancer risk prediction model for women targeted for mammography screening, although the model had modest discrimination power. Individualized prediction models including mammographic density and genetic variations are needed to improve the utility of risk prediction models to personalize breast cancer screening strategies.

Individualized screening

21 - Poster Presentation

A systematic review of personalized breast cancer screening strategies.

Roman, Domingo, Posso, Louro, Castells, Sala
Hospital del Mar Medical Research Institute (IMIM), BARCELONA, Spain

Aim: To systematically review studies assessing personalized breast cancer screening strategies.
Methods: The standard methods of the Cochrane Collaboration and PRISMA declaration were used, searching in *Medline*, *EMBASE* and *Clinical Trials* databases. We included studies published in English whose main objective was to assess personalized breast cancer screening strategies. The ISPOR-AMCP-NPC Questionnaire was used to assess quality of studies. Two independent reviewers screened full-texts and evaluated the risk of bias.
Results: Out of the 1119 initially retrieved citations, 63 studies were reviewed for full-text and 12 were included in the summary. Three of the studies were randomized controlled trials, and nine were mathematical modeling studies. The three trials are in the recruitment phase and its results are not available yet. Two are non-inferiority randomized trials, and the other is a randomized pragmatic adaptive study. All three include breast density and age to define risk groups, and two include family history, previous biopsies, and genetic information. The trials had a low risk of bias and were assessed has good quality studies.
Mathematical modeling studies were published between 2011 and 2018, and had a wide heterogeneity across studies. The age of the reference population varied between 30 years at onset and 90 years at completion. The main risk factors evaluated were age, breast density, family history, and previous biopsies. Three models also included genetic information. The most common outcome measures were the gain in quality-adjusted life years and costs. The quality was considered adequate with moderate to low risk of bias. All models showed favorable results for personalized screening strategies in terms of effectiveness.
Conclusion: Randomized controlled trials will assess personalized strategies, but have not yet presented results. Mathematical modeling studies showed evidence in favor of screening personalization. However, they do not consider the feasibility nor acceptance by the target population.

Individualized screening

22 - Poster Presentation

INTERVAL COLORECTAL CANCERS IN POPULATION SCREENING PROGRAMS

Molina-Barceló, Vanaclocha-Espi, Ibáñez, Salas
FISABIO-Salud Pública, VALENCIA, Spain

Introduction: Interval cancer (IC) is an adverse effect of population screening programs. The aim is to compare the characteristics of IC and colorectal cancers detected in screening (SC), and to determine the optimal cut-off of Fecal Immunochemical Test (FIT) to improve the balance between benefits and harms.
Methods: All screening tests (664,693) performed in 6 Spanish colorectal cancer screening programs (Canary Islands, Murcia, Basque Country and Valencian Community) were studied from each program´s implementation date to december 2012. Tumor characteristics were described for IC and SC. The fecal hemoglobin concentration (f-Hb) optimal cut-off level to detect cancer was estimated using ROC curves by sex and age. Outcome measures such as sensitivity, specificity, false positive (FP) and positive predictive value (PPV) were estimated for different f-Hb cut-off levels.
Results: The tumor stage I was more frequent in SC than in IC (SC:48.7%, IC:17.0% in women; SC:52.1%, IC:17.7% in men). Higher percentage of people with more than 3 lymph nodes affected was found in IC (SC:11.9%, IC:26.5% in women; SC:10.7%, IC:29.0% in men) as well as of tumors located in the cecum (SC:7.9%, IC:16.9% in women; SC:4.9%, IC:14.9% in men). From all the IC 21.8% had f-Hb=0µg and 8.8% f-Hb=15-19.9µg. PPV and sensitivity at a cut-off level of 20µg was 5.3 and 90.1 respectively, and was 6.0 and 85.9 for 25µg, with different results by sex and age. The optimal cut-off level for women was 13.7µg for 50-59y and 14.6µg for 60-69y; and for men was 13.0µg for 50-59y and 19.9µg for 60-69y. These cut-offs offered lower IC rates and higher FP.
Conclusions: IC has worse prognosis than SC. The 20µg cut-off level provides different outcome measures by sex and age, better for men aged 60-69. It is uncertain whether changing the cut-off level will improve the balance between benefits and harms.

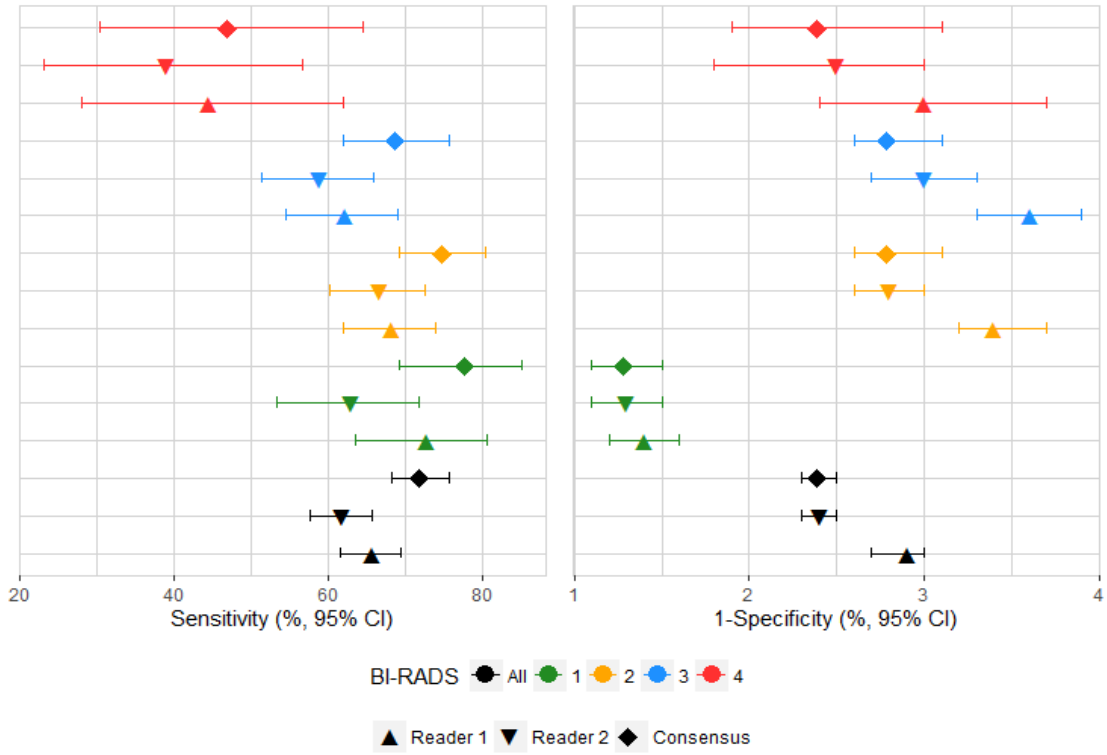
Individualized screening

24 - Oral Presentation

Screening mammography: benefit of double reading by breast density

Von Euler-Chelpin[1], Lillholm[1], Napolitano[1], Vejborg[2], Nielsen[1], E. Lynge[1]
[1]University of Copenhagen, COPENHAGEN, Denmark
[2]University Hospital Copenhagen Rigshospitalet, COPENHAGEN, Denmark

Purpose
The currently recommended double reading of all screening mammography examinations is an economic burden for screening programs. The sensitivity of screening is higher for women with low breast density than for women with high density. One may therefore ask whether single reading could replace double reading at least for women with low density. We addressed this question using data from a screening program where the radiologists coded their readings independently.
Methods
Data include all screening mammography examinations in the Capital Region of Denmark from 1 November 2012 to 31 December 2013. Outcome of screening was assessed by linkage to the Danish Pathology Register. We calculated sensitivity, specificity, number of interval cancers and false positive tests per 1000 screened women by both single reader and consensus BI-RADS density code.
Results
In total 54,808 women were included. The overall sensitivity of double reading was 72%, specificity was 97.6%, 3 women per 1000 screened experienced an interval cancer, and 24 a false positive test. Across all BI-RADS density codes, single reading consistently decreased sensitivity as compared with consensus reading. The same was true for specificity, apart from results across BI-RADS density codes set by reader 2.
Conclusions
Single reading decreased sensitivity as compared with double reading across all BI-RADS density codes. This included results based on consensus BI-RADS density codes. This means that replacement of double with single reading would have negative consequences for the screened women, even if density could be assessed automatically calibrated to the usual consensus level.



Picture 1:
Caption 1: Sensitivity and specificity of screening mammography for Reader 1, Reader 2 and Consensus, by Consensus BI-RADS density code

Individualized screening

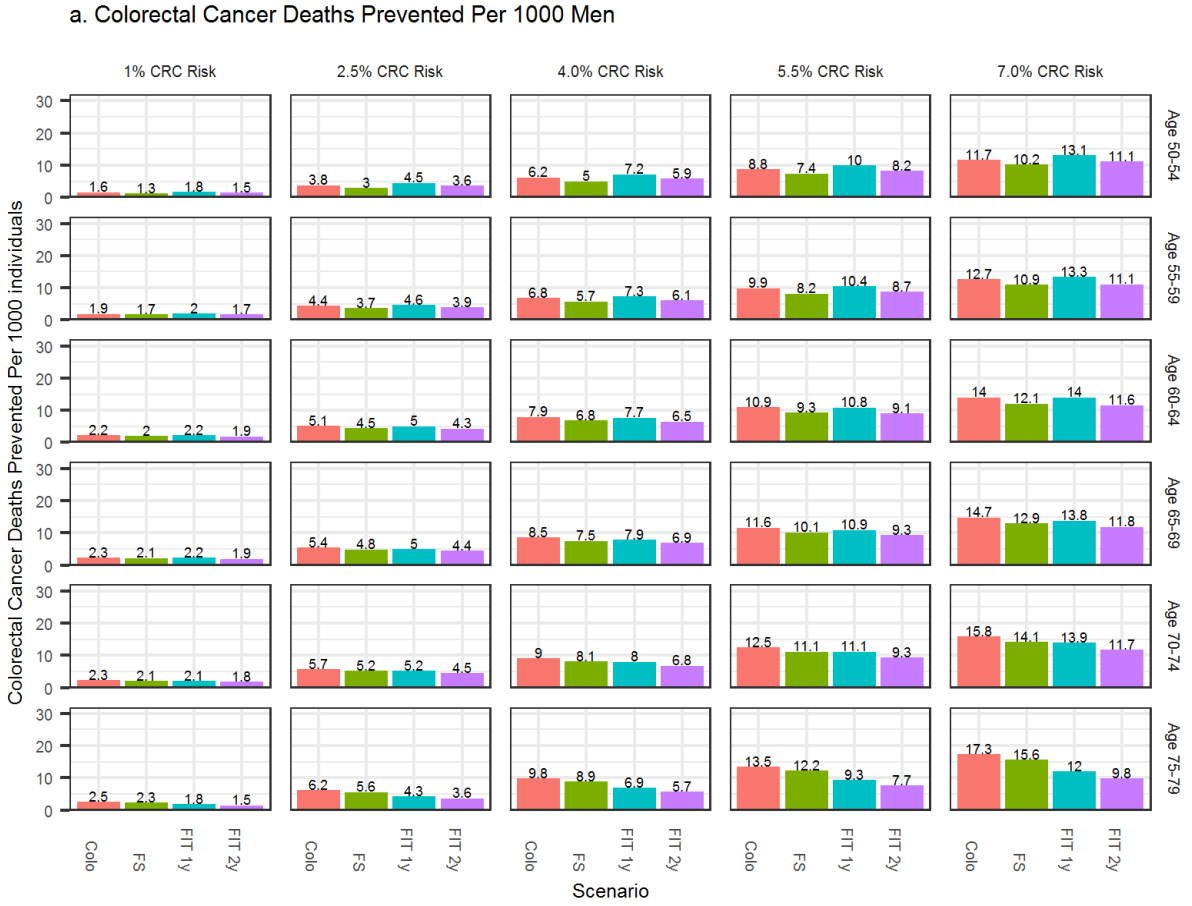
30 - Oral Presentation

Faecal immunochemical test, flexible sigmoidoscopy, colonoscopy or no screening for colorectal cancer individualized by sex, age and CRC risk : a microsimulation modelling study

M. Buskermolen[1], D.R. Cenin[1], L.M. Helsingen[2], G Guyatt[3], PO Vandvik[2], M Bretthauer[2], I Lansdorp-Vogelaar[1]
[1]Erasmus Medical Center, ROTTERDAM, The Netherlands
[2]Institute of Health and Society, University of Oslo, OSLO, Norway
[3]McMaster University, HAMILTON, Canada

Objective: To explore benefits and harms of different colorectal cancer (CRC) screening strategies, stratified by CRC risk, age and sex over a 15-year follow-up period.
Methods: We used the MISCAN-Colon microsimulation model - validated using the Norwegian Colorectal Cancer Prevention (NORCCAP) Trial 15-year follow-up results - to compare four screening strategies to a situation without screening: annual faecal immunochemical test (FIT); biennial FIT; once-only flexible sigmoidoscopy (FS); once-only colonoscopy. Primary outcomes were prevented CRC deaths by screening, and number needed to scope to prevent one CRC death (NNS) during 15-year follow-up. Results were stratified by 60 cohorts varying in 15-year CRC risk (1%; 2.5%; 4.0%; 5.5%; and 7.0%), age (50-54, 55-59, 60-64, 65-69, 70-74, 75-79) and sex.
Results: Once-only colonoscopy prevented the greatest number of CRC deaths in those aged 65-79 (8.8-10 per 1,000 median-risk males), closely followed by annual FIT (7.7-9.0 per 1,000; Figure 1). Annual FIT was slightly more effective in those aged 50-64: 7.6-8.2 prevented CRC deaths. The ordering of strategies was consistent across CRC risk and sex, but the absolute number of CRC deaths prevented varied widely from 1.1 per 1,000 low-risk women to 14.7 per 1,000 high-risk men. Consequently, NNS was lower in high-risk participants and higher in women. The NNS was lowest for once-only FS in ages 50-64 and biennial FIT in ages 65-79.
Conclusions: Once-only colonoscopy and annual FIT screening are most effective in reducing CRC mortality in most strata. The balance between harms and benefits of screening depends substantially on CRC risk.

Picture 1:



Caption 1: Figure 1

Individualized screening

37 - Poster Presentation

Assessment of Colorectal Cancer Family History in Organized Screening Programs: a Global Survey

Flugelman
Rambam Medical Center, HAIFA, Israel

Assessment of Colorectal Cancer Family History in Organized Screening Programs:
a Global Survey

Anath A. Flugelman, Zohar Levi

Background:
Screening reduces the burden of colorectal cancer (CRC). Most organized programs use a fecal-test and diagnostic colonoscopy strategy. Higher risk patients with CRC family history [FH] should be screened using colonoscopies. High-risk FH may be identified by family physicians or other methods. In practice, information is lacking for a large proportion of patients. Screening programs currently lack effective means to identify these patients, thus a sizeable number, warranting colonoscopic screening, are included in fecal-based screening. The priority in recent decades was to establish effective screening programs based on quality guidelines. Following these efforts, it is time to develop effective methods to improve risk stratified screening. We aimed to collect and summarize the FH policy in programs worldwide.

.Methods
A list of existing organized programs is available [Scheuders EH, Ruco a, Rabeneck L et al. Colorectal cancer screening: a global overview of existing programmes. Gut 2015;64:1637-49]. Our survey included questions inquiring whether the program has an integrated method to collect FH information and the method used (e.g. mailed questionnaire, computer assisted). The survey questionnaire was electronically delivered to members of the ICSN.

Results
We received responses from 56 public health professionals, representing 33 of 40 countries and regions listed among organized programs. All the large global programs were represented. The majority of programs do not have an integrated systemic FH collection strategy. Fifth of the programs used questionnaires attached to the fecal test kits (7/33).

Discussion and conclusion
Most countries do not systematically obtain FH. No program was found to integrate FH data using a computer- assisted strategy. Those finding may indicate a need for a FH data collection and integration tool. A global collaborative effort could be considered.

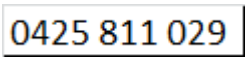
Individualized screening

70 - Oral Presentation

Testing the impact of providing both faecal and blood test options on participation in colorectal cancer screening.

EL Symonds[1], I Flight[2], D Hughes[2], G Chen[3], SK Pedersen[4], R Woodman[5], J Ratcliffe[6], RJL Fraser[1], C Wilson[7], GP Young[2]
[1]Flinders Medical Centre, BEDFORD PARK, Australia
[2]Flinders Centre for Innovation in Cancer, BEDFORD PARK, Australia
[3]Monash University, MONASH, Australia
[4]Clinical Genomics, NORTH RYDE, Australia
[5]Flinders University, BEDFORD PARK, Australia
[6]University of South Australia, ADELAIDE, Australia
[7]La Trobe University, BUNDOORA, Australia

Background: Poor participation rates are common in colorectal cancer (CRC) screening programs involving faecal immunochemical tests (FIT). Research into barriers to screening with FIT suggests a blood test based screening approach may improve participation. The study aimed to assess the impact of a novel blood test on screening participation when offered as either an upfront choice, or a "rescue" strategy for FIT non-participants.
Methods: People (50-74y) were randomly selected from the South Australian electoral roll and randomised to Control, Choice or Rescue arms (n=600/group). All invitees were mailed either a FIT (OC-Sensor, Eiken Chemical Company; Control group), or offered a blood test (Colvera, Clinical Genomics) at either the same time (Choice group) as FIT, or 12wk after FIT non-participation (Rescue group). Participation was assessed after 24 weeks. Attitudes to and knowledge of screening were assessed by surveys provided at invitation.
Results: Blood test uptake was more likely when offered as a rescue strategy (6.5%) than as an up-front choice (1.5%, $p<0.001$). However, overall participation was not significantly different between the groups, with total screening uptakes of 37.8% for the Control, 33.8% for the Choice, and 36.5% for the Rescue ($p>0.05$). There was a significant difference in awareness of testing options for CRC screening, with 96.1% of survey responders aware of the FIT, compared to only 22.7% awareness of a blood test ($p<0.001$). Of those offered an upfront choice, of those who chose FIT, 92.0% had previously completed a FIT. Anxiety about stool or blood sampling did not impact likelihood to screen ($p>0.05$).
Conclusion: In a population familiar with FIT-screening, provision of a blood test either as a rescue strategy or an upfront option did not increase overall CRC screening participation. This might reflect comparatively poorer knowledge of the appropriateness and efficacy of a blood test for screening compared to FIT.

Picture 1: 

Individualized screening

71 - Poster Presentation

Incidence of advanced neoplasia following low faecal immunochemical test haemoglobin concentrations.

EL Symonds[1], C Cock[1], P Bampton[2], RJL Fraser[1], GP Young[3]
[1]Flinders Medical Centre, BEDFORD PARK, Australia
[2]Royal Adelaide Hospital, ADELAIDE, Australia
[3]Flinders Centre for Innovation in Cancer, BEDFORD PARK, Australia

Background: In Australia, colorectal cancer (CRC) screening occurs with faecal immunochemical tests (FIT). A positive test can identify individuals with adenomas who are at elevated risk and require ongoing colonoscopies, which then places a burden on limited colonoscopy resources. It is possible that this burden could be reduced by using FIT haemoglobin (Hb) concentrations to guide colonoscopy frequency. The aim was to determine if FIT Hb can identify those at low risk for future advanced neoplasia.
Methods: Patients at elevated risk for CRC underwent 3-5 yearly colonoscopy with FIT offered in the years between (OC Sensor, Eiken Chemical Company). Incidence of advanced neoplasia (CRC or advanced adenoma) at subsequent colonoscopy was compared for individuals with FIT Hb of 0, 0.1-10 and 10.1-19.9µg Hb/g faeces.
Results: 5,049 individuals had a low FIT result followed by a colonoscopy 30.3 ± 15.3 months (mean±SD) later. Following 0µg Hb/g, no CRC was found at colonoscopy, but incidence increased to 0.3% following FIT results of 0.1-10µg Hb/g and 10.1-19.9µg Hb/g. The incidence of advanced neoplasia with 0µg Hb/g was significantly lower than all other groups (Table). After adjusting for gender, age, socioeconomic status and time from FIT until colonoscopy, the odds ratio for advanced neoplasia was lowest in those following a FIT result of 0µg Hb/g (Table).
Conclusions: Risk of future advanced neoplasia is associated with FIT Hb concentration, with lowest risk following 0µg Hb/g. FIT results may provide a means to personalise care by increasing the colonoscopy intervals in patients with 0µg/g faeces.

Picture 1:

	0µg Hb/g faeces N=1466	**0.1-10µg Hb/g faeces N=3254**	**10.1-19.9µg Hb/g faeces N=329**
Incidence for advanced neoplasia	9.5%	13.2%	24.0%
Odds ratio (95%CI)	1.0	1.3 (1.1-1.6)	2.5 (1.8-3.4)

Individualized screening

73 - Oral Presentation

Faecal haemoglobin concentration among subjects with negative FIT results is associated with the detection rate of neoplasia at subsequent rounds.

Senore[1], Zappa[2], Campari[3], Crotta[4], Armaroli[1], Arrigoni[1], Cassoni[5], Fracchia[6], Gili[1], Grazzini[2], Lolli[4], Orione[7], Rapi[8], Rubeca[2], Sassatelli[9], Visioli[2], N. Segnan[1]
[1]University Hospital Città della Salute e della Scienza, TURIN, Italy
[2]ISPRO, FLORENCE, Italy
[3]AUSL Reggio Emilia, REGGIO EMILIA, Italy
[4]AUSL Valle d'Aosta, AOSTA, Italy
[5]University of Turin, TURIN, Italy
[6]Mauriziano Umberto I Hospital, TURIN, Italy
[7]ASL Cuneo1, CUNEO, Italy
[8]Careggi University Hospital, FLORENCE, Italy
[9]IRCCS Santa Maria Nuova, REGGIO EMILIA, Italy

Background. A correlation of faecal haemoglobin (f-Hb) concentration at first screening tests with the subsequent risk of colorectal cancer (CRC) and advanced adenomas, has been documented. We aimed to estimate the predictive role of f-Hb concentration among subjects with faecal immunochemical test (FIT) results below the positivity cut-off for the subsequent risk of advanced neoplasia (AN: CRC or advanced adenoma).
Methods. Prospective cohort of subjects aged 50 to 69, undergoing their first FIT between January 1st, 2004 and December 31st, 2010, in the context of 4 population based programs in Italy, adopting the same analytical procedure (OC Sensor, Eiken Japan), performed every 2 years, on a single sample, with the same positivity cut-off (20 µg Hb /gr faeces). We estimated the cumulative AN risk over the 4-year period following the second FIT using the Kaplan-Meier method.
Results. The cumulative probability of a positive FIT result over the subsequent 2 rounds ranged between 7.8% (95%CI:7.5-8.2) for subjects with undetectable f-Hb at the initial 2 tests (49% of the screenees) and 48.4% (95%CI:44.0-53.0) among those with a cumulative f-Hb concentration ≥ 20 µg Hb/gr faeces (0.7% of the screenees). The corresponding figures for cumulative DR were: 1.4% (95%CI:1.3-1.6) and 25.5% (95%CI: 21.4-30.2) for AN; 0.17% (95%CI:0.12-0.23) and 4.5% (95%CI: 2.8-7.1) for CRC.
Conclusion. The association of cumulative f-Hb concentration with subsequent AN risk may allow to design tailored strategies to direct available colonoscopy (TC) capacity towards high-risk subjects: those with cumulative f-Hb concentration ≥ 20 µg /gr faeces over 2 negative tests could be referred immediately for TC, while screening interval might be extended for those with undetectable f-HB at repeated FITs, reducing unnecessary assessments among low-risk subjects. Sequential randomized trials would be needed to confirm these hypotheses.

Individualized screening

122 - Oral Presentation

Risk-based Prediction Model with Fecal Hemoglobin Concentration, Conventional Risk Factors, and Genetic Markers for Personalized Colorectal Cancer Screening

Chen[1], Hsu[1], Yen[1], Hsu[2], Chiu[2]
[1]Taipei Medical University, TAIPEI, Taiwan
[2]National Taiwan University Hospital, TAIPEI, Taiwan

Background
The personalized screening strategy by selecting risk groups based on fecal hemoglobin (f-Hb) concentration and other correlates for facilitating triage test is attention-getting. Individually-tailored screening for CRC by using f-Hb concentration only or using f-Hb concentration in combination with genetic markers with the application of multi-state Markov model is presented.

Materials and Methods
Data on Taiwanese population-based FIT screening program between 2004 and 2014 were used for analyzing the incremental effect of f-Hb on CRC mortality with early indicator of tumor staging and for estimating three-state natural history of normal-adenoma-colorectal cancer was constructed to build up a risk assessment model. Approximately 5 million Taiwanese adults aged between 50 and 74 years were simulated. The probability distribution of susceptible colorectal cancer risk was addressed to classify the risks from low to high percentile of the underlying population.
Results
An incremental increase in both of baseline and updated f-Hb on the risk of advanced CRC cancer and CRC mortality were noted. Taking 10-14 ug Hb/g category (similar CRC mortality as general population) as standard screening interval in to consideration, subjects with higher f-Hb at first screen may have a shorter inter-screening interval with FIT. By simulation, the high risk of top 5% subject for 10-year risk of being CRC was 8.9 fold risk and 35.6-fold for lifetime risk compared with average-risk group. According to the risk score stratification, the top 5% high risk is recommended to take the multiple modalities (colonoscopy, stool DNA and genetic counseling) and to start screen earlier. Different inter-screenings by different risk scores are also recommended.
Conclusions
We demonstrate how to achieve individually tailored cancer screening in CRC by making use of fecal hemoglobin concentration in combination of conventional risk factors and genetic research findings with a novel quantitative approach.

Individualized screening

132 - Oral Presentation

A Markov Simulation Model for the Evaluation of Risk-Oriented Oral Cancer Screening

Siewchaisakul[1], Su[2], Yen[1], Chen[1]
[1]Taipei Medical University, TAIPEI, Taiwan
[2]Big Data Center, Changhua Christian Hospital, CHANGHUA, Taiwan

Background
In addition to the dose-response effect of betel quid chewing and cigarette smoking on multistate progression for oral potentially malignant disorders and oral cancer, there are quite amount of researches emphasizing on genetic and epigenetic effect. We proposed a computer simulation algorithm to combine those state-of-the-art evidence for the efficacy of personalized screening program for oral cancer in light of translational medicine.

Materials and methods
We developed a risk assessment model incorporating risk factors like betel quid chewing and cigarette smoking, and genetic and epigenetic factors. A Markov simulation model was applied to simulate a hypothetical cohort with distribution of risk profiles the same as a high-risk group for oral screening in Taiwan. The effectiveness with different inter-screening intervals with or without health education for quitting betel quid chewing and cigarette smoking were examined, so as to varying attendance rate, and compliance to treatment once detected as 50%, 60%, and 80%.

Results
We found a 48% oral cancer incidence reduction for annual screening program with 60% attendance rate, and 80% compliance rate to treatment once detected compared with the control group. The figure decreased with longer inter-screening interval. The incidence rate reduction showed a steady trend across different risk groups regardless of inter-screening interval. When education program for quitting betel quid chewing and cigarette smoking was introduced in the screening program, a further 3-5% incidence reduction was achieved. The extra benefit from health education was more significant for higher risk.

Conclusions
By using a Markov simulation, we developed a risk assessment model to stratify the risk of oral squamous-cell carcinoma considering unhealthy oral habits like betel quid chewing and cigarette smoking, genetic and epigenetic factors in a multistate progression model to demonstrate how different prevention programs have varying effectiveness across different risk groups for decision-making on screening policy.

Individualized screening

134 - Poster Presentation

Cost-effectiveness Analysis of Risk-guided Screening for Breast Cancer

Chang[1], Chiu[2], Chen[1]
[1]Institute of Epidemiology and Preventive Medicine, National Taiwan University, TAIPEI, Taiwan
[2]Chang Gung University, TAO-YUAN, Taiwan

Background
Individually-tailored screening strategies for breast cancer (BC) require a comprehensive risk-guided model for evaluation of benefit and cost. However, a systematic economic evaluation of these strategies has been hardly addressed. We aimed to provide economic evaluation of universal and risk-guided preventive strategies by the stratification of the status of BRCA1/2.
Method
Around one million women were simulated by the stratification of the status of BRCA 1/2. A three-stage partially-hidden Markov model was then developed to identify asymptomatic BC and symptomatic BC. Decile risk stratification derived from these models enable us to stratify the population and further provide the backbone for probabilistic cost-effectiveness analysis according to risk-guided preventive strategies.
Result
For women of non-BRCA carrier at their 50 years, the lifetime risks were 1.23% and 11.90% for the first and tenth decile. The incremental cost-effectiveness ratio (ICER) for personalized strategy with risk-based inter-screening interval was $35,278 (95% CI: $35,155-$35,401) which was lower than that of universal annual ($48,026, 95% CI: $47,871-$48,181) and biennial ($37,473, 95% CI: $37,331-$37,615). The results of acceptability curve show personalized strategy with various inter-screening was acceptable when 2GDP (Gross Domestic Product) was taken as the threshold of WTP (Willingness To Pay).
For women with BRCA carrier, the lifetime risks were 16.5% and 84.3% for the first and tenth decile. The most cost-effective strategy was offered by prophylactic mastectomy for top 20% high risk women and annual mammographic for the rest of population with the order of the ICER value estimated as $2,722 (95% CI: $2,630-$2,815).
Conclusion
We provide a systematic economic evaluation of breast cancer screening with personalized preventive strategies for women with carrier and non-carrier of BRCA. Designing such personalized preventive strategies in the light of risk-based model are not only efficacious but also cost-effective.

Individualized screening

136 - Oral Presentation

Personalising the stop-age of colorectal cancer screening - the role of comorbidity and screening history

Cenin[1], Tinmouth[2], Naber[1], Dube[3], McCurdy[3], Paszat[2], L. Rabeneck[3], Lansdorp - Vogelaar[1]
[1]Erasmus MC, ROTTERDAM, The Netherlands
[2]Sunnybrook Health Sciences Centre, ONTARIO, Canada
[3]Cancer Care Ontario, TORONTO, Canada

Background
While colorectal cancer (CRC) screening is generally recommended until age 74, the expected harm-benefit ratio of screening at that age varies widely. We aimed to optimize the stop-age based on sex, comorbidity status and prior screening adherence.
Methods
Using Microsimulation Screening Analysis-Colon (MISCAN-Colon) we estimated the harms and benefits of undergoing one more screen with a faecal immunochemical test (FIT) in males and females aged 66-90 years, by comorbidity status and prior screening adherence. Screening occurred within an organised CRC screening program utilising biennial FIT. Results are presented as the suggested age of last screen, based on the harm-benefit ratio at that age versus at a later age. As the harm-benefit ratio screening is considered to be acceptable in the average-risk population at age 74, the age of last screen is defined by a threshold determined by this balance compared to undergoing one additional screen at 76.
Results
Previously unscreened females without comorbid conditions can continue screening until 90 years, while males can continue until 88 (Table 1). As screening compliance improved, or comorbidity increased, the age of last screen decreased, regardless of sex. Unless previously unscreened, those with severe comorbidity should stop screening at or before the recommended stop-age (range: <66-74 years).
Conclusions
Based on the harm-benefit balance, screening stop-age varies from <66 (unhealthy individuals with prior screening) to 90 years (healthy individuals without prior screening). These findings assist patient and clinician decision-making related to CRC screening participation and can be used to inform future CRC screening guidelines.

Picture 1:

Table 1: Suggested age of last screening episode with faecal immunochemical test for colorectal cancer based on the number needed to screen to gain one life year, by sex, comorbidity status and prior screening with faecal immunochemical testing.

Screening History /	Females				Males			
Comorbidity status	No	Low	Mod	Sev	No	Low	Mod	Sev
Perfect (100%) Prior Screening with FIT	78	72	72	66	76	76	72	66
Most (75%) Prior Screening with FIT	80	74	72	68	78	76	74	66
Moderate (50%) Prior Screening with FIT	84	82	76	72	80	80	76	70
Some (25%) Prior Screening with FIT	86	84	82	76	84	84	80	74
No Prior Screening with FIT	90	90	88	84	88	88	86	80

FIT = faecal immunochemical test; Mod = moderate; Sev = Severe
Key: Blue – stop screening later than recommended in guidelines; Green – stop screening in line with guidelines; Red – stop screening earlier than recommended in guidelines

Individualized screening

139 - Oral Presentation

Optimizing FIT screening by using different cut-off values for different age groups and sex

SHN Njor[1], MR Rasmussen[2], LF Friis-Hansen[3], BA Andersen[1]
[1]Randers Regional Hospital, RANDERS, Denmark
[2]Bispebjerg University Hospital, COPENHAGEN, Denmark
[3]Hilleroed Hospital, HILLEROED, Denmark

Background
Most FIT (Faecal Immunochemical Test) based colorectal cancer screening programmes use similar cut-off values for women and men and for all age groups. It is known that colorectal cancer screening increases colorectal cancer incidences more among men than among women and that colorectal cancer screening increase colorectal cancer incidence more among older men than among younger men. It might therefore be reasonable to use different cut-off values for men and women or for different age groups.

Methods
We used data from the Danish FIT based colorectal cancer screening programme that invited citizens aged 50-74 years to the initial screening round in 2014-2017. A cut-off value of 100 mg haemoglobin(Hb)/L was used for all citizens. We included all citizens who participated before 31. July 2015 and followed them for colorectal cancer diagnoses for 2 years. Number of positive tests, sensitivity, specificity and interval cancer rate were calculated for various cut-off values for 5 year age groups for both men and women.

Results
Increasing the cut-off value to 300 mg/L for 50-59 year old men and decreasing the cut-off value to 80 mg/L for all women will increase overall sensitivity 72.9% to 73.2%, increase specificity from 93.6% to 93.9% and decrease number of positive test by 3.6%. From the perspective of the individual citizens it might be better to choose cut-off values that give all citizens the same risk of interval cancer, the same detection rates or the same risk of a false positive test. These results will be presented at the conference.
Conclusions
It is possible to decreasing the number of needed colonoscopies while at the same time increase the overall sensitivity and specificity, by using different cut-off values for men and women and for different age groups.

Individualized screening

163 - Oral Presentation

MyPeBS: Personalising Breast Cancer Screening. Managing communication of a clinical trial on breast screening.

Di Stefano[1], Jaramillo[1], Rouge Bougat[2], Guindy[3], Burrion[4], Gilbert[5], Giorgi Rossi[6], Levy-Lahad[3], Balleyguier[7], Lasne[8], Evans[9], Baron[8], Delaloge[8], Giordano[1]
[1]University Hospital „AOU Città della Salute e della Scienza di Torino„, TORINO, Italy
[2]CNGE, PARIS, France
[3]ASSUTA, TEL AVIV, Israel
[4]Institut Jules Bordet, BRUXELLES, Belgium
[5]University of Cambridge, CAMBRIDGE, United Kingdom
[6]IRCCS S Maria Nuova, REGGIO EMILIA, Italy
[7]Institut Goustave Roussy, PARIS, France
[8]UNICANCER, PARIS, France
[9]University of Manchester, MANCHESTER, United Kingdom

Background
MyPeBS is an international, multicenter, randomized clinical trial conducted in France, Belgium, Italy, Israel and UK. It aims at comparing current practices for breast cancer screening vs a personalized strategy. 5-years breast cancer risk assessment based on personal and family history, breast density and saliva genotyping, will be used to assign women in the intervention group in one of four risk groups (low, average, high, very high) with different screening schedules. Multiculturality, stakeholders' plurality, and intrinsic difficulties in communicating health risk, make this trial's communication highly complex.
Methods
After assessing screening programmes and communication strategies in participating countries, MyPeBS Communication Plan was designed considering country-specificities and multiple targets.
Eligible women are the major audience. Several tools have been developed aiming at promoting both a well informed choice to participate and a good compliance during the trial: Informed Consent Form, information leaflet, two videos, a userfriendly "Questions & Answers", and personal sheets with infographics and relevant links to explain individual risk evaluation and what it leads to. Leaflet and risk sheets were pre-tested among potential participants and key-informants, through web-based questionnaires. Strategies to inform/educate health professionals and to involve stakeholders have been developed. All materials are submitted to Ethics Committees.
Results
Pre-testing was highly accepted and gave fruitful feedback: information needs to be simple and easy to read but exhaustive, expecially on participation pros and cons and on individual's risk level. The effectiveness of the whole communication strategy will be monitored and evaluated during the trial's progress and at the end.
Conclusions
This trial's communication is a challenge: 1) it needs to be transparent, exhaustive, and simple for eligible women; 2) it is conducted in a context (breast cancer screening) in which communication has often been questioned; 3) it concerns a sensitive topic as risk (including genetic risk) communication.

Individualized screening

170 - Poster Presentation

MICRORNA, GUT MICROBIOME AND LIFESTYLE RELATED FACTORS AS INDICATORS OF DIFFERENT RISK PROFILES FOR COLORECTAL CANCER AND PRE-INVASIVE LESIONS

Armaroli[1], Naccarati[2], Senore[1], Carozzi[3], Bellisario[1], Tarallo[2], Gunter[4], Sinha[5], Segnan[1]
[1]AOU Città della Salute e della Scienza di Torino, CPO, TORINO, Italy
[2]Italian Institute for Genomic Medicine, TURIN, Italy
[3]Istituto per lo Studio , la Prevenzione e la Rete Oncologica (ISPRO), FLORENCE, Italy
[4]International Agency for Research on Cancer, LYON, France
[5]National Cancer Institute, ROCKVILLE PIKE, United States of America

High false positives rates, leading to unnecessary colonoscopies, represent a limitation of FIT as primary screening test. Moreover, current screening protocols are based on age only, ignoring other risk factors. This study aims to: identify miRNA signatures as biomarkers for Advanced Neoplasia (advanced adenoma/CRC-AN) risk among FIT+ subjects (as triage-tests); investigate the association of microbiome profiles with the AN-risk; explore modulation from lifestyle factors (diet, other lifestyle factors) of AN-risk associated with biomarkers profiles and to identify risk patterns (miRNA profiles, lifestyle-factors, haemoglobin levels at baseline) among FIT- subjects
METHODS:The Turin CRC screening program targets all residents aged 59-69 years. All subjects referred for colonoscopy (TC) following a FIT+ result in the study period have been asked to participate and provide additional blood and stool samples, to compare miRNA expression profiles and microbiome composition between AN subjects and a matched sample of subjects with FIT+ test and negative colonoscopy. Information on lifestyle-factors have been collected at the time of enrolment. A sample of subjects with FIT- result will be followed up to compare risk patterns at baseline and at the second round among 3 'risk groups' of subjects
RESULTS:Enrollment started in May 2017. At October 2018, 2120 subjects have been enrolled (813 subjects classified as FIT+ (Hb>99 ng/ml), 1307 as FIT-. Among FIT+ subjects, 201 (25%) agreed to participate to the study and 191 questionnaire, blood and fecal samples were collected. 173 subjects underwent TC and 48 AN were found, being the AN detection similar to non participants who underwent TC. For about 50% of FIT- subjects information on lifestyle factors have been collected
CONCLUSIONS:the present study will help to identify biomarkers to complement the available screening tests, and to reduce unnecessary invasive and expensive procedures. Tailored screening programmes according to different CRC-risk criteria may maximize the impact of screening.

Individualized screening

203 - Poster Presentation

Age-specific HPV Exit Testing Results for Subgroups within the Intervention (HPV) Arm of the HPV FOCAL Trial

Coldman, Smith, Van Niekerk, Krajden, Gondara, Ogilvie
BC Cancer Research Centre, VANCOUVER, Canada

Background
In many populations HPV testing is replacing cytology for cervical cancer screening. HPV-based screening requires triaging and management of those testing HPV+. The HPV FOCAL trial examined every 4-year screening in women aged 25-65 using HPV with triage of positive results using cytology and for those NILM retesting after 12 months and those ASCUS or greater, referred to colposcopy. We examine the age-specific exit testing results in subgroups defined by test results at study entry.
Method
Results at 48-month exit testing for women randomized to the intervention (HPV) arm were separated into subgroups based upon baseline and any subsequent re-testing or colposcopic evaluation results. Analysis was restricted to women who presented for exit screening and uses age at testing.
Results
In the intervention arm 8,768 (of 9,539) tested HPV negative at baseline, of which 7,838 attended and had valid 48 month exit testing (see Table). 48-month exit HPV+ rates were lower (4.0%) in those HPV negative at baseline compared to baseline testing (8.1%) and these rates both declined with age. 48-month HPV+ rates were elevated in women HPV+ at baseline but negative at 12-month retesting (19.9%), or in those who had a negative or CIN1 colposcopy at baseline (24.7%) but were not significantly different between these two groups (P=0.17): these rates were not strongly related to age.
Conclusion
Women HPV negative at baseline had lower rates of HPV+ at 48-month exit but rates among those HPV positive at baseline, who reverted at 12 months, were elevated.

Table: HPV+ rates in the intervention arm of the HPV FOCAL trial by age for subgroups defined by result of baseline and follow-up testing.

Baseline Result →	All	HPV Negative	HPV Positive & Cytology NILM	HPV Positive & Cytology ≥ASCUS	HPV Positive & Cytology NILM
12 Month Retest →	N/A	N/A	HPV Negative	N/A	HPV Positive
Colposcopy Result →	N/A	N/A	N/A	Neg or CIN1	Neg or CIN1
	Baseline Result ↓	Exit Result ↓	Exit Result ↓	Exit Result ↓	
Age ↓	Proportion HPV+ % (95%CI)				
25-29	23.2 (20.5-26.2)	15.6 (6.9-31.8)	57.1 (25.0-84.2)	44.4 (18.9-73.3)	
30-34	13.7 (11.7-16.0)	9.6 (7.3-12.4)	21.7 (13.1-33.6)	17.1 (9.9-28.2)	
35-39	9.2 (7.8-10.8)	6.9 (5.3-8.9)	21.1 (12.5-33.3)	22.2 (13.7-33.9)	
40-49	6.2 (5.4-7.1)	4.1 (3.4-5.0)	18.4 (12.1-27.0)	29.6 (20.8-40.3)	
50-64	3.7 (3.1-4.4)	2.6 (2.1-3.2)	16.7 (10.5-25.4)	24.2 (15.2-36.2)	
65+	3.5 (1.0-11.9)	1.7 (0.9-3.0)	25.0 (7.1-59.1)	50.0 (15.0-85.0)	
All	8.1 (7.6-8.6)	4.0 (3.5-4.4)	19.9 (16.0-24.6)	24.7 (20.1-30.1)	
Number	9,539	7,838	331	283	

Picture 1:

Individualized screening

216 - Oral Presentation

Risk stratification of women with positive HPV test on self-taken samples: Results from Slovenian HPV self-sampling study

Jerman, Ivanus, Kloboves Prevodnik, Primic Zakelj
Institute of Oncology Ljubljana, LJUBLJANA, Slovenia

Background
Some countries have already implemented HPV self-sampling for non-responders into cervical cancer screening programmes, yet there is still lack of data about the optimal triage strategies of women with positive test result on self-taken sample. A large-scale randomised controlled trial was conducted among non-responders of organised, population-based screening programme in Slovenia. Women with positive result of HPV test on self-taken sample were invited to colposcopy clinic where cervical samples were taken for the triage tests to assess their risk for a high-grade lesions.
Methods
All 430 women with HPV-positive test on self-taken samples from 26.556 women enrolled to Slovenian HPV self-sampling study were invited to colposcopy clinic, 333 attended prescheduled appointment and 55 visited their personal gynaecologist instead. At colposcopy clinic samples were taken for cervical cytology, p16/Ki-67 dual-staining and HPV test prior the colposcopy. Within one year of inclusion of women in the study 40 CIN2+ and 32 CIN3+ were detected in 333 women with positive HPV test who attended the appointment at colposcopy clinic. We followed these women for three years within National cervical cancer screening registry.
Results
Cumulative 3-year risk of CIN2+ and CIN3+ among women with positive HPV tests on self-taken samples will be presented according to the results of cervical cytology, p16/Ki-67 dual-staining, HPV test taken by a clinician and colposcopy performed on the first visit at colposcopy clinic after self-sampling. Results will be presented by age groups, level of protection due to previous screening and three self-sampling devices used in the study.
Conclusion
We will propose an optimal, risk-based triage strategy for women with positive result on HPV self-sampling based on their background risk due to age and level of protection due to past screening and according to the results of the test performed on the first visit at the clinic.

Individualized screening

225 - Poster Presentation

Slovenian national breast cancer screening - rollout completed - and moderate risk women surveillance

Jarm, Krajc, Kadivec, Zadnik
Institute of Oncology Ljubljana, LJUBLJANA, Slovenia

Background:

Slovenian breast cancer screening programme (SBCSP) is organized, population based with national screening policy. It provides biennial mammography for all women aged 50-69 years (target population of 280,000 women). Also within the BCSP, biennial surveillance of moderate breast cancer risk women is proceeded.
Methods:
SBCSP strictly follows all requirements of European Guidelines for Quality Assurance in Breast Cancer Screening and Diagnosis since its introduction in 2008, with emphasis on the quality control. Slovenian Guidelines for breast cancer diagnosis and treatment were introduced in 2018. Beside treatment of symptomatic and cancer diagnosed women, they include recommendations for surveillance of women at different breast cancer risk. Individual risk is assessed with IBIS Breast Cancer Risk Evaluation Tool.
Results:
The rollout of the SBCSP was successfully completed ten years after its initiation, in December 2017, covering the whole country. In ten years, we observed 73% average participation rate. Since the implementation, the technical quality assurance and the monitoring of work performance indicators of radiographers, radiologists, surgeons and pathologists are in place. Slovenian Guidelines for breast cancer diagnosis and treatment recommend women at average breast cancer risk to attend the SBCSP. Women at moderate risk are recommended yearly mammography: every second year within the SBCSP, and in between in the breast unit. High risk women are followed at the hereditary cancer clinic.
Conclusion:
According to the European guidelines, the SBCSP is comprehensive with defined screening policy for inviting eligible women, national screening organization, centralized screening register, supported by distinguished informational system for data storage and monitoring of screening outcomes, linkage with crucial national registries and quality assurance system. The essential performance indicators of the programme are consistent with the target values of European guidelines. Women at moderate breast cancer risk are yearly followed; within the BCSP and in the breast units.

Individualized screening

235 - Poster Presentation

The Cost-Effectiveness and Benefit-to-Harm Profile of Polygenic Risk-Tailored Screening for Prostate Cancer

Callender[1], Emberton[1], Morris[1], Eeles[2], Kote-Jarai[2], Pharoah[3], Pashayan[1]
[1]University College London, LONDON, United Kingdom
[2]Institute for Cancer Research, LONDON, United Kingdom
[3]University of Cambridge, CAMBRIDGE, United Kingdom

Background
The harms from overdiagnosis of screening for prostate cancer with prostate-specific antigen (PSA) are considered to outweigh its mortality benefit. Risk-tailoring based on age and polygenic profile might preserve the mortality benefit of screening, whilst mitigating overdiagnosis. This analysis evaluates the benefit-to-harm profile, and the cost-effectiveness of a programme of polygenic risk-tailored screening for prostate cancer.
Methods
Using a life-table approach, hypothetical cohorts of 4.48 million men in England between the ages of 55 and 69 were followed to the age of 90. No screening, age-based screening (quadrennial PSA testing from 55 to 69), and risk-tailored screening (men above a risk threshold based on age and polygenic risk profile receive quadrennial PSA testing from the age they reach the risk threshold to 69) were compared.
Benefits and harms were quantified in terms of prostate cancer deaths prevented, overdiagnosed cases, biopsies performed, and quality-adjusted life-years (QALYs). The cost-effectiveness of screening strategies was evaluated using the incremental cost per QALY gained and net monetary benefit (NMB). The analysis was performed from the perspective of the National Health Service.
Results
Age-based screening was the least cost-effective strategy when ranked by NMB. Screening men at higher risk of developing prostate cancer improved the benefit-to-harm profile and cost-effectiveness of risk-tailored screening, with a plateau seen at a 4% 10-year absolute risk, above which the gains levelled-off. At this threshold, risk-tailored screening led to 66 fewer deaths from prostate cancer at the expense of 142 overdiagnosed cases per 10,000 men, when compared with no screening. The resulting cost was £30,934 ($40,214; €34,027) per QALY gained. Compared with age-based screening, this strategy led to a three-fold reduction in overdiagnosed cases for every prostate cancer death not averted.
Conclusion
Tailoring screening at higher risk men could improve the cost-effectiveness and benefit-to-harm profile of screening for prostate cancer.

Individualized screening

238 - Oral Presentation

WHAT IS THE DIFFERENCE IN RISK BETWEEN VACCINATED AND UNVACCINATED WOMEN AGAINST HUMAN PAPILLOMAVIRUS AND THE IMPLICATIONS IN SCREENING POLICY

E. Naslazi[1], Kim[2], De Kok[1], Van Ballegooijen[1], Burger[2], Hontelez[1], Canfell[3], Smith[3], Kulasingam[4], Zhao[4]
[1]Erasmus Medical Center, ROTTERDAM, The Netherlands
[2]Harvard School of Public Health, BOSTON, United States of America
[3]Cancer Council NSW, SYDNEY, Australia
[4]University of Minnesota School of Public Health, MINNEAPOLIS, United States of America

Background
In developed countries, Human Papillomavirus (HPV) vaccination uptake is 30-90%. Will it be reasonable to have the same cervical screening policy for both vaccinated and unvaccinated women in a specific cohort? In addition to feasibility issues, an important consideration is the difference in cervical cancer risk between the two groups. We investigated the difference in HPV and cervical cancer risk between vaccinated and unvaccinated cohorts through comparative modeling as part of the Cancer Intervention and Surveillance Modeling Network (CISNET) consortium.

Methods
We compared predictions from four HPV transmission models in terms of HPV16/18 and cervical cancer risk reduction and resulting herd immunity in women aged 15 to 64 years in the decades following vaccination. Vaccination scenarios modeled were 12 year old females versus females and males assuming 20, 40, 60, 80 and 100% vaccination uptake.

Results
Unvaccinated women have a higher prevalence of HPV 16/18 that varies from 2.4 to 3.3 for the four independent models under the assumption of 60% coverage in the steady state. This difference between unvaccinated and vaccinated women was up to 4-fold higher under lower coverage assumptions. The steady state was reached after more than five decades in three models (when almost all women in the age group had been offered vaccination) and a few years earlier in the fourth one.

Conclusions
Using four independent transmission models, we found notable differences in HPV and cervical cancer risk between vaccinated and unvaccinated populations. Since the absolute disease risk is the most important variable that determines an optimal screening program, applying the same screening algorithm may potentially result in over- or under-screening in theory; although in practice the screening interval for HPV programs has been tailored to unvaccinated cohorts with the explicit aim of garnering more evidence to support longer interval screening in vaccinated cohorts.

Communicating screening in balance

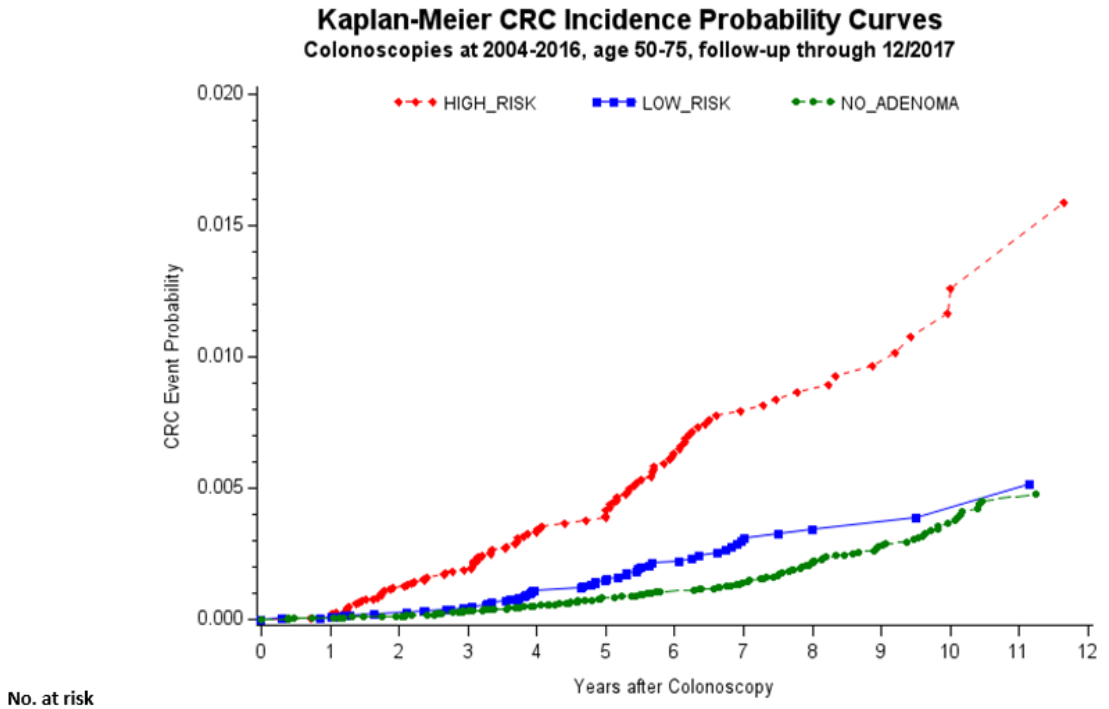
4 - Oral Presentation

RISK OF COLORECTAL CANCER AND RELATED-MORTALITY FOLLOWING DETECTION AND REMOVAL OF LOW- AND HIGH-RISK ADENOMAS

Lee, Jensen, Levin, Udaltsova, Zhao, Quesenberry, Corley
Kaiser Permanente Division of Research, OAKLAND, United States of America

Background: Patients with adenomas are advised to undergo post-polypectomy surveillance to prevent subsequent colorectal cancer (CRC), but the risk of CRC and mortality following detection and removal of adenomas is unclear. The aim of our study was to examine the long-term risks of CRC and related death, by adenoma findings on baseline colonoscopy, in a large, community-based, healthcare setting.
Methods: Average-risk Kaiser Permanente Northern California health plan members who underwent a baseline colonoscopy between 2004-2016 were followed for subsequent CRC and related death. Baseline colonoscopy findings were categorized as high-risk adenoma, low-risk adenoma, or no adenoma. CRC incidence rates were stratified by colonoscopy findings. Risks of CRC and related death in the high- and low-risk adenoma groups were compared with the no adenoma group using Cox regression adjusted for confounders
Results: Among 180,000 average-risk patients who underwent a baseline colonoscopy, 85,646 were men (47.6%), and the mean age was 61.2 (7.1) years. 307 CRCs were subsequently identified over a mean follow-up time of 5.1 (2.9) years. Age-adjusted CRC incidence rates for patients with low-risk adenomas, high-risk adenomas, and no adenomas were 30.0, 91.2, and 26.0 per 100,000 person-years, respectively. Compared to those with no adenomas, patients with low-risk adenomas did not have significantly different risks of CRC (hazard ratio (HR), 1.36; 95% confidence interval (CI): 0.99-1.85) and related death (HR, 1.69; 95% CI: 0.80-3.55). In contrast, patients with high-risk adenomas had significantly increased risks of CRC (HR, 3.32; 95% CI: 2.54-4.33) and related death (HR, 2.77; 95% CI: 1.34-5.72).
Conclusion: High-risk adenomas, but not low-risk adenomas, were associated with increased subsequent risks of CRC and related death compared to patients with no adenomas. These findings suggest that intense surveillance is needed in patients following detection of high-risk adenomas but may not be needed in patients with low-risk adenomas.

Picture 1:



No. at risk						
High Risk Adenoma	22106	15058	9824	5414	1049	189
Low Risk Adenoma	38586	25651	15522	8104	1792	281
Non-Adenoma Group	119308	87547	59711	34448	9417	1537

Communicating screening in balance

52 - Oral Presentation

Informed decision-making about prostate cancer screening supported by a leaflet

E.A.M. Heijnsdijk, T. Dierks, I.J. Korfage, M.J. Roobol, H.J. De Koning
Erasmus MC, University Medical Center, ROTTERDAM, The Netherlands

Background: Although there are not yet population based prostate cancer screening programs, opportunistic screening for prostate cancer frequently happens. We aimed to assess to what extent men make informed choices in the context of prostate cancer screening and how written material contributes to that.
Methods: We developed a leaflet describing prostate cancer screening and a questionnaire consisting of knowledge, attitude and intended screening uptake component to asses informed decision-making. The leaflet and questionnaire were pilot tested with men of the target population, adapted accordingly and sent to 761 members of an online research panel. Having read the leaflet was operationalized as 1. respondents spending at least 1 minute on the leaflet page and 2. on self-report about having read the leaflet.
Results: The response rate was 66% (501/761). Men who read the leaflet (n=342) answered significantly more knowledge items correctly (10.9 versus 8.8; p <0.001) than those who had not read the leaflet (n=159) and made more informed choices (73% versus 56%; p=0.001, Table 1). Attitudes and intended screening-uptake did not significantly differ between both groups.
Conclusion: Having read the leaflet was associated with higher levels of knowledge and higher rates of people who made informed choices. Increasing knowledge and supporting informed decision-making by written material seems to be feasible in prostate cancer screening.

Picture 1:

Informed choice *No. of respondents, (%)*	*All respondents n=501*		*Respondents who read the leaflet n=342*		*Respondents who did not read the leaflet n=159*	
Informed choice	338	(68)	249	(73)	89	(56)
Negative attitude and unlikely to participate	40	(8)	27	(8)	13	(8)
Neutral attitude and undecided about participation	17	(3)	11	(3)	6	(4)
Positive attitude and likely to participate	281	(56)	211	(62)	70	(44)
Uninformed choice	163	(33)	93	(27)	70	(44)

Caption 1: Table 1. Informed choice and attitude of participants, split by having read the leaflet.

Communicating screening in balance

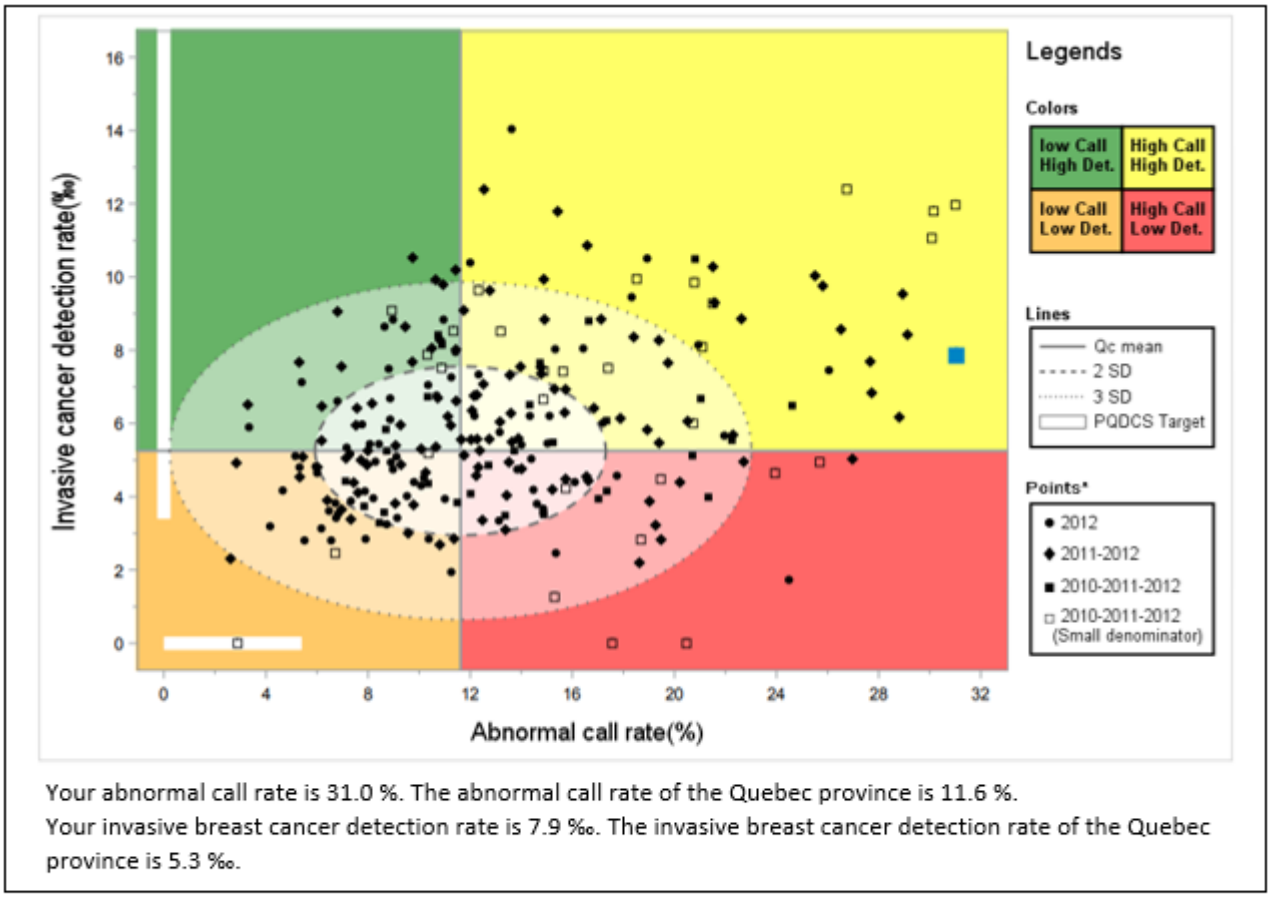
83 - Poster Presentation

Feedback for radiologists working in the Quebec Breast Cancer Screening Program

Théberge, Vandal, Pelletier
Institut national de santé publique du Québec, QUEBEC CITY, Canada

Background: Communicating results concerning the performance indicators to the radiologists working in the Quebec Breast Cancer Screening Program is fundamental to assure its quality. Radiologists must have access to their statistics in order to improve their practice.
Methods: A result report is produced for each radiologist and center in the program. The main figure shows the invasive breast cancer detection rate in relation with abnormal recall rate (see figure). It contain also others indicators as interval cancer rate, screening sensitivity, and others. Each marker on the graph represents performance reached by one radiologist. Provincial performance and targets are also represented. All performance indicators are adjusted for many women's characteristics.
Results: These result reports are used at three different levels. First, each radiologist has a web access to a report containing both his personal and working center performance. Recommended actions are proposed for each location in the graph (green, yellow, orange or red area). Second, regional program coordinator has a web access to a report containing the performance of all the center participating in the program. They can then organize meetings with radiologists of their region to discuss the results. Last, centers result reports are examined by a Tripartite Committee formed by representatives of Ministry of Health, professional order of physicians and radiologists association. When a center seems to be outsider, this committee appoints an expert radiologist who visits the center and makes recommendations.
Conclusions: In the Quebec Breast Cancer Screening Program, a process was established to give feedback to radiologists.

Picture 1:



Caption 1: Invasive breast cancer detection rate and abnormal call rate per radiologist, PQDCS 2016

Communicating screening in balance

108 - Poster Presentation

SELF-CARE: WILLINGNESS TO SHORT-TERM CONDOM USE IN WOMEN DIAGNOSED WITH CERVICAL INTRAEPITHELIAL NEOPLASIA GRADE 2

Skorstengaard, Suhr, Lynge
University of Copenhagen, COPENHAGEN K, Denmark

Background
Patients increasingly request opportunities for self-care making them able to take part in their own treatment and follow-up by health care providers. Condom use is expected to increase regression of cervical intraepithelial neoplasia (CIN) by reducing the viral load of Human Papillomavirus (HPV). We undertook a randomized controlled trial to test acceptability and effect of this self-care. Here we report on participation as a measure of acceptability.
Methods
A randomized controlled trial recruiting woman aged 18-45 years with CIN grade 2 (CIN2) and scheduled for conservative treatment with a 6 months follow-up at a gynecologist. The intervention group was advised to convince partners to use condoms at every intercourse in the period between diagnosis and follow-up visit. The control group received standard care.
Results
In total, there were 1415 women diagnosed with CIN2 in the project period and of these 1110 women were eligible. Consent forms for contact were available from 309 (28%) women. For 87 women immediate conization was decided leaving 222 women relevant for randomization. There were 121 women allocated to the intervention group and 101 to the control group. In the intervention group, 74 women (61%) agreed to participate. Of the 47 women who did not participate; 19 agreed on the phone but did not return written consent for participation; 14 could not be reached; 8 did not want to participate; 5 withdrew later; and one woman was excluded for other reasons.
Conclusion
This study introduces a self-care tool for women with CIN2. Participation in the intervention group was lower than expected. It was surprisingly difficult to reach women even after several calls and text messages, and also surprising that women who agreed to participate on the phone did not return the written consent. This suggests that self-care is maybe less popular than expected.

Communicating screening in balance

111 - Poster Presentation

Enhancing elements of informed choice in colorectal cancer screening among Danish citizens using a decision aid: an RCT

P Gabel[1], A Edwards[2], P Kirkegaard[1], MB Larsen[1], B Andersen[1]
[1]Central Denmark Region , Randers Regional Hospital, RANDERS NØ, Denmark
[2]Cardiff University, CARDIFF, United Kingdom

ObjectivesThis trial sought to test the effectiveness of a newly developed self-administered web-based decision aid, targeted at citizens with lower educational attainment, on informed choice about colorectal cancer screening participation.

MethodsThe trial was a randomised controlled effectiveness trial, nested into the colorectal cancer screening programme in the Central Denmark Region.
A population-based random sample of 2,702 screening-naïve citizens, 53-74 years old, with lower educational attainment, received a baseline questionnaire. Respondents (62%) were allocated to intervention and control groups.
Both groups received the standard screening reminder, and the intervention group also received the decision aid.
Primary outcome was informed choice as assessed by group levels of knowledge, attitudes and uptake. Secondary outcomes were worries and decisional conflict.

ResultsA total of 339 citizens was eligible for analysis. The decision aid did not affect knowledge (mean difference in score change between intervention and control group: 0.00, 95% confidence interval (CI): -0.38;0.38). There were trends towards more positive screening attitudes (mean difference in score change: 0.72, 95% CI: -0.38;1.81) and higher screening uptake (7.6%, 95% CI:-2.2;17.4%). Worries decreased marginally (-0.33, 95% CI: -0.97;0.32) and decisional conflict was slightly reduced (mean difference: -3.5, 95%CI: -7.0;-0.1).

ConclusionsAn overall effect of the web-based decision aid on informed choice was not observed in this study, but being a simple intervention, easily administered in a screening programme, it could represent a cost-effective way of enhancing screening uptake, and some elements of informed decision-making.

Communicating screening in balance

116 - Oral Presentation

DONNA INFORMATA: a web decision aid tested in a randomized controlled trial in breast cancer screening centers. Preliminary results

Mosconi[1], Giordano[2], Paci[3], Satolli[4], Colombo[1], Candiani[4], Orione[5], Belmessieri[5], Marchiò[5], Mantellini[6], Falini[6], Verdi[6], Deandrea[7], Silvestri[7], Luciano[7], Valenza[8], Campari[9], Caroli[9], Faggiano[9], Castagno[2], Jaramillo[2], Roberto[1]
[1]Istituto di Ricerche Farmacologiche Mario Negri IRCCS, MILAN, Italy
[2]SSD Epidemiologia e Screening - CPO Piemonte - AOU Città della Salute e della Sc, TORINO, Italy
[3]LILT, Lega Italiana per la lotta contro i tumori, Sezione di Firenze, FIRENZE, Italy
[4]Zadig - Science and Health Publishing, MILANO, Italy
[5]Screening Unit, Cuneo, CUNEO, Italy
[6]SC Screening e Prevenzione Secondaria Istituto per lo Studio ISPRO, FIRENZE, Italy
[7]UOC Medicina Preventiva delle Comunità - Screening, UOS di Milano, MILANO, Italy
[8]U.O. Centro Gestionale Screening, Azienda Sanitaria Provinciale di Palermo, PALERMO, Italy
[9]S.S. Screening Oncologici - Azienda Unità Sanitaria Locale - IRCCS, REGGIO EMILIA, Italy

Background. Breast cancer (BC) is the most frequent cancer among women. Population-based mammography screening in Italy begins at the age of 45 or 50 years. Physicians, policy makers, general population and patient associations agree on the need to convey women complete information on potential benefits/harms and controversy to foster an aware decision process. Decision aids are considered effective tool to support health decisions, rarely tested in BC screening with randomized controlled trials (RCT). DONNA INFORMATA project aimed to design, develop and test a web-based decision aid to support informed choice about screening for BC.
Methods. With the support of a multidisciplinary group, the web decision aid was developed through literature review, results of three focus groups, and analysis of leaflets/websites on BC screening. It was tested in 6 screening centers through a pragmatic RCT comparing the web decision aid to the standard brochure. The impact is measured with a questionnaire at two weeks from the randomization and the allocation. The sample size was 816 questionnaires. The following endpoints are considered: informed choice, measured via knowledge, attitudes and intentions concerning BC screening as primary, and participation rate, satisfaction on information and the decisional conflict process, as secondary.
Results. The trial started on September 2017 and it will end in January 2019. About 21,000 women have been invited. Of these, 1,959 accepted to participate and 807 completed the two-week questionnaire. Preliminary results will be discussed next March, and presented at the ICSN 2019.
Conclusions. The results will provide information on how to improve the feasibility of a RCT in the setting of public, and transferability of the open source web decision aid. If the primary outcome informed choice will be reached, DONNA INFORMATA will available for public BC screening programs.
Trial registration: NCT03097653.
Funded by Italian Association for Cancer Research IG2015-17274.

Communicating screening in balance

143 - Oral Presentation

Reasons for non-follow up after a positive screening test in the Dutch colorectal cancer screening program: a qualitative study

L.S. Bertels[1], B.J. Knottnerus[1], P. Lucassen[2], E. Dekker[1], K.M. Asselt[1], H.C.P.M. van Weert[1]
[1]Amsterdam UMC, location AMC, AMSTERDAM, The Netherlands
[2]Radboud universitair medisch centrum, NIJMEGEN, The Netherlands

Background: Persons who receive an unfavorable result in the Dutch screening program for colorectal cancer (CRC) are recommended a colonoscopy. However, in 2016 12% (n=6578) did not undergo a colonoscopy, for unknown reasons. 8% of these individuals are estimated to have colorectal cancer and 43% an advanced adenoma. We investigated their motives for not undergoing a colonoscopy.
Methods: 21 semi structured in-depth interviews were conducted until data saturation was reached.
Results: The interviews were thematically analyzed using open coding and constant comparison. Five persons had not undergone the colonoscopy because they had recently undergone one. For the remaining 16, the found motives were divided into external factors and internal mechanisms.
External factors were the directive way the screening program is set up, influence of health care professionals (family physician or specialist), unfamiliar or distant colonoscopy location, having other things on mind, and increased deductible of medical insurance. Internal mechanisms found were foremost having a low risk perception for CRC, as well as a need for self-determination, distrust towards the screening organization, aversion to colonoscopy, and a certain life attitude comprising living day by day, not wanting treatment and fatalism. This attitude often followed experience of a critical life event. Arguments used to support the decision of not undergoing a colonoscopy included an alternative explanation for the blood found in the stool (e.g. hemorrhoids), ‘knowing the body’ or not experiencing CRC symptoms, living healthy and having a negative family history of CRC. These arguments may be indicative of cognitive biases, specifically an optimism bias and an illusion of control.
Conclusions: Low risk perception of colorectal cancer seems the main internal mechanism for not undergoing a colonoscopy after a positive screening result. Cognitive biases might be an underlying cause or a coping mechanism following this decision.

Communicating screening in balance

164 - Poster Presentation

How do women want to be informed about breast cancer screening's limits? Lessons learned from a 'think aloud' study in an Italian mammography screening programme.

De Nard[1], Deandrea[2], Bastiampillai[2], Carnevali[1], Cavazzana[1], Principi[1], Silvestri[2], Castaldi[3], Schulz[4]
[1]Post Graduate School of Public Health, University of Milan, MILAN, Italy
[2]Health Protection Agency Metropolitan City of Milan, MILAN, Italy
[3]Fondazione IRCCS Ca' Granda Ospedale Maggiore Policlinico, MILAN, Italy
[4]Institute of Communication and Health, Università della Svizzera Italiana, LUGANO, Switzerland

Background

Empowerment about the choice to attend breast cancer screening (BCS) programmes should be pursued by providing balanced information regarding benefits and harms. To assess acceptability and communicative effectiveness (CE) of such a strategy, the Health Protection Agency Metropolitan City of Milan tested information materials through a 'think aloud' study.
Methods
We tested an information leaflet (to be delivered with first invitation letter) and a questions-and-answers online set. Materials met readability (GULPease index ≥ 60), suitability and comprehensibility criteria (SAM+CAM score ≥ 70). Women aged 40-74 years from the Milan area (naïve to organized BCS for the leaflet group) were enrolled in hospital waiting rooms. We performed purposive sampling including different age ranges and health literacy levels (detected through the Single Item Literacy Screener). We used a 'think aloud' method. Statements concerning BCS main limitations (false positive and false negative results, overdiagnosis) were analyzed through content and thematic analysis. We detected comprehension and CE through semi-structured interviews. After amending the text on the basis of the results, we repeated the test.
Results
We analyzed 29 statements addressing BCS limitations from 18 out of 21 interviewees (range 1-5) at first, and 14 statements from 10 out of 13 women (range 1-3) after the amendments. An unclear explanation of overdiagnosis and negative emotional responses to BCS limitations were the critical issues emerged from the analysis. The text was thus made simpler and overdiagnosis' definition reworded in order to meet women's expectations. Subsequent interviews showed an increase in trust attitude. Overall comprehension remained optimal, while CE was unchanged (leaflet group) or slightly improved (web group: from 55,6% to 87,5%, p=0.294).
Conclusions
A negative framing of overdiagnosis may reduce trust in BCS. While providing complete and reliable information, women's concerns should be addressed, in order to prevent decisions being driven by distrust or fear.

Communicating screening in balance

167 - Poster Presentation

Perceptions about colorectal cancer screening after a non-cancer colonoscopy result. Qualitative study

Pia Kirkegaard[1], Edwards[2], Andersen[1]
[1]Department of Public Health Programmes, Randers Regional Hospital, Denmark, RANDERS, Denmark
[2]Division of Population Medicine, Cardiff University, CARDIFF, United Kingdom

Background: Population-based screening programs for colorectal cancer have been implemented in many countries using fecal occult blood testing (FOBT). Screening involves risks of 'false alarm' which might cause residual uncertainty and distress in some individuals, but results about psychological impact of screening participation are inconsistent. There is, however, little research on how participants perceive colorectal cancer screening when they have experienced a 'false alarm' for colorectal cancer, i.e. a positive FOBT followed by a non-cancer colonoscopy result.
The objective was to explore perceptions of colorectal cancer screening among screening participants with normal follow-up investigations, including perceptions about the relevance of colorectal cancer screening for themselves and for others in the future.
Methods: Semi-structured interviews were conducted with screening participants who had participated in the Danish colorectal cancer screening program and experienced a 'false alarm' for colorectal cancer. A thematic analysis was performed, based on an interpretive tradition of ethnography.
Results: Perceptions about colorectal cancer screening after a non-cancer colonoscopy result were characterized by trust in the colonoscopy result showing no colorectal cancer, and satisfaction with the offer to get screened despite the risk for 'false alarm'. The patient-involving behavior of the healthcare professionals during the examination was for most participants a cornerstone for trusting the validity of the colonoscopy result showing no CRC. Strong notions about perceived obligation to participate in screening were common.
Conclusions: The study suggests that patient involvement during colonoscopy may support patients' trust in the validity of the non-cancer colonoscopy result. Information to future invitees after a 'false alarm' experience could build on peoples' trust in the validity of a previous non-cancer result and should underscore the importance of subsequent screening even after a 'false alarm' for cancer.

Communicating screening in balance

176 - Oral Presentation

Persistent challenges to reducing overuse of cervical cancer screening in the United States

Rendle, Schapira, Ogden, Bocage, Eriksen, Glanz
University of Pennsylvania, Perelman School of Medicine, PHILADELPHIA, United States of America

Background. To examine the role of provider communication, patient awareness and beliefs, and updated screening guidelines on cervical cancer screening practices and preferences in the United States. **Methods**. Female patients (aged 21 or older) who received routine cervical cancer screening between April-June 2018 at the University of Pennsylvania Health System were identified from the electronic medical record. Eligibility for routine screening was confirmed during recruitment and all women identified as high-risk were excluded. A random sample of 150 patients were invited to participate, and 32 patients enrolled. A semi-structured interview guide and written questionnaire were used to examine: a) influential factors shaping screening modality decisions [Pap smear and/or human papillomavirus (HPV) testing]; b) strategies for decreasing overuse; and, c) perspectives on primary HPV testing as a screening strategy. A concurrent mixed-methods approach was used to describe and examine data. **Results**. The majority of respondents (68%) believed that women should be screened annually, and over half (53%) reported that they would be uncomfortable discontinuing screening at the recommended age of 65. In their last visit, most women (69%) reported that their provider recommended they return in 1-2 years for their next screening, with 53% reporting annual screening. If recommended by their provider, 34% and 53% of women stated that they would be comfortable being screened every five years using primary HPV testing or cotesting (respectively). In the interviews, women discussed several barriers to less frequent screening including: lack of awareness of screening guidelines and HPV testing, limited provider communication regarding screening choices, and concerns regarding the evidence supporting extended screening intervals. **Conclusions**. Overuse in cervical cancer screening is a persistent challenge in the United States. Patient and provider-level strategies to increase communication about and adoption of evidence-based screening are needed.

Communicating screening in balance

180 - Oral Presentation

Ten Ways to Enhance the Estimation, Reporting & Interpretation of the Cost-Effectiveness of Cancer Screening Interventions

J F O'Mahony
Trinity College Dublin, DUBLIN, Ireland

BACKGROUND: Despite the publication of cost-effectiveness analysis (CEA) methods guidelines, CEAs of cancer screening interventions often feature basic shortcomings in their analysis and presentation of results. This compromises their usefulness as guides to policy.

METHODS: We use examples from the cancer screening literature to show how the reporting and interpretation of cost-effectiveness estimates can fail to clearly identify optimal policy choices and how this can be avoided.

RESULTS: The ten recommendations are: (i) report costs and effects, rather than just incremental cost-effectiveness ratios (ICERs) or a cost-effectiveness plane; (ii) present a cost-effectiveness plane; (iii) report cost and effects for all strategies, not just those on the efficient frontier; (iv) do not report ICERs for dominated strategies; (v) do not report multiple ICERs for each strategy based on comparisons with multiple comparators (vi) report costs and effects to sufficient significant figures to permit at least approximate replication of the reported ICERs; (vii) include all relevant comparators in the basecase analysis; (viii) do not report ICERs for strategies for which it is anticipated the inclusion of additional strategies would lead to significant changes in the estimated ratio; (ix) when there are multiple factors to vary in a screening programme, only vary these factors one at a time when simulating alternative strategies; (x) if possible, attempt to include a sufficiently large variety of screening strategies such that the analysis yields an efficient frontier with ICERs that increase gradually from below the cost-effectiveness threshold to above it.

CONCLUSIONS: Our analysis shows there are a number of simple ways in which the estimation and reporting of screening cost-effectiveness can be improved. The ten-item list presented offers an easy-to-implement guide that will yield more reliable and relevant evidence for policy makers. These findings will be of use to analysts, journal editors and policy makers alike.

Communicating screening in balance

200 - Poster Presentation

A Simplified Model of the Cost-Effectiveness of Screening: An Open-Source Teaching and Research Tool Coded in R

J F O'Mahony[1], Y S Lin[1], J van Rosmalen[2]
[1]Trinity College Dublin, DUBLIN, Ireland
[2]Erasmus University, ROTTERDAM, The Netherlands

BACKGROUND: Models applied in cost-effectiveness analyses of cancer screening are typically designed to address specific policy questions and consequently tend to be large and complex. They are not well suited to teaching the fundamentals of cancer screening modelling or to demonstrating novel modelling methods.

METHODS: We describe a lightweight, fully shareable and transparent screening model for teaching and methods research. This is a simplified, discrete-event, microsimulation model of cancer screening coded in R and supported with an Excel-based user interface for the specification of input parameters. We demonstrate the model's components relating to the natural history of disease, test performance and anticipated health gain and healthcare costs. Using comparative statics, we show how the efficient frontier and incremental cost-effectiveness ratios of alternative screening programmes vary with changes in key parameters such as disease incidence and test sensitivity.

RESULTS: We demonstrate how the choice of the optimal screening policy for a given cost-effectiveness threshold varies as key parameters are changed once at time. This informs a more intuitive understanding of screening cost-effectiveness and its variation between alternative interventions. As such, the model provides a tool with which to demonstrate the qualitative relationships between parameters and optimal policy in a way that is faster and more accessible than employing a full applied model. Further applications and extensions of the model, including probabilistic sensitivity analysis and calibration, are described.

CONCLUSIONS: The simplified model provides a transparent and easy-to-use demonstration of the fundamentals of the cost-effectiveness of screening. The model is fully shareable and represents a useful open-source teaching and research tool to enhance methods research in the cost-effectiveness of screening. Most models used in applied research are based on proprietary code, which compromises transparency and hinders methods research. Our simplified model avoids these problems and can be easily employed and adapted by anybody.

Communicating screening in balance

227 - Poster Presentation

Synthesis Pathway Maps of Breast and Colorectal Cancer Screening Programs in Canada: The Patient Perspective

AD Domingo[1], PJ Jones[2], MM Mitchell[1], CP Politis[1], EN Nicholson[1], NB Baines[1]
[1]Canadian Partnership Against Cancer, TORONTO, Canada
[2]OCAD University, TORONTO, Canada

Background: A seamless patient experience in screening can be supported by an integrated and person-centred system that is responsive to the needs and preferences of patients and their families. Embedding a person-centred perspective in the planning and delivery of care is a cancer system priority advanced by the Canadian Partnership Against Cancer (the Partnership). In efforts to better understand the patient experience in screening and identify opportunities for improvement, the Partnership collaborated with OCAD University Health Design Studio to map the patient experience for breast and colorectal screening programs in Canada.
Methods: Pathway maps were informed by an environmental scan and key informant interviews. A jurisdictional review of breast and colorectal screening programs was conducted to map the programmatic pathway from recruitment for eligible individuals through to test acquisition and completion, and notification of a result. Programmatic screening pathways were validated by program screening leads, and patient experiences were mapped based on interviews with patient advisors.
Results: Each map presents two personas with experiences shared from patients who received a normal or abnormal result. Enablers of a seamless experience in screening identified by patients include: coordination of services and communication between levels of care; primary care involvement in facilitating screening decisions and empowering patients to ask questions; access to patient navigators; and social support from relatives and friends. Challenges identified include: potential harms of screening procedure; service wait time; limited access to primary care; and fear and anxiety of test results.
Conclusions: Pathway maps illustrate the programmatic screening process as experienced by patients and serve as tools for enabling informed and shared decision making between patients and health care providers. Use of pathway maps increase awareness of the importance of person-centred care in screening and the need for continued efforts to improve the patient experience as a cancer system priority.

Communicating screening in balance

237 - Poster Presentation

Implicit and Explicit Attitudes, and informed decisions in the Context of Breast Cancer Screening

L.M. Kregting, N.T. van Ravesteyn, T. Dierks, H.A. Geuzinge, H.J. de Koning, I.J. Korfage
Erasmus MC, ROTTERDAM, The Netherlands

BACKGROUND
The participation rate of breast cancer screening has been decreasing slightly over the past years in the Netherlands. It is not clear why fewer women attend and whether they make an informed decision. To understand this, we will investigate the role of explicit attitudes and implicit associations towards and knowledge about breast cancer screening on participation.
METHODS
Women aged 49-74 were invited to participate in this study four months before they were invited for the population-based breast cancer screening program. By means of a web-based questionnaire, data regarding explicit attitude, breast cancer screening knowledge, intention to participate and demographics were collected. Also a priming task was included to determine implicit associations based on response time. We assessed correlations between implicit association and explicit attitude, breast cancer screening knowledge, and intention to participate.

RESULTS
Preliminary analyses of 1034 participating women, of whom 436 completed the prime task, showed that 802 (89%) had adequate knowledge and 736 (84%) made an informed choice (based on intention to participate). Implicit association was correlated with level of education (0.15, $p=0.002$) and previous invitation for screening (0.10, $p=0.036$). No correlation was seen between implicit associations and intention (0.083, $p=0.082$), and explicit attitude (0.022, $p=0.652$). Correlations were seen between intention and explicit attitude (0.68, $p<0.001$), and previous participation (0.58 $p<0.001$) and between explicit attitude and level of education (0.07 $p=0.04$) and previous participation (0.37 $p<0.001$).
CONCLUSIONS
The majority of women invited to the Dutch breast cancer screening program had adequate knowledge and made an informed participation decision. Implicit associations towards breast cancer screening were not found to be correlated with intention to participate in breast cancer screening, but was found to correlate with level of education and a previous invitation for breast cancer screening. Future analyses will study the relation between implicit association and actual attendance.

Communicating screening in balance

241 - Poster Presentation

Lung cancer screening decision-making among African Americans in Detroit, USA

Lau[1], Hung[1], Bhattarai[1], Arenberg[1], Caverly[1], Coté[2], Meza[1]
[1]University of Michigan, ANN ARBOR, United States of America
[2]Karmanos Cancer Institute, DETROIT, United States of America

Background
Significant disparities in the burden of lung cancer exist in the US, where African American men have the highest incidence rate for the disease compared to other groups. However, to the best of our knowledge, the available web-based decision aids for lung cancer screening have not been designed with substantive feedback from this high-risk group. Therefore, we sought to evaluate and redesign an existing decision aid with input from African Americans in Detroit.
Methods
Using insights obtained from participatory design workshops, we implemented content changes to http://shouldiscreen.com/ and evaluated this modified version with a before-after study. Surveys took place between April and July 2018. Data were collected from 78 participants who were current/former smokers, had no history of lung cancer, and aged between 45 and 77.
Results
Knowledge about lung cancer risk factors and screening between before and after viewing the modified decision aid was 6.4 and 8 out of 15 points respectively. Notably, half of the participants felt uncomfortable answering surveys electronically and requested paper versions. There was a 31% improvement in knowledge score among those who took the electronic survey (6.7 to 8.8), while it was 18% for paper (6.1 to 7.2). Acceptability was high – 93% said the decision aid helped them consider lung cancer screening. Concordance between individual preference and eligibility for screening changed from 22% to 33%.
Conclusions
Improvements in knowledge and concordance were modest. Additional design modifications and modes of information delivery of current decision aids should be considered to increase their ability in helping populations of lower educational attainment and computer literacy learn about lung cancer screening. Partnering with community organisations to demonstrate the use of the tool and explain the benefits of lung cancer screening is paramount to help a population that stands to gain much from this procedure.

Reaching the hard-to-reach populations

11 - Oral Presentation

Financial Incentives to Increase Colorectal Cancer Screening and Decrease Screening Disparities: A 3-arm Randomized Controlled Trial

BB Green[1], ML Anderson[1], AJ Cook[1], J Chubak[1], S Fuller[1], KJ Kimbal[1], JT Kullgren[2], RT Meenan[3], SW Vernon[4]
[1]Kaiser Permanente Washington, SEATTLE, United States of America
[2]University of Michigan School of Medicine, ANN ARBOOR, United States of America
[3]Kaiser Permanente Northwest, PORTLAND, United States of America
[4]University of Texas, HOUSTON, United States of America

Background: Colorectal cancer screening rates are suboptimal, particularly among disadvantaged populations. The study objective was to determine whether fixed (monetary) or propablistic (lottery) financial incentives conditional on completion of colorectal cancer screening increased screening uptake and decreased screening disparities.

Methods: A parallel three-arm randomized controlled trial was conducted between March 2017 and May 2018 with twenty-two medical centers in an integrated health care system in Washington state. 838 participants age-eligible and overdue for colorectal cancer screening were enrolled and randomized to either: (1) Up to three mailings with information on the importance of colorectal screening, screening test choices, a mailed fecal immunochemical test (FIT), and a reminder letter; or this plus one of two different financial incentives conditional on completion of colorectal cancer screening: (2) Guaranteed Monetary ($10US cash); or (3) Probabilistic Lottery (1 in 10 chances of $50US). The primary outcome was completion of colorectal cancer screening within 6 months. Secondary outcomes included FIT completion and colonoscopy completion within 6 months. Intervention effects were compared across sociodemographic subgroups and self-reported psychosocial measures.

Results: Participants were predominantly female (65%) and non-White or of Hispanic ethnicity (48% non-White race, 12% Hispanic). Completion of any colorectal screening was not significantly higher among +Monetary (76.6%) and +Lottery (74.7%) than mail only (71.5%), P=0.11. When limiting the analysis to FIT, there was a statistically significant intervention effect (P=0.032), with a net increase of 8.1% (+Monetary) and 7.0% (+Lottery) compared to mail only. Patient subgroups more responsive to financial incentives included those with Medicaid insurance (FIT completion rates: mail only 42.9%, +Monetary 81.8%, +Lottery 82.6%; P=0.028).

Conclusion: Financial incentives increased FIT uptake, but not colonoscopy completion. Financial incentives combined with direct mailing of FIT kits may decrease FIT completion disparities among some disadvantaged and harder-to-reach groups

Reaching the hard-to-reach populations

12 - Poster Presentation

A geographical display tool for participation in a population-based cancer screening programme

Van Hal, Goossens, Martens, Hoeck, Kellen, Jidkova, Andries
Centre for Cancer Detection, ANTWERP, Belgium

Goossens M, Martens P, Van Hal G, Hoeck S, Kellen E, Jidkova S, Andries E
Centre for Cancer Detection, Belgium

Abstract

Background

Providing comprehensive participation and coverage rates for a population-based cancer screening programme (PCSP) to national and local stakeholders is an important but challenging aspect of a quality management system. At the Flemish Centre for Cancer Detection (CvKO) we aimed to have a user friendly tool to display participation rates on several geographical levels.

Method

We upload participation and coverage data on a yearly basis into the existing *Swing Mosaic* tool (www.abfresearch.nl). This is done for all three Flemish PCSP (colorectal cancer, cervical cancer, breast cancer) in cooperation with the Belgian Cancer Registry who provides the CvKO with oncological data and reimbursement based opportunistic screening data .

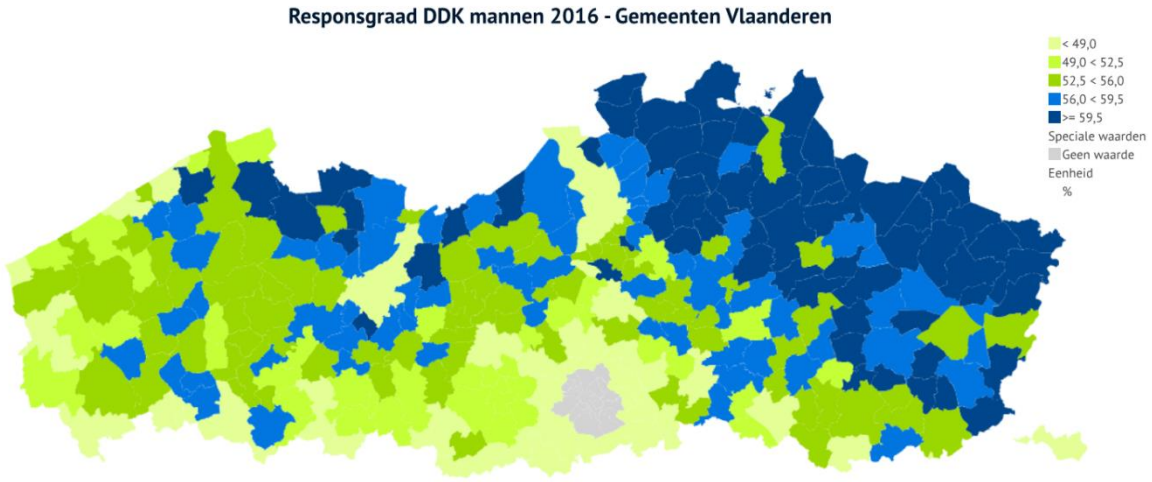
Results

The website bevolkingsonderzoek.incijfers.be easily and rapidly displays participation rates at the level of the municipality and other larger geographical areas (such as provinces). By clicking on a municipality it is also possible to visualise the number of people in the target group, number of screenings, etc. By generating tables, the tool also allows to make comparisons between areas, and graphs can be made to visualise the evolution in rates. Downloads can be made to excel, pdf and other formats. Privacy concerns are dealt with by displaying no data for areas in which fewer than 5 people live. The tool also contains information on how the indicators are calculated, thereby increasing transparency.

Conclusion

The developed tool allows easy and comprehensive display of reliable participation and coverage rates, accessible to everyone. At the moment the website is only accessible in Dutch.

Picture 1:



Caption 1: Participation rate colorectal cancer screening - men 2016 (Flemish Communities)

Reaching the hard-to-reach populations

42 - Oral Presentation

HPV SELF-SAMPLING AS A TOOL TO REDUCE SOCIAL INEQUALITY IN CERVICAL CANCER SCREENING PARTICIPATION

Tranberg[1], Bech Hammer[2], Blaakær[3], Skov Jensen[4], Svanholm[1], Andersen[1]
[1]Randers Regional Hospital, RANDERS NØ, Denmark
[2]Aarhus University, AARHUS, Denmark
[3]Department of Obstetrics and Gynecology, ODENSE, Denmark
[4]Statens Serum Institut, COPENHAGEN, Denmark

Background:
Social inequality in cervical cancer screening participation exists. Self-sampling for high-risk human papillomavirus testing (HPV self-sampling) improves participation among non-participants. We evaluated if all socioeconomic groups of non-participants benefit from self-sampling and if the invitation strategy for offering self-sampling influences participation in various socioeconomic groups.
Method:
The study was based on registry data applied to data from a randomized controlled trial (N= 9,791) measuring the effect of self-sampling on participation among Danish women aged 30-64 due to receive their second screening reminder. The women received either: 1) self-sampling kit mailed directly to their homes (directly mailed group), 2) invitation to order the kit (opt-in group), or 3) a standard second reminder to attend routine cytology screening (control group). Women offered self-sampling could also attend routine cytology screening if wanted. Participation was analyzed as intention-to-treat and linked to registry data on socioeconomic factors.
Result:
Women in the directly mailed group participated more often than women in the control group, regardless of their socioeconomic status. The largest effects occurred in Western immigrants (participation difference (PD): 18.1%, 10.2-26.0%) and social welfare recipients (PD: 15.2%, 9.7-20.6%). Compared with the control group, opt-in self-sampling increased participation in most socioeconomic groups, but immigrants, retired, or less educated women had no significant effect. Western immigrants had a significantly higher increase in participation than native Danish women when kits were mailed directly, compared with the opt-in strategy (PD: 18.1%, 10.2-26.2% and PD: 5.5%, 2.9-8.1%, respectively).
Conclusion:
All socioeconomic groups benefitted from the directly mailed strategy in terms of higher participation, but Western immigrants and social welfare recipients benefitted the most, indicating that this intervention may be a promising tool to reduce social inequality in participation. As immigrants and some lower socioeconomic groups had only insignificant effect of opt-in self-sampling, the directly mailed strategy may be favored.

Reaching the hard-to-reach populations

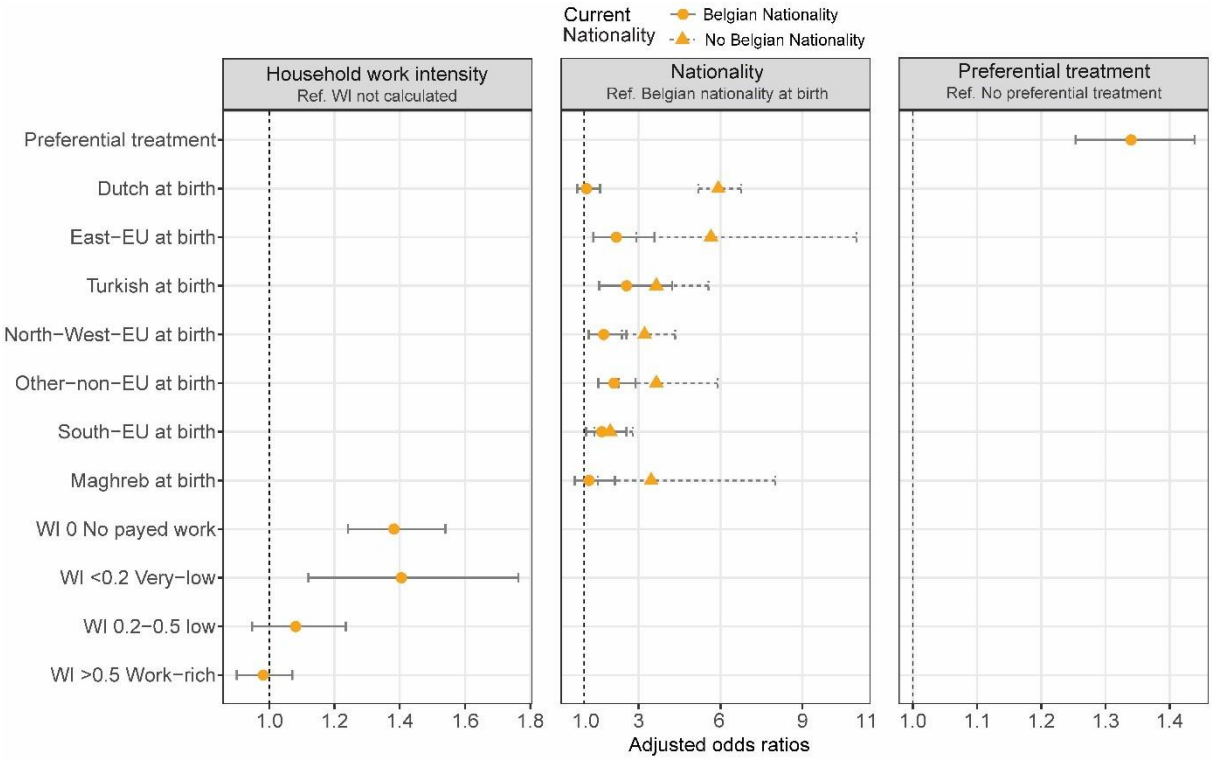
46 - Poster Presentation

Are socio-demographic factors associated with adherence to follow-up colonoscopy after a positive FIT in the colorectal cancer screening programme in Belgium (Flanders)?

Hoeck[1], Van de Veerdonk[1], De Brabander[2]
[1]University of Antwerp, ANTWERP, Belgium
[2]Belgian Cancer Registry, BRUSSELS, Belgium

Background: In Belgium (Flanders), a population-based colorectal cancer (CRC) screening programme started in 2013, coordinated by the Centre for Cancer Detection (CCD) in cooperation with the Belgian Cancer Registry (BCR). The CCD offers a biennially faecal immunochemical test (FIT) to Flemish citizens aged 56-74. A positive FIT should be followed by a colonoscopy. The study's objective is to investigate sociodemographic differences in adherence to follow-up colonoscopy after a positive FIT.
Methods: Characteristics of the study population were derived by linkage of the social security number with data of the CCD, BCR and the Crossroads Bank for Social Security, resulting in aggregated tables to ensure anonymity. 37,834 men and women aged 56-74 with a positive FIT in 2013-2014 were included to explore differences in adherence to follow-up colonoscopy. Adherence was calculated for age, sex, work intensity at household level, preferential reimbursement status and first and current nationality. Descriptive analyses and logistic regression were performed.
Results: Non-adherence to follow-up colonoscopy was associated with increasing age, and significantly higher in men (OR 1.08), participants with preferential reimbursement status (OR 1.34), very low work intensity (OR 1.41), no payed work (OR 1.38) and other than Belgian nationality (OR ranging from 1.6 to 4.65).
Conclusion: To increase health benefits at population level, adherence to follow-up colonoscopy after a positive FIT is crucial. Strategies to improve uptake in Flanders are needed and should be directed at all stages of screening, including follow-up after a positive FIT and especially in the subgroups defined in this study.

Picture 1:



Caption 1: Adjusted ORs for non-adherence to follow-up colonoscopy after positive FIT in the CRC screening programme according to socio-demographic factors.

Reaching the hard-to-reach populations

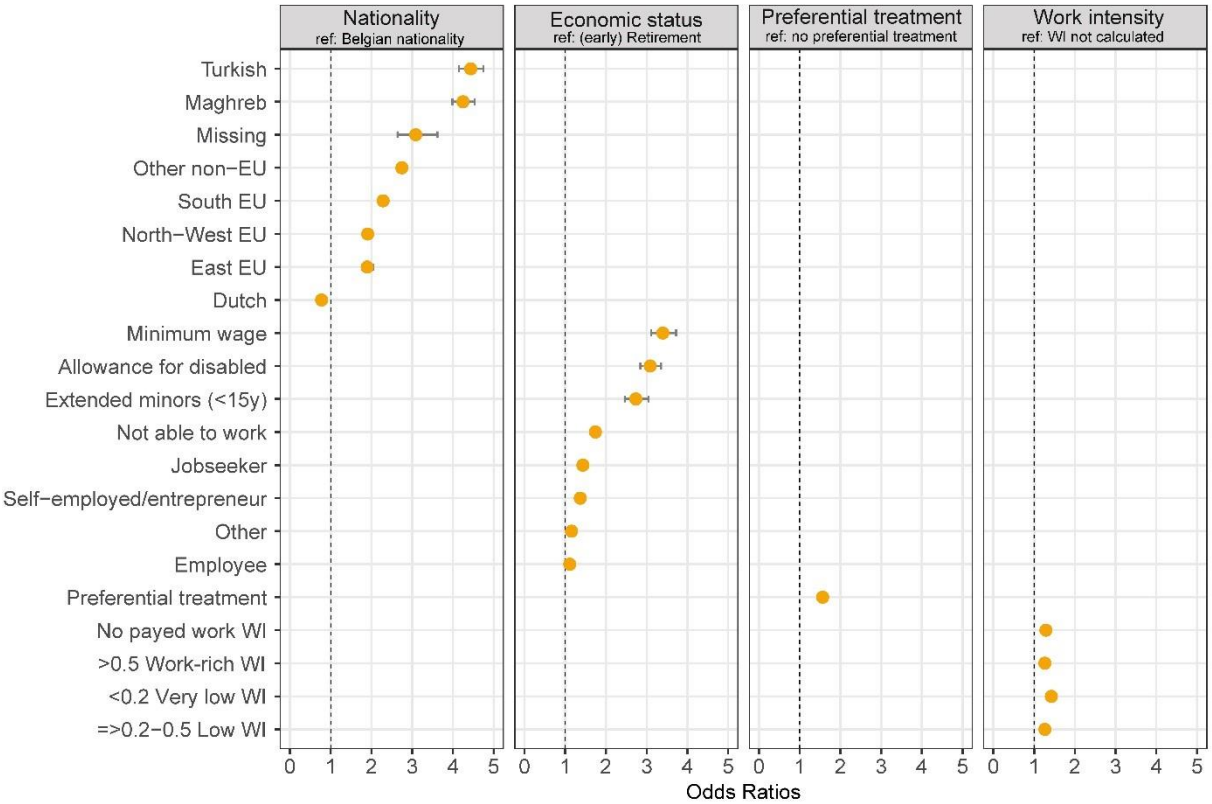
47 - Poster Presentation

Does the Flemish colorectal cancer screening programme reach equity in FIT uptake?

Hoeck[1], Van de Veerdonk[1], De Brabander[2], Kellen[3]
[1]University of Antwerp, ANTWERP, Belgium
[2]Belgian Cancer Registry, BRUSSELS, Belgium
[3]University Hospital Leuven, LEUVEN, Belgium

Background: In Flanders (Belgium), a population-based colorectal cancer (CRC) screening programme started in 2013. The Centre for Cancer Detection (CCD) offers a biennially faecal immunochemical test (FIT) to Flemish citizens aged 56-74. The starting age is gradually extended to 50 years in 2020. The study's objective is to investigate FIT uptake according to sociodemographic factors.
Methods: Characteristics of the study population were derived by linkage with data of the CCD, Belgian Cancer Registry and the Crossroads Bank for Social Security. The social security number was used as an unique patient identifier between all databases, resulting in aggregated tables to ensure anonymity. FIT uptake was calculated for age, sex, first and current nationality and several proxies for socio-economic status. Descriptive analyses and logistic regression were performed.
Results: In this study 1,184,426 men and women aged 56-74 invited in 2013-2014 were included. The overall screening uptake was 52,3% and varied by nationality and socio-demographic factors. Lower uptake was associated with the youngest and oldest age categories (56-60 and 70-74), being male, having an allowance for being disabled, entitled to preferential reimbursement status, not being able to work, being an extended minor and having a social allowance/minimum wage. All other nationalities than Belgian or Dutch were significantly more likely not to be screened.
Conclusion: There is a significant difference between FIT uptake and sociodemographic factors in the first two years of the population-based screening programme in Flanders. Based on the study results, implementing strategies to improve participation in those subgroups is needed.

Picture 1:



Caption 1: Adjusted ORs (for age and gender) for not being screened in the CRC screening programme in Flanders according to socio-demographic factors

Reaching the hard-to-reach populations

54 - Poster Presentation

Are there inequalities in the uptake of colorectal cancer screening programmes? A systematic review

I Mosquera[1], I Portillo[2], N Mendizabal[3], U Martín[4], A Bacigalupe[4], CRC inequalities study group[5]
[1]Biocruces Health Research Institute, BILBAO, Spain
[2]Colorectal Cancer Screening Programme. Basque Health Service, BILBAO, Spain
[3]Primary Care Research Unit of Bizkaia, BILBAO, Spain
[4]Department of Sociology 2. University of the Basque Country, LEIOA, Spain
[5]Basque Health Service, BILBAO, Spain

Background
Colorectal cancer (CRC) is a major public health problem due to its incidence and mortality. Screening programmes help decrease its impact on the population through early detection. However, the uneven distribution of social determinants of health can cause inequalities. The aim of this study was to identify the social inequalities in the uptake of CRC screening programmes.
Methods
A systematic review of the literature was carried out searching in health and social databases for papers published since 2000 in English, Spanish, Portuguese and French. The search strategies combined terms regarding screening, CRC, participation and social inequalities. Included papers were quantitative or qualitative primary studies analysing gender, socioeconomic and geographic inequalities in the uptake of CRC screening programmes implemented by public institutions and addressing 45 to 75 year-old population. Studies based on self-reported data of participation were excluded.
Results
The review included 112 studies described in 115 articles. They were carried out mainly in the UK (n=30) and the USA (n=20). Most assessed population-based screening programmes, but opportunistic screenings were also identified (n=21). A wide variety of screening techniques were used.
Participation in screening programmes varied from 7.3% using various techniques to 67.2% with faecal immunochemical test (FIT). The majority of the studies assessed uptake by sex, but failed to provide an analysis from a gender perspective. Most found that women were more likely to participate. Findings were inconclusive regarding distance to screening centre. Regarding deprivation, which was assessed mainly in the UK, both at an individual and small area level, there was a gradient favouring those in a most advantaged position. Several studies found access inequalities.
Conclusions
There was a great variability in studies, being inequalities in uptake by sex and deprivation the most relevant findings. Screening techniques and health insurance play an essential role in participation.

Reaching the hard-to-reach populations

89 - Poster Presentation

Using an Ecological Model and FIT to Increase Colorectal Screening Rates in an Urban Community-a pilot study

Alzate-Duque, Otero, Doshi, Natale-Pereira
Rutgers New Jersey Medical School, NEWARK, United States of America

Colorectal Cancer(CRC) is the second leading cause of cancer-related deaths in the US(1). In 2014, Newark ranked 471 among the 500 largest cities in the US in colorectal screening(2). A multifaceted approach involving the creation of accessible, culturally acceptable, and actionable interventions is necessary to tackle colorectal screening disparities in minority populations, such as that of Newark, NJ(3).
Community engagement and patient navigation have aided in reduction of cancer care disparities(4,5). Fecal immunochemical testing(FIT) has become the most common method for CRC screening worldwide(6).
We hypothesize an ecological model intervention in combination with FIT will increase colorectal screening rates.
Recruitment occurred at community-based events. Eligibility criteria included being between 45-85 years old and not being up-to-date with recommended screening. Participants were given and instructed on completion of FIT kits for return within 2 weeks. Patient navigators performed language concordant motivational interviews to ensure FIT return.
Eighty-one persons received education; 34 met eligibility criteria. Four participants(11%) were male. The mean age was 60.6 years. Most participants reported not having a primary care provider(PCP), insurance, or prior screening.
Forty-four percent of FIT kits were returned. Individuals without a PCP or without insurance, in comparison to the counterparts, were less likely to have had prior screening.
By 60, participants should have undergone at least 2 screenings based on recommendations. This is an at-risk population that would not achieve screening. Barriers to FIT kit return were misplaced or lost FIT kit, lack of time, and feeling uncomfortable handling fecal sample were addressed through motivational interviewing. Limitations of this study include low number of participants.
In conclusion, the use of an ecological model has the potential to improve colorectal screening rates for at-risk populations. Additional research is warranted to assess multifaceted approaches along with FIT uptake among other at-risk populations who necessitate culturally acceptable interventions.

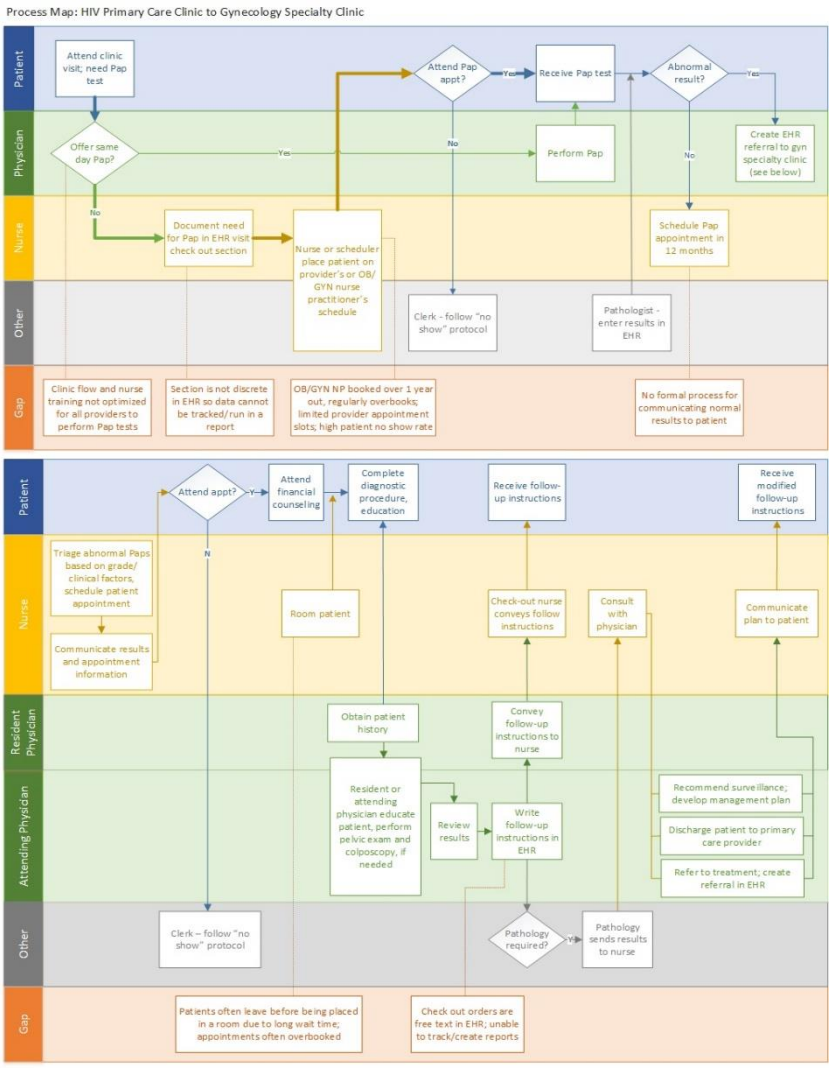
Reaching the hard-to-reach populations

90 - Oral Presentation

Delivering cervical cancer screening and follow-up to women with HIV in an integrated safety-net setting

Rodriguez[1], Betts[1], Higashi[1], Luque[1], Werner[1], Chavez[1], Lee[1], Tiro[1], Barnes[2]
[1]University of Texas Southwestern Medical Center, DALLAS, United States of America
[2]Cornell Scott Hill Health Center, NEW HAVEN, United States of America

Background: Women with HIV have elevated risk of cervical cancer compared to women without HIV. In our safety-net setting, 56% of women with HIV are under-screened for cervical cancer, and only 40% completed follow-up colposcopies when indicated. This study developed process maps to 1) illustrate patient flow, provider and staff inputs, and gaps in cervical cancer screening and follow-up for women with HIV; and 2) identify intervention opportunities to optimize screening and follow-up.
Methods: We conducted interviews with providers and staff in HIV primary care and gynecology specialty clinics. Topics included: screening/follow-up processes; provider-patient communication; patient transition between clinics; perceived barriers to screening/follow-up; and suggestions for improvements. Interviews were double coded with three deductively driven codes: care processes; barriers to care; and intervention opportunities. We developed process maps iteratively presenting drafts to clinic stakeholders and patients for refinement.
Results: Gaps in care delivery included: 1) electronic health records (EHR) limitations identifying/tracking patients overdue for screening/follow-up; 2) logistics (e.g., scheduling, staffing, equipment); 3) inconsistent communication between clinics; and 4) primary care provider discomfort performing Pap tests. Intervention opportunities included adaptation of EHR documentation and reporting systems and development of a surveillance registry to identify/track women overdue for screening/follow-up.
Conclusion: We identified disparities in care for women living with HIV within our integrated safety-net healthcare system and system-level gaps as patients interfaced with multiple teams moving from primary care to specialty care following abnormal Pap results. Addressing these gaps is critical for this subpopulation of women at elevated risk of cervical cancer.



Picture 1:
Caption 1: Process Map: HIV Primary Care Clinic to Gynecology Specialty Clinic

Reaching the hard-to-reach populations

104 - Oral Presentation

Australian National Bowel Cancer Screening Program: the optimal screening age range for Aboriginal and Torres Strait Islander peoples

Lew[1], Feletto[1], Worthington[1], D'Onise[2], Miller[3], Karla[3], Canfell[1]
[1]Cancer Council NSW, WOOLLOOMOOLOO, Australia
[2]South Australian Department for Health and Wellbeing, ADELAIDE, Australia
[3]South Australian Health and Medical Research Institute, ADELAIDE, Australia

Background: The Australian National Bowel Cancer Screening Program (NBCSP) will provide biennial immunochemical faecal occult blood test (iFOBT) screening to average-risk Australians aged 50-74 years from 2020. Aboriginal and Torres Strait Islander peoples, representing 3.3% of the total Australian population, have a younger mean age of colorectal cancer (CRC) diagnosis (61 years) than non-Indigenous Australians (69 years) and poorer health outcomes. This study aims to (i) adapt a previously developed Australian model of CRC natural history and screening for Aboriginal and Torres Strait Islander peoples, and (ii) identify the optimal NBCSP screening age range for this population subgroup.
Methods: A microsimulation model, *Policy1-Bowel*, was adapted to simulate CRC screening for Aboriginal and Torres Strait Islander peoples. The model was parameterised and calibrated to the best available data on burden of disease, NBCSP outcomes and demographic information.
Results: Compared to non-Indigenous Australians, Aboriginal and Torres Strait Islander peoples had lower life-expectancy (71.6 vs. 80.4 years for males, 75.6 vs 84.6 years for females), lower CRC incidence rates for people 65 and over (71.2/100,000 vs. 92.3/100,000), lower reported NBCSP participation rate (19.5% vs. 41.0%), and higher iFOBT positive rate (11.1% vs 7.7%). Aboriginal and Torres Strait Islander CRC patients were more likely to be diagnosed at advanced stage and had a lower survival rate than non-indigenous CRC patients. *Policy1-Bowel* was calibrated to these data and was used to estimate health benefits (CRC incidence and mortality), harms (excessive colonoscopy assessments), and cost-effectiveness of the biennial iFOBT screening from 40, 45, and 50 to 74 years for this population subgroup.
Conclusions: The study findings will inform the optimal NBCSP age range for Aboriginal and Torres Strait Islander peoples, considering the health benefits, harms and cost-effectiveness associated with different screening age ranges. *Policy1-Bowel* could also be adapted to evaluate CRC screening for other population subgroups.

Reaching the hard-to-reach populations

110 - Oral Presentation

INEQUALITIES IN SCREENING AND RISK FACTORS ASSOCIATED TO COLORECTAL CANCER IN NON PARTICIPANTS

IP Portillo[1], MS Solis[1], AL Lebeña[1], JLB Bilbao[1], JLH Hurtado[2], LMI Martinez-Indart[3], II Idigoras[1], IB Bilbao[1]
[1]The Basque Health Service, BILBAO, Spain
[2]Araba Integrated Health Service, VITORIA, Spain
[3]BioCruces Research Institute, BARAKALDO, Spain

Colorectal Cancer (CRC) Screening started in 2009 in the Basque Country (Spain), targeting 50-69y (586,700) by biennially Immunochemical quantitative test (FIT) and colonoscopy under sedation in positive cases. Although the participation rate was very high (>70%), inequalities by sex, age and deprivation index have been identified. Still, inequalities in cancer risk factors such as diabetes, hypertension, tobacco, obesity were found as well. And, non participation in the screening was related to less survival in case of CRC.
Objective
To analyse specific risk factors associated to non participation and lesion detected in the CRC screening.
Methods
People invited from 2015 to 2017. Link the screening database with risk factors detected in the patient medical record before the invitation date. Variables: sex, age, participation in previous rounds, FIT participation and colonoscopy compliance in the current round, lesions detected, diabetic, hypertension, smoker and obesity. Alcohol intake and lifestyle were not available. Deprivation quintile and morbidity index were added. Frequencies, Chi-square and Multivariable analysis were performed by SPSS v 23.0.
Results
515,388 invitations were registered, 72.7% participated in FIT and 93.8% had definitive colonoscopy (19,593 positive cases). 23.1% have never participated in the programme, significantly higher in men and 50-60y. In multivariable analysis, probabilities for non participation were found in FIT: being men, diabetic, hypertensive, non overweight and most deprived quintile. However, no compliance in colonoscopy was found for non smoker, not overweight, and low or high comorbidity level. Neither of them obtained a significant area in ROC curve. 6,651 advanced adenomas and 757 CRC were detected, significantly higher in men in both cases and with differences depending on deprivation and comorbidity index.
Conclusions
Although inequalities were found in our study, many predictor factors of non participation are unknown. Moreover, qualitative studies are needed in order to carry out interventions to improve it.

Reaching the hard-to-reach populations

126 - Poster Presentation

An intervention to improve BowelScreen uptake among hard-to-reach clients and middle-income areas in Ireland

Mooney[1], Byrne[1], Fahy[1], Ryan[1], Heffernan[1], Yeates[2], Fitzpatrick[3], Coffey[1]
[1]National Screening Service, DUBLIN, Ireland
[2]Marie Keating Foundation, DUBLIN, Ireland
[3]University College Dublin, DUBLIN, Ireland

Background:
BowelScreen, the Irish National bowel cancer screening programme commenced in 2012. The first round had an uptake of 40.2% against a standard of >50%. International research has shown a letter of endorsement from a respected group or person can increase uptake by up to 9%. In addition, outdoor advertising can raise awareness of the bowel screening programme. The aim was to increase uptake among initial invitees and to raise awareness of BowelScreen.
Methodology:
Two intervention areas were selected; one in a hard-to-reach area of Dublin and one in Galway, a middle-income area. Comparison areas with similar population size and deprivation score eliminated contemporaneous confounding factors of uptake. The intervention involved 1) a plain-English letter of endorsement from the Marie Keating Foundation , a well-respected cancer charity, encouraging uptake; 2) advising of a drop-in centre in busy local shopping centre where a nurse would explain the test and answer questions on four consecutive Fridays; 3)sensationalised outdoor advertising .
Results:
Following the intervention in Dublin, there was a 6.4% increase in uptake compared to the comparison area. An extreme weather event in the region may have affected both arms, as clients may not have travelled to the shopping centre or to post their sample. The intervention in Galway was held at a different time with a 7.1% increase in uptake. Uptake in all areas remained suboptimal. During the intervention period in Galway, a controversy erupted about cervical screening in Ireland. This may have affected confidence in all screening programmes, but would have affected both intervention and comparison areas equally.
Conclusion:
It is difficult to tease-out the multiple parts of this intervention, however overall uptake among initial invitees increased by 7.3%. Uptake of bowel screening may be improved in disadvantaged and middle-income areas by the endorsement of a respected agency.

Reaching the hard-to-reach populations

175 - Poster Presentation

Individual invitation of non-attenders to Czech colorectal cancer screening programme: results after four years

Majek[1], Ngo[1], Zavoral[2], Suchanek[2], Seifert[3], Jung[4], Chloupkova[1], Dusek[5]
[1]Masaryk University, Institute of Health Information and Statistics, BRNO, Czech Republic
[2]Military University Hospital, PRAGUE, Czech Republic
[3]1st Faculty of Medicine, Charles University, PRAGUE, Czech Republic
[4]Ministry of Health of the Czech Republic, PRAGUE, Czech Republic
[5]Masaryk University, Institute of Biostatistics and Analyses, BRNO, Czech Republic

Background
Individual invitation to cancer screening programmes is recommended to promote their high effectiveness. The aim of our study was to investigate participation rates after invitation of previous non-attenders.
Methods
Participants in Czech colorectal cancer (CRC) screening programme are enrolled by GPs or gynaecologists as part of their regular preventive check-up (faecal immunochemical test, FIT) or directly by gastroenterologists (screening colonoscopy). A project was initiated in 2014 to introduce invitation of non-attenders by health insurance companies, which cover the entire population. Eligible individuals aged 50 to 70, who had not recently attended CRC screening examination, have been personally invited, possibly to more than one screening programme if eligible.
Results
Between January 2014 and June 2015, 1,720,143 individuals received their first invitation. Participation rate was 22% in total and was slightly higher for women. The participation rate was highest in the group of women invited only for CRC screening (i.e., already attending breast and cervical screening) – 30%. Altogether, more than 2.2 million of individuals were invited in 2014-2017 (4.6 million of invitations), 40% participated at least once. Considering invitations sent in 2017, 24% of individuals participated after first invitation; however, the rate decreased with further invitations. Only 17%, 15%, and 9% of individuals responded to their second, third, and fourth invitation, respectively. Whereas coverage by FIT in age group 55-69 was 31% in 2013, it was already 39% in 2015; however, the coverage then dropped again to 35% in 2017. The responders to invitation contributed 6 percent points to coverage in 2015 and 5 percent points in 2017.
Conclusions
The project integrating the invitation of non-attenders was partially effective for Czech CRC screening, where spontaneous attendance had led to a low coverage. Unfortunately, the invitation effectiveness is decreasing, underlining the need to further optimize the organization of the programme.

Reaching the hard-to-reach populations

178 - Oral Presentation

Predictors of modifiable failures to screen for colorectal cancer at appropriate intervals or follow-up on abnormal results

Doubeni[1], Jensen[2], Levin[2], Schottinger[3], Selby[4], Wainwright[1], Saia[1], Lee[2], Williams[5], Mehta[1], Corley[2]
[1]University of Pennsylvania, PHILADELPHIA, United States of America
[2]Kaiser Permanente Northern California, OAKLAND, United States of America
[3]Kaiser Permanente Southern California, PASADENA, United States of America
[4]University of Lausanne, LAUSANNE, Switzerland
[5]Louisiana State University Health Sciences Center, NEW ORLEANS, United States of America

BACKGROUND: Failure to screen for colorectal cancer (CRC) or to follow-up abnormal screening results increases the risk of CRC death up to 7-fold, but the influence of patient and health system factors on such screening process lapses is not well-studied.
METHODS: This retrospective cohort study utilized health plan members from Kaiser Permanente Northern and Southern California and included 1,597 individuals aged 55-90 who died from CRC in 2006-2012 who were matched to 3,174 CRC-free individuals (controls). Data was collected from electronic databases and medical records in the 10-year period prior to the reference date (CRC diagnosis date). Screening histories prior to the reference date were classified as failure to screen; failure to screen at appropriate intervals; failure of surveillance; or failure to follow-up abnormal/incomplete results. We examined associations between patient-level factors, area-based socioeconomic (SES) measures, and medical region, and each failure type using multinomial regressions.
RESULTS: Compared with being up to date on screening, fewer primary care visits and higher comorbidity scores both increased the odds of each failure type. Lower SES and older age increased the odds for failure to screen at appropriate intervals; younger age reduced the odds of failure to follow-up. Compared with non-Hispanic (NH) whites, Hispanics had higher odds of failure to screen; Hispanics and NH-blacks both had lower odds of failure of surveillance. Risk of failures varied across medical regions.
CONCLUSIONS: Within two US screening programs, we identified socio-demographic, clinical, and health system variations in lack of screening and rescreening, and follow-up of abnormal results, that were associated with deaths from CRC. The findings highlight populations and potential intervention targets to further decrease avoidable CRC deaths.

Reaching the hard-to-reach populations

226 - Oral Presentation

Breast cancer screening program participation and socioeconomic deprivation metropolitan France and French West Indies

Rogel, Deborde, Chatignoux, Quintin, Hamers
Public Health France, SAINT-MAURICE, France

Background:
The objective of this study was to estimate the relationship between participation in the national breast cancer screening program and socioeconomic deprivation in Mainland France and in the French West Indies.
Methods:
The data of women participating in national program in 2013-2014 living in France (metropolitan and French West Indies) were analyzed using ecological indices of social deprivation. The observation unit was the municipality of residence. The mainland France analysis includes 4,805,390 participating women living in 36,209 municipalities from 95 departments and uses the French Deprivation Index (FDep). French West Indies analysis includes 61,461 participating women living in 66 municipalities from Guadeloupe and Martinique and uses a deprivation index developed for these territories. To take into account the spatial hierarchical structure of the data (municipalities in department, departmental organization of the program), a mixed effects model estimating the relation between participation and deprivation was constructed. Geographical variations in participation have been quantified. The model has been applied to urban and rural municipalities.
Results:
In metropolitan France, the relationship between participation and socioeconomic deprivation of the municipality of residence was inverted U-shaped: participation was lower for the least and most disadvantaged municipalities. This form was also observed for rural and urban municipalities. But the effect of deprivation remained moderate in view of the remaining geographical variations at departmental and municipality levels. No link was observed In Martinique and Guadeloupe.

Conclusion:
This study provides a national description of socioeconomic inequalities and participation in the breast cancer screening program in France. However, deprivation appears to have little influence on geographical variations in participation rates. There is a need to better understand the factors that affect these geographic variations, particularly the use of opportunistic screening and access to health care.

Reaching the hard-to-reach populations

239 - Poster Presentation

Barriers associated with non-participation at screening programmes in the Czech Republic

Ngo[1], Majek[2], Dusek[3], S. Dankova[4]
[1]Institute of Biostatistics and Analyses; Institute of Health Information and Sta, BRNO, Czech Republic
[2]Masaryk University, Institute of Health Information and Statistics, BRNO, Czech Republic
[3]Masaryk University, Institute of Biostatistics and Analyses, BRNO, Czech Republic
, Prague, Czech Republic

Background: High level of participation is essential to ensure the effectiveness of a programme. However, participation rate after invitation gradually decreased with further invitations in Czechia and overall coverage remains under desirable levels. The objective of our study was to identify barriers related to an attendance at the programmes in Czechia.
Methods: The study was based on a national data from European Health Interview Survey carried out in Czechia in 2014–2015. Individual cancer screening programmes were analysed separately according to their target populations and multivariate logistic regression models were used to identify barriers (the model included age, gender, degree of urbanization, education, social status and income).
Results: Attendance in all programmes was associated with age. Women aged over 65 years and over 50 years were less likely to participate in a breast and cervical screening, respectively. For colorectal screening, women were more involved in a programme than men (OR=1.3, 95% CI=1.1-1.5). Women living in households with higher income were more likely to attend breast or cervical screening (OR=1.6, 95% CI=1.1-2.4; OR=2.0, 95% CI=1.6-2.6) compared to women with the lowest income. High level of education was positively associated with higher chance of attendance at breast and colorectal screening (OR=1.7, 95% CI=1.1-2.6; OR=1.5, 95% CI=1.1-2.0) than those with a lower level. For cervical screening, marital status and level of urbanization were also positively associated with participation.
Conclusion: The findings of this study suggest that higher age, lower household income or lower level of education are associated with lower attendance in screening programmes, which could help to focus further health educational interventions. These findings were also used in a follow-up survey, which will closely describe the barriers and motivators of participation and will lead to an appropriate graphic and content modification of the current form of invitation letters.

Reaching the hard-to-reach populations

264 - Poster Presentation

Development and pilot-testing of a Colorectal Cancer Screening Decision Aid for individuals with varying health literacy levels

MP Fransen[1], AJ Woudstra[1], E Dekker[1], THF Broens[1], SK Smith[2], K McCaffery[3], EMA Smets[1]
[1]Amsterdam UMC, AMSTERDAM, The Netherlands
[2]UNSW Sydney, SYDNEY, Australia
[3]The University of Sydney, SYDNEY, Australia

Abstract
Objective: Making an informed decision about colorectal cancer screening requires health literacy. Our aim was to develop and pilot-test a computer-based decision aid to support informed decision making about whether or not to participate in colorectal cancer screening for individuals with varying health literacy levels in the Netherlands.
Methods: First, we designed and adapted the decision aid prototype among 25 individuals with low (n=10) and adequate (n=15) health literacy. Second, we used a before/after study to assess changes in knowledge, attitude, intention, decisional conflict, deliberation, anxiety and risk perception in an online survey among 81 individuals eligible for colorectal cancer screening with low (n=35) and adequate (n=46) health literacy.
Results: The decision aid was acceptable, comprehensible, reduced decisional conflict, increased deliberation and improved knowledge about colorectal cancer screening, but not about colorectal cancer, among individuals with adequate and low health literacy. Usability was slightly higher for participants with adequate health literacy compared to those with low health literacy.
Conclusion: The decision aid is promising in supporting informed decision making about colorectal cancer screening, also among individuals with lower health literacy.
Practice implications: Further refinement of interactive features, such as videos, animations and the values clarification exercise, is needed to increase the usability of the decision aid.