STATE OF CANCER SCREENING PROGRAMMES IN THE CZECH REPUBLIC AND METHODOLOGY OF PERSONALISED INVITATION TO SCREENING

O. Májek, J. Daneš, M. Zavoral, V. Dvořák, B. Seifert, J. Dušková,
M. Skovajsová, Š. Suchánek, A. Beková, T. Malík, D. Klimeš,
M. Blaha, T. Pavlík, J. Gregor, J. Mužík, L. Dušek

WWW.MAMO.CZ

WWW.KOLOREKTUM.CZ

WWW.CERVIX.CZ

MU
IBA
UNIVERSITAS MASARYKIANA BRUNENSIS

Team of authors:
RNDr. Ondřej Májek, Ph.D. (Institute of Biostatistics and Analyses at the Masaryk University)
prof. MUDr. Jan Daneš, CSc. (Department of Diagnostic Radiology at the General University Hospital in Prague)
prof. MUDr. Miroslav Zavoral, Ph.D. (Department of Internal Medicine at the Central Military Hospital Prague)
MUDr. Vladimír Dvořák (Centre for Outpatient Gynaecology and Primary Care)
doc. MUDr. Bohumil Seifert, Ph.D. (Institute of General Medicine at the 1st Faculty of Medicine at the Charles University in Prague)
doc. MUDr. Jaroslava Dušková, CSc., F.I.A.C. (Institute of Pathology at the General University Hospital in Prague)
MUDr. Miroslava Skovajsová, Ph.D. (Breast Unit Prague, JSC)
MUDr. Štěpán Suchánek (Department of Internal Medicine at the Central Military Hospital Prague)
MUDr. Alena Beková, M.I.A.C. (CGOP, Ltd.)
MUDr. Tomáš Malík (GYNEKO, Ltd.)
RNDr. Daniel Klimeš, Ph.D. (Institute of Biostatistics and Analyses at the Masaryk University)
Ing. Milan Blaha, Ph.D. (Institute of Biostatistics and Analyses at the Masaryk University)
RNDr. Tomáš Pavlík, Ph.D (Institute of Biostatistics and Analyses at the Masaryk University)
Mgr. Jakub Gregor, Ph.D. (Institute of Biostatistics and Analyses at the Masaryk University)
RNDr. Jan Mužík, Ph.D. (Institute of Biostatistics and Analyses at the Masaryk University)
doc. RNDr. Ladislav Dušek, Ph.D. (Institute of Biostatistics and Analyses at the Masaryk University)

Reviewed by:
MUDr. Helena Bartoňková (Department of Radiology at the Masaryk Memorial Cancer Institute)
MUDr. Milana Šachlová, CSc., Ph.D. (Department of Gastroenterology at the Masaryk Memorial Cancer Institute)

ISBN 978-80-210-6504-8

CONTENTS

SHRNUTÍ

Občanům ČR jsou dostupné všechny mezinárodně doporučené programy screeningu zhoubných nádorů. Všichni občané od 50 let mohou využít screeningu nádorů tlustého střeva a konečníku, ženy od 45 let mohou podstoupit mamografické vyšetření pro screening nádorů prsu a všechny dospělé ženy se mohou zúčastnit screeningu nádorů děložního hrdla. Dle doporučení Rady Evropské unie by měla být screeningová vyšetření nabízena prostřednictvím organizovaných programů, s jasně definovanými postupy a zajištěnou kontrolou kvality. Proto jsou vybraná zdravotnická zařízení provádějící screening (mamografická centra, centra pro screeningovou kolonoskopii a cytologické laboratoře) průběžně kontrolována tak, aby poskytovala vyšetření ve vysoké kvalitě. Předkládaná publikace shrnuje důkazy o účinnosti organizovaného screeningu zhoubných nádorů, epidemiologii uvedených nádorových onemocnění a principy monitoringu a hodnocení organizovaného screeningu v ČR. Publikace taktéž přináší aktuální výsledky jednotlivých screeningových programů v dostupných datech. Rada Evropské unie a mezinárodní týmy odborníků dále doporučují, aby byli občané z cílových skupin na tato vyšetření pravidelně a adresně zváni. Jen tak lze zajistit, že všichni občané, pro které je screening určen a kteří z něj tak mohou mít významný prospěch, mají stejné informace a stejnou možnost se jej zúčastnit. Proto byl Ministerstvem zdravotnictví ČR ve spolupráci se zdravotními pojišťovnami a odbornými lékařskými společnostmi připraven projekt adresného zvaní občanů ke screeningu. Publikace ve své závěrečné části představuje konkrétní metodiku implementace systému adresného zvaní a jeho monitoringu využívající podporu a spolupráci zdravotních pojišťoven ČR.

SUMMARY

All internationally recommended cancer screening programmes are available for citizens of the Czech Republic. People aged 50 years and over can participate in colorectal cancer screening, women aged over 45 can undergo mammography, and all adult women can attend cervical cancer screening. According to the recommendation of the European Council, all screening examinations should be offered by means of organised programmes, which have strictly defined procedures and ensured quality control. Health care facilities selected for providing screening examinations (mammography centres, colonoscopy centres, and cytology laboratories) are therefore continuously monitored to provide high-quality examinations. This publication summarises the evidence on effectiveness of organised cancer screening programmes, epidemiology of respective cancer diagnoses, as well as principles of monitoring and assessment of Czech cancer screening programmes. Latest results of individual screening programmes are presented as well, based on available data. The European Council and international expert teams have also recommended personalised invitation of citizens to participate in screening examinations. That is the only way to ensure that all citizens from target groups, who might profit from their participation in screening programmes, get equal information, and an equal chance to participate. Therefore, the Czech Ministry of Health has cooperated with health insurance companies and expert medical societies, and these joint efforts have led to a project of personalized invitation of Czech citizens to participate in cancer screening programmes. The final part of this publication introduces the methodology of implementation of a system for personalized invitation and its monitoring, based on the support and cooperation of Czech health insurance companies.

ACKNOWLEDGEMENTS

This publication is a result of the project entitled "Evaluation report on existing early detection programs on cancer in the Czech Republic", which was supported by the World Health Organization within the realization of BCA 2012–13, and another project entitled "Ensuring information support and evaluation of cancer screening programmes in the Czech Republic", which was realised within the National Action Plans and Conceptions of the Czech Ministry of Health.

PREFACE

Dear Reader,

This publication is intended to provide information on the state of cancer screening programmes in the Czech Republic, to emphasise their results and strengths, but also to point out their weaknesses. In cooperation with numerous experts, we have written this publication in order to assess all available information sources that contribute to a representative description of effectiveness and quality of Czech cancer screening programmes. The availability of all internationally recommended cancer screening programmes (i.e., colorectal cancer screening in men and women, breast cancer screening and cervical cancer screening in women) in the Czech Republic is an undeniable strength, which would be unconceivable without the enormous efforts made by hundreds of dedicated health professionals. The high quality of collected data is another strong point: many aspects of current screening programmes can be only monitored based on that data.

In particular, valuable data from the Czech National Cancer Registry must be emphasised; this registry contains cancer epidemiology records that cover the Czech population almost entirely. Population impact of preventive programmes, effectiveness of early cancer diagnosis and its consequences on both short-term and long-term mortality trends - all of these issues can only be assessed thanks to the existence of the Czech National Cancer Registry. Data from registries maintained within screening centres make it possible to assess the quality and performance of screening programmes. Population-based exports of records on screening and diagnostic examinations, as provided by health care payers through the mediation of the Czech National Reference Centre, are of significant importance, too.

It is beyond doubt that the available data give evidence of many positive results achieved by the Czech health care system with respect to cancer care. A significant improvement in survival times is one of the most important outcomes: this trend has been recorded in most cancer types over the last 15 years. Regardless of these strenghts, however, regularly performed assessments on both national and international level have shown that cancer prevention efforts in the Czech Republic are rather unconvincing. Cancer incidence burden in the Czech population is one of the highest in Europe, and yet the country has not developed nor supported any policy of primary prevention of cancer, not even in smoking prevention. In international statistics, the Czech population is reported to have a high prevalence of obesity (including among children), a high and still growing proportion of smokers, and one of the highest rates per capita of alcohol consumption in Europe. Inadequate support by authorities is also perceived in Czech cancer screening programmes which, although being properly established and having a sufficient capacity, cannot achieve the much needed performance without the government's support, invitation to screening, and other motivational measures. Paradoxically, although the density of hospital network is among the highest in Europe, and the proportion of hospitalisations

is well above average among developed countries, early cancer diagnosis has not much improved in the Czech Republic.

For those reasons, the introduction of a system of personalised invitation of citizens for screening programmes is of an enormous significance. This is not only due to the fact that the Czech Republic is one of the few European countries which have not implemented this system yet. Even the best preventive health programmes cannot be successful if they are not accepted and attended by citizens. This is why our publication introduces a well-prepared and verified methodology of implementation of a system of personalised invitation in the Czech Republic, which makes use of the support and cooperation by health care payers. It is therefore evident that the political will of Czech health care authorities will be essential to strengthen Czech cancer screening programmes; all other aspects are ready and well-prepared. After all, an OECD Expert Group called on the Czech Republic to enhance prevention efforts in its report from November 2013, entitled "Health Policy Studies – Cancer Care: Assuring Quality to Improve Survival" (cited from the national press release):

"OECD considers an early diagnosis of cancer to be the most critical prerequisite for the improvement in survival times of cancer patients. Its key recommendations therefore emphasise properly organised and high-quality cancer screening programmes. Similarly to other developed countries, the Czech Republic has a system of informational support for cancer screening programmes: its citizens can find important information on these programmes at dedicated websites (www.mamo.cz, www.kolorektum.cz, www.cervix.cz). However, the Czech Republic has not yet met the recommendations of the Council of the European Union, the European Commission, and the International Agency for Research on Cancer: namely, it does not provide population-based screening programmes, of which personalised invitation of citizens for screening form an integral part, accompanied by an advanced data background, and a comprehensive quality assurance. The OECD report states that a strong political and legislative support needs to be implemented in the Czech Republic in order to introduce population-based screening programmes, and to assess them. An interconnection of population-based registries (namely cancer registries and screening registries) would significantly facilitate the assessment of screening effectiveness, and also would bring the organisation of the system closer to developed countries of northern and western Europe."

We strongly believe that the summary of information sources presented in our publication will contribute to correct decisions which would eventually strengthen key aspects of cancer prevention in the Czech Republic.

On behalf of the team of authors
doc. RNDr. Ladislav Dušek, Ph.D.
RNDr. Ondřej Májek, Ph.D.

IMPORTANCE OF CANCER SCREENING PROGRAMMES

Breast cancer, colorectal cancer, and cervical cancer screening programmes have been repeatedly proved to decrease mortality rates for these malignant tumours. Meta-analyses of large randomized clinical trials have brought the evidence of effectiveness of breast cancer screening and colorectal cancer screening, while the benefit of cervical cancer screening was demonstrated following the introduction of organised programmes in Nordic countries.

The efficacy of breast cancer screening with mammography has been proven by randomised controlled trials, including studies in the United States (1) and in Europe (2). Swedish randomised controlled trials were re-evaluated in meta-analyses (3, 4) showing a long-lasting protective effect of mammography screening. A reduction in breast cancer mortality by up to 29% was observed in women aged 50-69 years. Organised breast cancer screening programmes have been implemented in many developed countries worldwide (5) and evidence of their effectiveness has gathered over the years. Trials results were successfully replicated in many European countries: Denmark (6), Finland (7), Iceland (8), Italy (9), the Netherlands (10), Spain (11), Sweden (12) and the United Kingdom (13). For example, a Swedish analysis of the mammography programme's impact on mortality observed a significant 43% reduction in incidence-based breast cancer mortality (12) among women attending the programme. Breast cancer screening seems to be cost-effective, namely in countries with centralised setting of the programme, high attendance rate, high quality of the programme, and high incidence and mortality rates of breast cancer (14).

CRC is the most common newly diagnosed cancer and the second most common cause of cancer death in Europe. More than 430,000 European citizens are diagnosed and over 210,000 die each year from malignant tumours of colon and rectum (15). However, many of these deaths can be avoided. CRC screening with annual guaiac faecal occult blood test (gFOBT) was demonstrated to decrease the CRC mortality by 33 percent in a U.S. randomized trial (16). European trials showed a reduction of CRC mortality rates by 15% (17) and 18% (18) when using the biennial gFOBT. The reduction persisted after 9 rounds and reached 43% in all-rounds participants (19), emphasising the importance of regular attendance by participants. Including also the unpublished results of the Göteborg trial, the mortality reduction of 16% was estimated in the Cochrane systematic review (20). Annual or biennial FOBT screening also significantly decreases the CRC incidence rate (21). Immunochemical faecal occult blood test (iFOBT) seems to have even better performance than gFOBT (22, 23), and first promising results from randomized trials have been published (24). Colonoscopy seems to be a powerful screening tool, with an estimated decrease of CRC incidence up to 90% (25–28); however, direct evidence is necessary to estimate its effectiveness (29). Currently, two large randomised trials investigating colonoscopy screening efficacy are in progress: Spanish and Nordic–European Initiative on Colorectal

Cancer (NordICC) trials (30). The low risk of CRC after colonoscopy persists for more than 10 years (31–33), which potentially enables a long interval between screening examinations. Flexible sigmoidoscopy is another promising modality with a demonstrated effect on mortality reduction (34). In June 2011, a systematic review of colorectal cancer screening cost-effectiveness analyses was published (35). The study included 32 unique models from individual European, North American, Asian and Australian studies. Most studies evaluated costs per life-year gained from the perspective of a health care payer. Studies were very variable as regards their assumptions and parameters used – this resulted in very variable results. However, all studies found colorectal cancer screening cost-effective in comparison with no screening and six models found some strategies to be cost-saving. Another favourable result is colorectal cancer economy improving with time. This is not surprising, as costs for treating colorectal cancer constantly increase while costs for screening remain pretty stable (36).

Screening for cervical cancer based on cytology was not evaluated using randomized controlled trial assessing the decrease in mortality rates; evidence was derived from cohort and case-control studies (37). Nevertheless, these observational studies showed an outstanding decrease in cervical cancer incidence rates by up to 80% (38). Decrease in mortality rates ranging from 25-80% was confirmed in a subsequent international study (39). This study also confirmed that an unorganized cervical cancer screening may completely fail to show the outlined benefit. A Finnish case control study comparing organised and spontaneous pap-smear screening concluded that the latter is less effective, more expensive and results in more harm in screened women (40). The cervical cancer screening using Pap smear seems to be cost-effective in high-income countries; however, this largely depends on the number of smears offered to women during their lifetime (41). Recently, HPV primary testing was shown to be another suitable strategy for cervical cancer screening; however, it may lead to overdiagnosis in younger women (42).

EPIDEMIOLOGY OF PREVENTABLE CANCERS IN THE CZECH REPUBLIC

The Czech Society for Oncology has developed an information system which, by the combination of data from the population-based Czech National Cancer Registry (CNCR) and from clinical databases, covers the main areas of health care assessment: monitoring of epidemiological burden, prediction of cancer patient numbers, results of diagnosis and treatment. Presented data prove a high cancer burden in the Czech population: each year more than 75,000 people are diagnosed with cancer in the Czech Republic, and there are over 28,000 deaths from the disease. Despite high incidence rates of the three above-mentioned cancers, mortality rates have stabilized in the long term and even slightly decreased recently, which has led to a significant increase in prevalence rates. Health care provided to high numbers of cancer patients will undoubtedly require significant financial resources. Epidemiological data alone prove the importance and benefits of organised screening programmes, as an early diagnosis significantly improves the chance of curing the patient, and saves health care costs at the same time.

CNCR is an integral part of the comprehensive cancer care, covering the entire Czech population (100%) and containing over 1.7 million records from the period 1977-2010. Cancer registration is required by law and is obligatory (43). CNCR data has been made available to the general public at the website www.svod.cz (44). The epidemiological cancer burden of the Czech population is one of the highest in Europe, which unfortunately applies to the three preventable diagnoses as well. In summary, incidence of these cancers exceeds 15,000 newly diagnosed patients each year. The good news is that mortality rates of all three cancers have seen a decrease in the long term, which can surely be attributed - at least to a certain extent - to ongoing cancer screening programmes. However, a steeply growing prevalence of these cancers is a logical consequence of the above-described trends: in other words, the numbers of cancer patients, which would need a long-term care provided by the Czech health care system, are on the increase. Medical, ethical and social consequences of these developments are evident. The problem is all the more pressing when taking into account that the above-mentioned cancer types significantly affect patients in working age. The high burden of cancer in the population can also be expressed as the cumulative risk, or the lifelong risk of developing a specific disease. These analyses also provide alarming numbers for the Czech population: for example, the risk of colorectal cancer amounts to 6.5% in men aged 0-74 years, and 4.5% in women aged 0-79 years. Similarly, the lifelong risk of breast cancer in Czech women is 8.9%, while the risk of cervical cancer is 1.4%.

A steep increase in prevalence, which has been recorded in all three preventable cancers, has many potential causes, which vary among individual diagnoses with respect to their influence and representation. However, longer survival times of cancer patients represent a unitary and significant factor (45, 46). Survival times of cancer patients in the Czech Republic have seen a large increase over the last 15 years in all three monitored cancers. Paradoxically, longer-surviving cancer patients gain time to develop secondary malignancies. In a way, this is a price for a successful health care programme, because secondary malignancies must also be treated properly, and financial costs of a specific health care segment grow together with cancer incidence. And these are not insignificant sums: it is anticipated that 16-17% of colorectal cancer incidence in 2013 will be represented by cancers developed in patients treated already for another primary malignancy. The statistically significant prolongation of survival times mainly applies to less advanced, curable clinical stages of cancer. The trend in survival for primarily diagnosed metastatic stages has stagnated in the long term, ranging between 13 to 15% in colorectal cancer and cervical cancer, and between 25 to 26% in breast cancer. This data, too, represent a very convincing argument for strenthening prevention programmes and for making every effort to diagnose cancer in its early stages.

It is widely known that a cancer diagnosed at an early clinical stage (or ideally, in a precancerous stage) is much more likely to be treated successfully, and that the patient is much more likely to survive in the long term. On top of that, early diagnosis of cancer is the principal objective of population-based screening programmes, the effectiveness of which has been repeatedly proved by evidence-based medicine. Unfortunately, available population-based data show rather unfavourable results for the Czech health care system. Cancers in advanced stages are still being diagnosed in a large proportion of patients. The situation is by far the worst in the case of colorectal cancer, where more than 50% of patients are diagnosed in clinical stage III or higher. This situation is not getting any better over time, and the latest available data from the period 2005-2010 does not indicate a positive trend, rather the opposite. Furthermore, available data show that the high proportion of advanced stages applies to all Czech regions. The current situation and recent development of epidemiological burden of all three preventable cancers is a challenge to strengthen all activities aimed at the prevention of these diseases, focusing on organised, population-based screening programmes in the first place.

PRINCIPLES OF CANCER SCREENING AND ITS EVALUATION

Cancer screening is defined as 'the testing of apparently healthy volunteers from the general population for the purpose of separating them into groups with high and low probabilities of having a given cancer' (47). The early diagnosis of an asymptomatic disease makes it possible to treat a localised tumour or even to prevent an invasive cancer completely. In such cases, treatment is usually much more successful and less debilitating for patients. Treating malignant tumours in early stages is also considerably cheaper than treating a generalised disease.

To maintain the favourable balance between benefits and harms when addressing large populations, it is necessary to apply appropriate and comprehensive quality standards as well as best practice in the implementation of cancer screening programmes. The programmes should be implemented with an organised, population-based approach, with quality assurance at all appropriate levels, and in accordance with the European Guidelines for Quality Assurance (48–50). The policy of a screening effort should be documented in a law or an official regulation to qualify as a screening programme (51). IARC Handbooks of Cancer Prevention (52) state six characteristics of an organised screening programme: 1) a policy specifying target population, screening method and interval; 2) a defined target population; 3) a team responsible for overseeing screening centres; 4) a decision structure and responsibility for health care management; 5) a quality assurance system utilising relevant data;6) a monitoring of cancer occurrence in target population. The highest level of programme organisation, population-based screening, requires that all persons eligible for screening are identified and personally invited to attend screening examination in each round of screening (51).

At the moment, the healthcare system in the Czech Republic includes three national cancer screening programmes: for breast cancer, colorectal cancer and cervical cancer. These programmes can be considered as organised according to the IARC definition; however, they still lack a system of personalised invitation of individuals from the target population, which precludes their classification as population-based programmes. This chapter describes the organisational background of national screening programmes, including definitions of their target populations, screening modalities used, and managerial structure. The following chapters will describe the system of information support applied in these programmes.

DATA COLLECTION FOR INFORMATION SUPPORT OF CZECH CANCER SCREENING PROGRAMMES

The system for information support is a necessary part of organised cancer screening programmes. The Council of the European Union recommends (53) that member states "regularly monitor the process and outcome of organised screening and report these results quickly to the public and the personnel providing the screening." Information system should be therefore able to "collect, manage and evaluate data on all screening tests, assessment and final diagnoses." Components of the system operating in the Czech Republic include monitoring of cancer burden, monitoring of screening process using clinical data, and monitoring of screening process using administrative data (Figure 1).

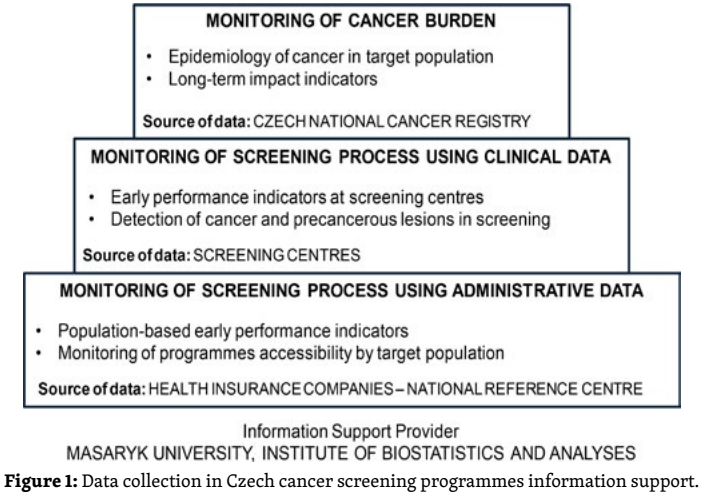

Figure 1: Data collection in Czech cancer screening programmes information support.

Expert medical societies responsible for the management of screening and diagnosis of preventable cancers (breast cancer, colorectal cancer and cervical cancer) have agreed with the Czech Ministry of Health to appoint an academic institute responsible for coordination of the information support, namely operating cancer screening registries and monitoring of the programmes using all of the above-mentioned sources of data; this role has been attributed to the Institute of Biostatistics and Analyses at Masaryk University in Brno, Czech Republic (IBA MU).

IBA MU performs a regular evaluation of data in the Czech National Cancer Registry (CNCR), making it freely available at www.svod.cz (44). The system for monitoring of breast, colorectal, and cervical cancer screening programmes has been established according to international recommendations, as provided by the European Commission (48–50). As required by the EU Council Recommendation on Cancer Screening, data on screening tests and the following diagnostic procedures is regularly collected in all screening centres (i.e., health care facilities recommended for cancer screening examinations). The information system enables the collected data to be analysed and published, thus allowing a thorough quality control by the programme management, as well as the publication of programme performance and the results on dedicated cancer prevention websites (www.mamo.cz, www.kolorektum.cz, www.cervix.cz).

CZECH NATIONAL BREAST CANCER SCREENING PROGRAMME

The organised nationwide breast cancer screening programme was initiated in September 2002. The programme is administered by the Breast Cancer Screening Committee at the Czech Ministry of Health. The screening facilities are overseen by the Expert Committee on Breast Radiology, which closely cooperates with the Association of Czech Breast Radiologists. A rigorous accreditation system for screening centres has been established, encompassing criteria for entering the network, on-site inspections at reaccreditation, as well as regular performance monitoring. A set of performance indicators was defined and implemented in accordance with the European Guidelines. The network of accredited screening centres covers the entire territory of the Czech Republic.

The target population of the Czech Breast Cancer Screening Programme comprises women aged over 45 years. The screening test is performed at two-year intervals, using two-view mammography (recommended double-reading). These tests are reimbursed from the general health insurance. Women are regularly referred to mammography screening by their GP or gynaecologist as part of preventive check-ups. Women outside the primary target population, who are aged at least 40 years, may also undergo mammography screening examination at the screening programme centres. Women may also receive their screening examination at one-year intervals. In both cases, women are required to pay for the examination themselves.

The Czech National Breast Cancer Screening Programme is based on the network of dedicated screening facilities. Each of these centres operates their own database system for the collection of screening data, which are regularly transferred to the Breast Cancer Screening Registry (run by the IBA MU), which was founded in 2002 and is the original part of the system for information support. This database includes information on screening mammography, additional imaging or invasive diagnostic procedures and final diagnosis. Regular data collection in breast cancer screening programme is performed in two stages. At the first stage, primary data containing records on examinations performed in the preceding year are centrally collected, and are subsequently stored in a secured central database. In the next step, data validity checks are centrally performed, and validation reports are generated and distributed. Data containing corrected entries is then collected in the second part of the collection process.

CZECH NATIONAL COLORECTAL CANCER SCREENING PROGRAMME

First colorectal cancer prevention efforts in former Czechoslovakia were already made in the 1980s (54) and continued throughout the 1990s (55, 56). The organised colorectal cancer screening programme was initiated in July 2000, based on the agreement of the Czech Ministry of Health, the health insurance companies and relevant medical societies. Since its very start, the programme has been monitored by the Board of Colorectal Cancer Screening at the Czech Gastroenterological Society, and the Czech Society of General Practice. Aggregated data on the monitoring of colonoscopy examinations were collected by the Council of Regional Coordinators, while data on the results of faecal occult blood tests (FOBT) were assembled by the General Health Insurance Company. Starting from 2006, the monitoring is based on individually collected clinical data. The programme is overseen by the Colorectal Cancer Screening Committee at the Czech Ministry of Health.

The organised programme is intended for all persons aged over 50 years. From January 2009, new screening options are available in addition to the original biannual FOBT followed by colonoscopy in positive patients. For the age group of 50-54 years, FOBT at one-year interval is suggested. In the age group of 55 years and over, there are two options: either to carry on with FOBT (at two-year intervals) or to undergo primary screening colonoscopy every 10 years. Guaiac faecal occult blood tests (gFOBT) have been used since the very beginning of colorectal cancer screening efforts. In recent years, however, these tests have been progressively replaced by more accurate and easy-to-use immunological faecal occult blood tests (iFOBT). FOBTs are performed as part of regular preventive checkups performed by the general practitioner or gynaecologist. Effective from January 2009, the existing group of gastroenterology centres has been transformed into a fully audited network of centres for screening colonoscopy. These centres are obliged to collect individual data on screening and diagnostic procedures. Other requirements include proper medical equipment, adherence to

colonoscopy recommendations, contract with a surgical facility for treatment of possible colonoscopy complications, and performance of sufficient colonoscopy volumes.

All facilities recommended for colorectal cancer screening – centres for screening colonoscopy – record all of their screening colonoscopies and FOBT follow-up colonoscopies into the standardised electronic forms of the Colorectal Cancer Screening Registry (run by the IBA MU). Data collection was initiated in 2007, while data from the preceding year was collected retrospectively. The system is consistent with other standards proposed for the collection of colonoscopy data (50, 57). Data collection is provided by an on-line application accessible to authorised persons via an ordinary web browser. The central web server and the central database server are key components of the application. The record on colonoscopy examination includes demographic information about the subject, indication for the examination (screening or FOBT follow-up colonoscopy), and basic data on performed colonoscopy, macroscopic and microscopic results. When entering the record, the physician confirms that the examined person has a negative family history of colorectal cancer, adenoma or inflammatory bowel disease, and does not show any symptoms of colorectal cancer.

CZECH NATIONAL CERVICAL CANCER SCREENING PROGRAMME

Preventive pap-smear testing has been used in the Czech Republic since the 1960s. As a part of the annual regular preventive check-up, a sample of cells from the uterine cervix is collected by the gynaecologist. The sample is then subjected to an examination by screening cytology. Gynaecological prevention check-ups are available to all women aged over 15 years.

This prevention, however, was not organised as a nationwide screening programme. In 2007, the Czech Ministry of Health issued a list of required criteria to be met by accredited screening cytology centres. In particular, this directive specified proper technical equipment, requirements on personnel, quality control mechanisms, and basic data audit requirements. A network of screening cervical cytology centres was established in January 2008. The programme is overseen by the Cervical Cancer Screening Committee at the Czech Ministry of Health.

In 2008, a proposal of the project documentation was approved that defined processes necessary in transforming the existing opportunistic prevention into an organised programme. The documentation included a description of the screening process and data collection. The pilot project of data collection was started in 2009 after establishing the central database – Cervical Cancer Screening Registry (run by the IBA MU). The key part of the screening process are cytology laboratories recommended for the cervical cancer screening, which provide examinations of screening Pap smears. These labs operate their own database systems recording results of cytology and pathology examinations. The source of data are standard cytology request forms (provided to the lab by the gynaecologist), results of cytology examination itself, and histopathology return form (provided to the lab by the gynaecologist or available in the laboratory itself). Each cytology examination has its own record in the central database, which stores data collected from each cytology laboratory.

CZECH NATIONAL REFERENCE CENTRE – ADMINISTRATIVE DATA

In the Czech health care system, most of the medical procedures relevant to secondary cancer prevention are reimbursed from the public health insurance by one of several health insurance companies. Therefore, data potentially exploitable for audits of national screening programmes and other preventive efforts only exists in separate databases of health insurance companies. However, these health insurance companies, associations of Czech hospitals and other medical centres have established the Czech National Reference Centre (CNRC). CNRC's principal objectives involve the effective utilisation of health insurance data in order to monitor the quality of provided health care. In addition, CNRC closely cooperates with the Czech Ministry of Health.

This administrative data can be used to facilitate the monitoring of all cancer screening programmes. In breast cancer screening programme, administrative data can be used to verify the information available in the Breast Cancer Screening Registry. Besides, data can be extracted to make a reliable estimate of the prevalence of opportunistic screening examinations. In colorectal cancer screening programme, administrative data is essential to determine the population coverage by the FOBT testing and its positivity rates, because the Colorectal Cancer Screening registry only collects data on colonoscopy examinations. Both systems complement each other very well in other to obtain a complete monitoring of the screening process in the Czech Republic. In the cervical cancer screening programme, the most important role of administrative data is the verification of population coverage in the central database.

MONITORING OF CANCER SCREENING PROGRAMMES

The principal objective of cancer screening programmes is to decrease mortality rates. Compared to randomised clinical trials however, it is troublesome to monitor this indicator in mass screening programme, and it may take many years to achieve a noticeable effect. The inception of the effect is somewhat slower than in randomised controlled trials due to observed deaths from cases diagnosed before the start of the screening programme, the time necessary to establish a nationwide coverage, and the learning time for the staff new to the screening programme. Even thereafter, it is very difficult to distinguish the effect of screening programme from similar cohort effects (trends in generation-specific prevalence of risk factors of the disease), improved cancer treatment, and of women's increased awareness of early symptoms of cancer (52).

It is therefore necessary to thoroughly monitor the entire screening process from the beginning of a screening programme to ensure a high quality at all screening centres, and to adopt corrective measures as soon as possible in necessary cases. A set of numerical indices, the so-called performance indicators, has been developed to allow an efficient monitoring of this process. These indicators focus on e.g. sufficient and regular participation of individuals in the target population, on the detection of malignant disease or pre-disease in screened individuals, or on minimising the adverse effects of screening (in particular, false positive results). Performance indicators also allow to predict a decrease in mortality rates in the future (58).

In the European Union, recommendations were issued regarding monitoring of standard performance indicators for all three above-mentioned screening programmes (48–50). These documents are a natural source of performance indicators to be implemented in Czech national screening programmes. Tables 1–3 show three sets of performance indicators used or proposed for usage in the Czech Republic, respecting the availability of data in cancer screening information systems (cancer screening registries and the Czech National Reference Centre).

Table 1. Early performance indicators used for monitoring of the Czech National Breast Cancer Screening Programme

1. **Attendance by women and their retention in the programme**
   - Coverage of the target population by screening examination
2. **Indikátory objemu**
   - Volume of women screened in the screening facility
   - Volume of breast cancer cases detected in the screening facility
3. **Performance indicators of the screening process**

   a. Validity of the screening test (estimates of sensitivity and specificity)
   - Breast cancer detection rate (proportion of positive among those undergoing screening)
   - Further assessment rate (proportion of screened women undergoing additional examination)
   - Recall rate (proportion of screened women recalled to the screening facility for additional examination)

   b. Quality of preoperative diagnosis
   - Benign to malignant open biopsy ratio

   c. Prognostic factors of detected cancer cases (surrogate for mortality reduction)
   - Proportion of advanced cases (TNM stage II+)
   - Proportion of invasive cases
     - Proportion of invasive cancer cases that are node-negative
     - Proportion of invasive cancer cases that are ≤ 10 mm in size

Table 2. Early performance indicators proposed for monitoring of the Czech National Colorectal Cancer Screening Programme

1. **Volume of individuals examined in dedicated screening facilities**
2. **Programme coverage and uptake**
   - Coverage by examination
3. **Outcomes with FOBT for primary screening**
   - Positive FOBT rate
   - Completion of follow-up colonoscopy after FOBT
   - Stage of screen-detected cancers
   - Positive predictive values for FOBT screening programmes (proportion of positive among those undergoing follow-up colonoscopy)
   - Endoscopic complications in FOBT screening programme
4. **Outcomes with colonoscopy (CS) as primary screening test**
   - Complete CS rate
   - Positive CS rate
   - Detection rates of CS screening programmes (proportion of positive among those undergoing screening)
   - Endoscopic complications of CS screening programmes
5. **Screening organisation**
   - Time interval between positive test and follow-up colonoscopy

Table 3. Early performance indicators proposed for monitoring of the Czech National Cervical Cancer Screening Programme

1. **Volume of samples examined in dedicated screening facilities**
2. **Screening intensity**
   - Coverage of target population by smear tests
3. **Screening test performance**
   - Distribution of screened women by results of cytology
   - Referral rate for repeat cytology
   - Compliance with referral for repeat cytology
   - Referral rate for biopsy
   - Positive predictive value of referral for biopsy (proportion of positive among those undergoing biopsy)
   - Test specificity (proportion of screening-negative among those without confirmed neoplasia)
   - Detection rate by histology diagnosis (proportion of positive among those undergoing screening)
4. **Diagnostic assessment and treatment**
   - Compliance to referral for biopsy

PERFORMANCE INDICATORS TO BE CONSIDERED IN FUTURE

At the moment, Czech national cancer screening programmes are organised, but not population-based. This means that the system of personal invitation has not yet been established. Moreover, a legislative framework has not yet been agreed for a more integrated utilisation of all three above-mentioned sources of data. An individual linkage of different sources of data – cancer registry, cancer screening registries, and administrative data – is not possible at the moment, due to individual data protection legislation. These gaps in integrated evaluation and monitoring system, as understood by the international recommendations (51), makes some dimensions of quality assurance unapproachable.

Inherently, it is not possible to compute performance indicators directly associated with personal invitation (coverage by invitation and participation rate). Most notably, the absence of individual record linkage between registries makes it impossible, to calculate interval cancer rates for all programmes. This very important performance indicator helps to estimate the programmes' sensitivity (58) and is therefore associated with the programmes' effectiveness. Moreover, individual-based epidemiological studies (cohort or case-control) used for the most precise estimation of screening impact on the population cancer burden would also require the linkage between cancer registration and screening histories of affected individuals (59).

The project for personal invitation of screening non-attenders is currently considered in cooperation between the Czech Ministry of Health and health insurance companies. Such a project would also include a system for monitoring participation rates integrated in the system for information support of cancer screening programmes.

SUMMARY OF CURRENT RESULTS OF SCREENING PROGRAMMES

BREAST CANCER SCREENING

The number of women examined in the screening programme has risen steadily. A steep increase was recorded in 2007 and 2008 due to an invitation programme run by the General Health Insurance Company (VZP). The increased participation rate has not dropped over the following years. There was another increase in participation rate in 2010, when the upper age limit for a screening examination was cancelled. While the absolute numbers of breast cancer cases newly diagnosed in the screening programme are on the rise, the proportion of cancers diagnosed at early stages (sum of carcinomas in situ and invasive stages of T1 category) has not changed over time (about 70%). Over the last few years, numbers of women to be screened for the first time have stabilized. Another good news is that the number of women returning to the screening programme is growing steadily. The ratio of first and subsequent visits has stabilized, which is an indication that once a woman enters the screening programme, she will probably return to it, understanding its benefits. In 2008, the coverage of breast screening in eligible women reached 50% for the first time ever (Figure 2). However, there has not been a significant increase in coverage since then. The highest participation rate has been repeatedly recorded in women aged over 45 years, and the coverage decreases slightly in older age groups. The coverage of oldest age groups has increased recently, due to a free-of-charge examination offered to women aged over 69. Coverage is relatively low in some districts, because screening is performed there beyond the organised programme (opportunistic screening). Although the influence of the opportunistic screening has been continuously suppressed since 2002, it still remains quite significant in some regions. The opportunistic screening is generally not supported because the performance, safety and effectiveness of such screening cannot be guaranteed. Targeted data describing this issue has been provided on a regular basis to health care payers. Furthermore, a validation analysis has proved that data collection from breast screening centres is comprehensive, very plausible, and that this data can be used for a more detailed monitoring of quality.

COLORECTAL CANCER SCREENING

The annual number of performed faecal occult blood tests (FOBTs), which saw a dramatic increase in 2010 (year-on-year growth by 25%), did not rise significantly in 2011. The overall FOBT coverage of the Czech population aged over 50 was 24.8% in 2011 (taking into account the recommended screening intervals for individual age groups, Figure 2). A more significant increase in FOBT coverage in 2011 was reported in women, particularly in younger age groups. As a recent feature, the collected data now make it possible to assess the attending gynaecologists' involvement in the screening programme: in 2011, gynaecologists performed more than 13% FOBTs done in women. Furthermore, data from health care payers makes it possible to assess FOBT positivity rates: in 2011, these amounted to 6.7% (8.6% in tests performed by gynaecologists, 5.6% in those performed by GPs). More than 100,000 preventive colonoscopic examinations were recorded in the Colorectal Cancer Screening Registry; adenomatous polyps were diagnosed in more than 35,000 patients, while colorectal cancer (at early stages, in most cases) was diagnosed in more than 4,000 patients. The positive predictive value of FOBT for adenomas (i.e., the proportion of adenomas detected during FOBT+ colonoscopy) has gradually risen, amounting to 36.9% in 2012. The detection rate for adenomas (i.e., the proportion of adenomas detected during a primary screening colonoscopy) was 25.4%. CRC was detected in 3.6% of individuals examined by a FOBT+ colonoscopy, and in 0.8% of individuals examined by a screening colonoscopy. Apart from adenomatous polyps and carcinomas, colonoscopic examinations revealed other types of polyps (hyperplastic polyps in particular) or other pathological findings; no abnormality was found in only 28% of individuals with FOBT+, and in 40% of individuals who underwent the

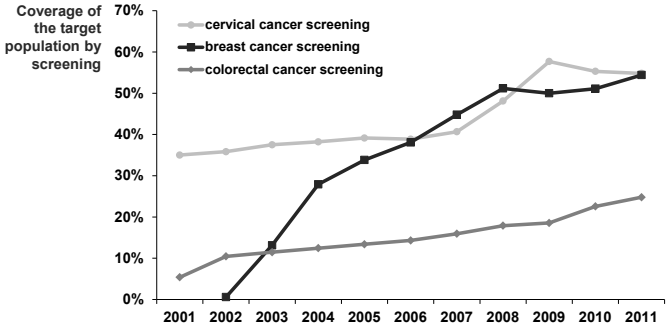

Figure 2. Development of coverage of cancer screening programmes in the Czech Republic (Source of data: Czech National Reference Centre, Breast Cancer Screening Registry)

primary screening colonoscopy. Growing participation rates, inevitably accompanied by an increased demand for preventive colonoscopies, have revealed that the waiting time for screening colonoscopy (after a positive result of gFOBT/FIT) has become a critical performance indicator. Data from the Colorectal Cancer Screening Registry shows that this time interval has steadily grown longer: on average, it was 1.2 months in 2012. After a positive result of gFOBT/FIT, colonoscopy was performed within two calendar months in 93% of patients.

It is evident that the coverage of colorectal cancer screening is still significantly lower than that of two other screening programmes (Figure 2). This can be probably explained by a persisting concern of clients about the screening examination, which requires either the manipulation with faeces (FOBT), or involves an invasive endoscopic examination. The most pronounced benefit of personalised invitation, accompanied by a nationwide health education campaign, can be therefore expected in this particular screening programme. A progressive replacement of obsolete guaiac tests with modern immunochemical tests (60) could also enhance higher participation rates. Last but not least, lower coverage rates can be partly attributed to a lack of financial motivation of screening colonoscopic centres: unlike breast cancer screening and cervical cancer screening, colorectal cancer screening has not given rise to a specialised screening expertise, which would allow proper reimbursements of preventive colonoscopies and all related procedures without unnecessary limitations.

CERVICAL CANCER SCREENING

Cervical cancer screening features an information system represented by the Cervical Cancer Screening Registry, which monitor the programme based on data provided directly by accredited centres. This registry also makes it possible to monitor screening results. More than 95% of examinations provide a negative result (without any neoplastic changes); ASC-US and LSIL predominate among the abnormal results. Subsequently, the diagnosis of CIN II-III is histopathologically confirmed in about 70% of patients in which HSIL was found by cytological examination. Data from the Czech National Reference Centre (CNRC) make it possible to map the preventive care with respect to cervical cancer from 2000 onwards. This data confirm a continuous increase in the coverage of cervical screening over the last decade; in 2011, the coverage of cervical screening in women aged 25-59 was reported to be 54.8%. Destruction procedures upon cervix (which would rule out a thorough histopathological expertise) are applied less frequently. Unfortunately, a significant heterogeneity among regions has been reported; this applies both to ways of cervical screening provision, and to the treatment of pathological findings.

METHODOLOGY OF INVITATION OF CZECH CITIZENS TO SCREENING

The support of screening programmes by health education and motivation campaigns is essential in order to make the target population know about the programmes and understand them without unnecessary concerns. Personalised invitation organised by the state is one of the key measures: citizens will be regularly invited to participate in screening, their participation rate will be assessed, and acquired data will be used to optimise the programme. Preventive programmes affecting the entire target population in such organised manner are called population-based programmes (51). Introduction of population-based cancer screening programmes in the Czech Republic is in accordance with the methodical recommendation by the Council of the European Union (53) as well as with methodical standards for high-quality and functional prevention programmes – the European Guidelines, and the recommendation by the International Agency for Research on Cancer (37, 52). On top of that, the personalised invitation is an obvious expression of interest shown by the state and its political representation in a specific prevention programme.

International experience and data were employed to design the methodology of personalised invitation of Czech citizens to cancer screening programmes. This methodology has been widely discussed with panels of foreign experts during the European Colorectal Cancer Days (www.crcprevention.eu), which has recently become a new tradition and is regularly held in Brno, Czech Republic. Once the methodology was finished and approved by the Czech Ministry of Health, it was presented to health care payers (February 2013), who reviewed it, accepted it and implemented it broadly. As the administration of personalised invitation will be financed from the EU funds (as part of the Integrated Operational Programmes, IOP), negotiations between the Czech Ministry of Health and health care payers about this agenda are under way. The system of personalised invitation should be launched in the end of 2013.

There is no state institution in the Czech Republic which would collect personal data of all participants in health insurance, and which could therefore ensure the personalised invitation to the programme centrally. For this reason, it was approved that individual health care payers (i.e., health insurance companies) would ensure personalised invitations. This solution has many advantages:

- Health insurance companies can directly contact the persons insured, so there is no need for a lengthy legislative process to ensure the invitation.
- Health insurance companies work with the medical documentation, and therefore are capable of identifying persons insured which should be invited to a screening programme, and of excluding patients who are ineligible for a screening programme (e.g., gravely ill patients who cannot participate in screening etc.)
- Health insurance companies have organisational and professional experience in the implementation of various health education campaigns and their sustainability.
- Health insurance companies are capable of assessing the final effect of invitation by analysing their databases.

Personalised invitation will be therefore implemented by health insurance companies, which will use their current databases and information systems; partial extensions of those systems are expected in order to implement the agenda of invitation to screening programmes. Nevertheless, most of the data essential for invitation is already present in health care payers' databases. The selection of persons insured eligible for the invitation, together with the system for their invitation, will be administered by a unified methodology, which defines obligatory minimal common rules, and will ensure an equal availability of screening programmes for all citizens of the Czech Republic. Here is a list of those rules in particular:

- Who should be invited by health insurance companies to participate in a screening programmes, and who can be excluded from the invitation agenda
- The system of assessment, criteria to assess the effectiveness of invitation
- Time frame of invitation and repeated invitation
- Format of data transferred with the objective to assess the success rate of screening, and the rules for its transfer

In particular, the approved methodology defines the following stages of the process of personalised invitation:

1. Selection of persons insured who are eligible for invitation to screening
2. Contents of the invitation letter
3. Feedback on the effect of invitation (participation of the invited person in screening, performed examinations, results of examinations – such as the FOBT positivity, cervical cytology positivity, diagnostic findings)
4. Conditions of repeated invitation of clients to a screening programme
5. Assessment of results of personalised invitation on the population level

Table 4. Conditions to be met for sending an invitation letter to persons insured

The person insured will be included in the process of personalised invitation if:

- he/she is insured at the specific health insurance company for at least 4 years,
- he/she is in the eligible age group:
  - breast cancer: women aged 45–70,
  - colorectal cancer: men and women aged 50–70,
  - cervical cancer: women aged 25–70.

The person insured will be excluded from the process of personalised invitation if:

- he/she is a foreigner,
- he/she is a Czech citizen living abroad in the long term,
- his/her address is incomplete, such as the postcode 00000, or his/her address refers to a box, or if his/her mail is recorded to be undeliverable
- he/she was invited to a specific screening programme 11 or fewer months ago (calendar months will be taken into consideration),
- procedures/diagnoses referred in Table 5 have been reported in his/her records,
- his/her reported treatment costs over the last 365 days exceeded 1 million CZK (those costs amount to the sum of all reported costs of outpatient and inpatient documents, request forms and prescriptions; 1 point equals to 1 CZK).

Table 5. Reported procedures and diagnoses in health care payers' data on the basis of which a person insured is excluded from the process of personalised invitation to cancer screening programmes in the Czech Republic

Screening	**Screening or diagnostic procedures** (if reported in the last 3 or 5 years)	**Therapeutic procedures** (if reported any time in recorded history; last 4 years at least)	**Treatment of diagnoses** (if reported any time in recorded history; last 4 years at least)
breast cancer	89221, 89179	51237, 51235, 51239, 61449	C50.x
cervical cancer	95199, 95198, 63051, 63531, 63533, 63534, 63537, 63539, 63540, 63541, 63549	63543, 63573, 63574, 63575, 63579, 63594, 63595, 63525, 10191, 10200, 10194, 10197, 10196	C53.x, C54.x, C55.x, C56.x
colorectal cancer	**in the last 3 years** 15120, 15121 **in the last 5 years** 15101, 15105, 15403, 15404	15475, 15950, 51361, 51363, 51415, 51357, 51359, 51365	C18.x – C20.x

A precise specification of the eligibility of persons insured to be invited to a screening programme, together with the specification of criteria for excluding a person insured from the invitation process, are key prerequisites for a successful invitation process. A summary of those criteria, which is based on the consensus of an expert team that prepared the implementation of persona-

lised invitation, was clearly specified and implemented into algorithms that are used to search data warehouses of individual health insurance companies. All persons insured that would meet inclusion criteria of a specific screening programme (and would not be excluded from the process on the grounds of other below-specified conditions) will receive a specific variant of the invitation letter (Table 4).

It is evident from the above-mentioned criteria that the addressed invitation organised by health insurance companies will apply to citizens who have not participated in cancer screening yet, or to those who interrupted their participation in the last 3-5 years. With respect to the delay with which health care payers usually receive k-batches from health care facilities (up to three months), exclusion criteria can never be assessed with a 100% precision, and therefore might be slightly different from the current situation in some cases. At any given point in time, the criteria will be assessed in relation to currently available data. A certain error rate in the process of criteria assessment cannot be avoided; it is an expected part of the process of personalised invitation. Potential contradictions will be clearly explained in the text of invitation letters.

The following system and time frame for invitation has been set up in order to ensure sufficient capacities for cohorts of invited citizens newly entering the screening programme:

- Citizens will be invited continuously according to their birth month, which will ensure an even distribution of load over the entire year.
- Based on its records, the health insurance company will verify whether the person insured has or has not participated in screening (this will be done one year after sending the letter).
- If the invited person did not participate in screening (i.e., none of the codes referring to screening examinations were reported in his/her records), his/her invitation will be repeated

If the process of addressed invitation meets with a positive response of the population, the load of involved medical specialties will grow significantly: in particular, primary health care specialists (GPs and gynaecologists) and breast screening centres will be affected the most. Capacity must also be enhanced in accredited centres for screening colonoscopy. The population response, the growing number of examinations, and examination results will be continuously assessed with an already developed and implemented information background for screening. All subjects involved in the invitation process and screening implementation, including health care payers (by the means of the Czech National Reference Centre), will contribute to that assessment.

In the end of this chapter, it is essential to emphasise that although the administration of personalised invitation is financially demanding, it represents only a small proportion of costs that need to be invested with respect to the expected higher participation of citizens in screening programmes. Invitations will be aimed at that part of the population which does not participate in preventive check-ups in the long term, and therefore an increased proportion of positive findings might be expected. Cancer incidence rates can even grow for a certain interim period, due to a higher number of newly diagnosed cancers (the so-called harvesting effect). However, these costs represent an essential investment, which will pay off in the long term: incidence and mortality rates for specific cancers are expected to decline, while the proportion of cancers diagnosed at early stages (which are less expensive to treat than advanced stages) is anticipated to grow.

CONCLUSION

Cancer burden of the Czech population is among the highest in Europe, which manifests itself in one of the highest incidence rates for colorectal cancer worldwide, for example. However, colorectal cancer (together with cervical cancer) represents a condition that is detectable at early stages or even preventable by screening; a significant decrease in mortality rates can also be achieved in the case of breast cancer. Benefits and cost-effectiveness of screening for all three cancer types have been convincingly proved; breast, cervical and colorectal cancer screening programmes have thus been involved in international recommendations, such as the recommendation by the Council of the European Union from 2003, but also the latest OECD recommendation from autumn 2013. A population-based screening should be provided in the form of organised programmes with a proper system for quality assurance. The positive fact is that all of the above-mentioned screening programmes have been continuously implemented in the Czech Republic since 2000; over time, these programmes have grown mature into an organised form, featuring precise rules for their provision, systems for the accreditation of screening units, and last but not least, systems of informational support that can be employed to monitor the quality of screening units and of the entire programme. Participation rates of the Czech population, however, are still unsatisfactory. Experience from abroad has clearly shown that a better citizens' awareness and higher participation rates cannot be achieved without personalised invitations in particular. At the present time, a system of such invitations in the Czech Republic is prepared thanks to the cooperation among the Czech Ministry of Health, health insurance companies, specialists from expert medical societies, and the Institute of Biostatistics and Analyses at the Masaryk University. Let us believe that this publication will contribute to the implementation of this extremely useful system, as well as to a heightened interest in highly effective screening programmes by political representatives, health professionals and the general public.

REFERENCES

1. Shapiro S, Venet W, Strax P, Venet L, Roeser R. Ten- to fourteen-year effect of screening on breast cancer mortality. J Natl Cancer Inst 1982;69(2):349–55.
2. Tabar L, Fagerberg G, Duffy S, Day N. The Swedish two county trial of mammographic screening for breast cancer: recent results and calculation of benefit. Journal of epidemiology and community health 1989;43(2):107–114.
3. Nystrom L, Andersson I, Bjurstam N, Frisell J, Nordenskjold B, Rutqvist LE. Long-term effects of mammography screening: updated overview of the Swedish randomised trials. Lancet 2002;359(9310):909–919.
4. Nystrom L, Rutqvist L, Wall S, Lindgren A, Lindqvist M, Ryden S, et al. Breast cancer screening with mammography: overview of Swedish randomised trials. Lancet 1993;341(8851):973–978.
5. Shapiro S, Coleman EA, Broeders M, Codd M, de Koning H, Fracheboud J, et al. Breast cancer screening programmes in 22 countries: current policies, administration and guidelines. International Breast Cancer Screening Network (IBSN) and the European Network of Pilot Projects for Breast Cancer Screening. In: Int J Epidemiol; 1998. p. 735–742.
6. Olsen AH, Njor SH, Vejborg I, Schwartz W, Dalgaard P, Jensen MB, et al. Breast cancer mortality in Copenhagen after introduction of mammography screening: cohort study. Bmj 2005;330(7485):220.
7. Sarkeala T, Heinavaara S, Anttila A. Organised mammography screening reduces breast cancer mortality: a cohort study from Finland. Int J Cancer 2008;122(3):614–9.
8. Gabe R, Tryggvadottir L, Sigfusson BF, Olafsdottir GH, Sigurdsson K, Duffy SW. A case--control study to estimate the impact of the Icelandic population-based mammography screening program on breast cancer death. Acta Radiol 2007;48(9):948–55.
9. Paci E, Coviello E, Miccinesi G, Puliti D, Cortesi L, De Lisi V, et al. Evaluation of service mammography screening impact in Italy. The contribution of hazard analysis. Eur J Cancer 2008;44(6):858–65.
10. Otto SJ, Fracheboud J, Looman CW, Broeders MJ, Boer R, Hendriks JH, et al. Initiation of population-based mammography screening in Dutch municipalities and effect on breast-cancer mortality: a systematic review. Lancet 2003;361(9367):1411–7.
11. Ascunce EN, Moreno-Iribas C, Barcos Urtiaga A, Ardanaz E, Ederra Sanz M, Castilla J, et al. Changes in breast cancer mortality in Navarre (Spain) after introduction of a screening programme. J Med Screen 2007;14(1):14–20.
12. SOSSEG. Reduction in breast cancer mortality from organized service screening with mammography: 1. Further confirmation with extended data. In: Cancer Epidemiol Biomarkers Prev; 2006. p. 45–51.
13. Blanks RG, Moss SM, McGahan CE, Quinn MJ, Babb PJ. Effect of NHS breast screening programme on mortality from breast cancer in England and Wales, 1990–8: comparison of observed with predicted mortality. Bmj 2000;321(7262):665–9.
14. De Koning HJ. Breast cancer screening; cost-effective in practice? Eur J Radiol 2000;33(1):32–7.
15. Ferlay J, Parkin D, Curado M, Bray F, Edwards B, Shin H, et al. Cancer Incidence in Five Continents, Volumes I to IX: IARC CancerBase No. 9 [internetová stránka]. Lyon, France: International Agency for Research on Cancer; 2010 [14.11.2013]. Dostupné z: http://ci5.iarc.fr.
16. Mandel JS, Bond JH, Church TR, Snover DC, Bradley GM, Schuman LM, et al. Reducing mortality from colorectal cancer by screening for fecal occult blood. Minnesota Colon Cancer Control Study. N Engl J Med. 1993;328(19): 1365–71.
17. Hardcastle JD, Chamberlain JO, Robinson MH, Moss SM, Amar SS, Balfour TW, et al. Randomised controlled trial of faecal-occult-blood screening for colorectal cancer. Lancet. 1996;348(9040):1472–7.
18. Kronborg O, Fenger C, Olsen J, Jorgensen OD, Sondergaard O. Randomised study of screening for colorectal cancer with faecal-occult-blood test. Lancet. 1996;348(9040):1467–71.
19. Kronborg O, Jorgensen OD, Fenger C, Rasmussen M. Randomized study of biennial screening with a faecal occult blood test: results after nine screening rounds. Scand J Gastroenterol 2004;39(9):846–51.
20. Hewitson P, Glasziou P, Watson E, Towler B, Irwig L. Cochrane systematic review of colorectal cancer screening using the fecal occult blood test (hemoccult): an update. Am J Gastroenterol 2008;103(6):1541–9.
21. Mandel JS, Church TR, Bond JH, Ederer F, Geisser MS, Mongin SJ, et al. The effect of fecal occult-blood screening on the incidence of colorectal cancer. N Engl J Med. 2000;343(22):1603–7.
22. Guittet L, Bouvier V, Mariotte N, Vallee JP, Arsene D, Boutreux S, et al. Comparison of a guaiac based and an immunochemical faecal occult blood test in screening for colorectal cancer in a general average risk population. Gut 2007;56(2):210–4.
23. Levi Z, Rozen P, Hazazi R, Vilkin A, Waked A, Maoz E, et al. A quantitative immunochemical fecal occult blood test for colorectal neoplasia. Ann Intern Med 2007;146(4):244–55.
24. Zheng S, Chen K, Liu X, Ma X, Yu H, Chen K, et al. Cluster randomization trial of sequence mass screening for colorectal cancer. Dis Colon Rectum 2003;46(1):51–8.
25. Baxter NN, Goldwasser MA, Paszat LF, Saskin R, Urbach DR, Rabeneck L. Association of colonoscopy and death from colorectal cancer. Ann Intern Med 2009;150(1):1–8.
26. Brenner H, Hoffmeister M, Arndt V, Stegmaier C, Altenhofen L, Haug U. Protection from right- and left-sided colorectal neoplasms after colonoscopy: population-based study. J Natl Cancer Inst 2010;102(2):89–95.
27. Kahi CJ, Imperiale TF, Juliar BE, Rex DK. Effect of screening colonoscopy on colorectal cancer incidence and mortality. Clin Gastroenterol Hepatol 2009;7(7):770–5; quiz 711.
28. Winawer SJ, Zauber AG, Ho MN, O'Brien MJ, Gottlieb LS, Sternberg SS, et al. Prevention of colorectal cancer by colonoscopic polypectomy. The National Polyp Study Workgroup. N Engl J Med 1993;329(27):1977–81.
29. Ransohoff DF. How much does colonoscopy reduce colon cancer mortality? Ann Intern Med 2009;150(1):50–2.
30. Bretthauer M. Colorectal cancer screening. J Intern Med 2011;270(2):87–98.
31. Brenner H, Haug U, Arndt V, Stegmaier C, Altenhofen L, Hoffmeister M. Low risk of colorectal cancer and advanced adenomas more than 10 years after negative colonoscopy. Gastroenterology 2010;138(3):870–6.
32. Singh H, Turner D, Xue L, Targownik LE, Bernstein CN. Risk of developing colorectal cancer following a negative colonoscopy examination: evidence for a 10-year interval between colonoscopies. Jama 2006;295(20):2366–73.

33. Brenner H, Chang-Claude J, Seiler CM, Sturmer T, Hoffmeister M. Does a negative screening colonoscopy ever need to be repeated? Gut 2006;55(8): 1145–50.
34. Atkin WS, Edwards R, Kralj-Hans I, Wooldrage K, Hart AR, Northover JM, et al. Once--only flexible sigmoidoscopy screening in prevention of colorectal cancer: a multicentre randomised controlled trial. Lancet 2010;375(9726):1624–33.
35. Lansdorp-Vogelaar I, Knudsen AB, Brenner H. Cost-effectiveness of colorectal cancer screening. Epidemiol Rev 2011;33(1):88–100.
36. Lansdorp-Vogelaar I, van Ballegooijen M, Zauber AG, Habbema JD, Kuipers EJ. Effect of rising chemotherapy costs on the cost savings of colorectal cancer screening. J Natl Cancer Inst 2009;101(20):1412–22.
37. IARC Working Group on the Evaluation of Cancer-Preventive Strategies. Cervix Cancer Screening. Lyon: IARCPress; 2005.
38. Hakama M, Rasanen-Virtanen U. Effect of a mass screening program on the risk of cervical cancer. Am J Epidemiol 1976;103(5):512–7.
39. Laara E, Day NE, Hakama M. Trends in mortality from cervical cancer in the Nordic countries: association with organised screening programmes. Lancet 1987;1(8544):1247–9.
40. Nieminen P, Kallio M, Anttila A, Hakama M. Organised vs. spontaneous pap-smear screening for cervical cancer: A case-control study. International Journal of Cancer 1999;83(1):55–58.
41. van den Akker-van Marle ME, van Ballegooijen M, van Oortmarssen GJ, Boer R, Habbema JD. Cost-effectiveness of cervical cancer screening: comparison of screening policies. J Natl Cancer Inst 2002;94(3):193–204.
42. Ronco G, Giorgi-Rossi P, Carozzi F, Confortini M, Dalla Palma P, Del Mistro A, et al. Efficacy of human papillomavirus testing for the detection of invasive cervical cancers and cervical intraepithelial neoplasia: a randomised controlled trial. Lancet Oncol 2010;11(3):249–57.
43. Ústav zdravotnických informací a statistiky ČR. Národní onkologický registr (NOR) Praha: ÚZIS; 2007 [20/12/2007]. Dostupné z: http://www.uzis.cz/info.php?article=368&mnu_id=7300
44. Dušek L, Mužík J, Kubásek M, Koptíková J, Žaloudík J, Vyzula R. SVOD.cz – Epidemiologie zhoubných nádorů v České republice [internetová stránka]. Masarykova univerzita; 2007 [12.7.2013]. Dostupné z: http://www.svod.cz/.
45. Brenner H, Gefeller O, Hakulinen T. Period analysis for 'up-to-date' cancer survival data: theory, empirical evaluation, computational realisation and applications. Eur J Cancer 2004;40(3):326–35.
46. Pavlík T, Dušek L, Májek O, Žaloudík J. Five-Year Survival Rates of Cancer Patients in the Czech Republic. In: Dušek L, et al., editors. Czech Cancer Care in Numbers 2008–2009. Praha: Grada Publishing, a.s.; 2009.
47. Prorok P, Kramer B, Gohagan J. Screening Theory and Study Design: The Basics. In: Kramer B, Gohagan J, Prorok P, editors. Cancer Screening - Theory and Practise. New York: Marcel Dekker; 1999.
48. Perry N, Broeders M, de Wolf C, Tornberg S, Holland R, von Karsa L, et al., editors. European guidelines for quality assurance in breast cancer screening and diagnosis, 4th ed. Luxembourg: Office for Official Publications of the EC; 2006.
49. Arbyn M, Anttila A, Jordan J, Ronco G, Schenck U, Segnan N, et al. European guidelines for quality assurance in cervical cancer screening, 2nd ed. Luxembourg: European Communities; 2008.
50. Segnan N, Patnick J, von Karsa L, editors. European guidelines for quality assurance in colorectal cancer screening and diagnosis. Luxembourg: Publications Office of the European Union; 2010.
51. Karsa L, Anttila A, Ronco G, Ponti A, Malila N, Arbyn M, et al. Cancer Screening in the European Union: Report on the implementation of the Council Recommendation on cancer screening. Luxembourg: European Communities; 2008.
52. Vainio H, Bianchini F, editors. Breast Cancer Screening. Lyon: IARCPress; 2002.
53. The Council of the European Union. Council recommendation of 2 December 2003 on cancer screening (2003/878/EC) [online]. 2003 [28/09/2012]. Dostupné z: http://eur--lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:327:0034:0038:EN:PDF.
54. Frič P. The use of haemoccult test in the early diagnosis of colerectal cancer - experience from six pilot studies in Czechoslovakia. In: Hardcastle JD, editor. Haemoccult screening for the early detection of colorectal cancer. Stuttgart: Schattauer; 1986. p. 73–74.
55. Fric P, Zavoral M, Dvorakova H, Zoubek V, Roth Z. An adapted program of colorectal cancer screening—7 years experience and cost-benefit analysis. Hepatogastroenterology. 1994;41(5):413–6.
56. Fric P, Zavoral M, Cekal J, Oliva T, Kurzova H, Dosedel J, et al. Screening of Colorectal Cancer in the Present Health Care System (article in Czech). Endoskopie 1999;8(3):39–45.
57. Lieberman D, Nadel M, Smith RA, Atkin W, Duggirala SB, Fletcher R, et al. Standardized colonoscopy reporting and data system: report of the Quality Assurance Task Group of the National Colorectal Cancer Roundtable. Gastrointest Endosc 2007;65(6):757–66.
58. Day N, Williams D, Khaw K. Breast cancer screening programmes: the development of a monitoring and evaluation system. In: Br J Cancer; 1989. p. 954–958.
59. Moss S, Ancelle-Park R, Brenner H. Evaluation and interpretation of screening outcomes. In: Segnan N, Patnick J, von Karsa L, editors. European guidelines for quality assurance in colorectal cancer screening and diagnosis. Luxembourg: Publications Office of the European Union; 2010.
60. Hol L, van Leerdam ME, van Ballegooijen M, van Vuuren AJ, van Dekken H, Reijerink JC, et al. Screening for colorectal cancer: randomised trial comparing guaiac-based and immunochemical faecal occult blood testing and flexible sigmoidoscopy. Gut 2010;59(1):62–8.

STATE OF CANCER SCREENING PROGRAMMES IN THE CZECH REPUBLIC AND METHODOLOGY OF PERSONALISED INVITATION TO SCREENING

Team of authors:
RNDr. Ondřej Májek, Ph.D. (Institute of Biostatistics and Analyses at the Masaryk University)
prof. MUDr. Jan Daneš, CSc. (Department of Diagnostic Radiology at the General University Hospital in Prague)
prof. MUDr. Miroslav Zavoral, Ph.D. (Department of Internal Medicine at the Central Military Hospital Prague)
MUDr. Vladimír Dvořák (Centre for Outpatient Gynaecology and Primary Care)
doc. MUDr. Bohumil Seifert, Ph.D. (Institute of General Medicine at the 1st Faculty of Medicine at the Charles University in Prague)
doc. MUDr. Jaroslava Dušková, CSc., F.I.A.C. (Institute of Pathology at the General University Hospital in Prague)
MUDr. Miroslava Skovajsová, Ph.D. (Breast Unit Prague, JSC)
MUDr. Štěpán Suchánek (Department of Internal Medicine at the Central Military Hospital Prague)
MUDr. Alena Beková, M.I.A.C. (CGOP, Ltd.)
MUDr. Tomáš Malík (GYNEKO, Ltd.)
RNDr. Daniel Klimeš, Ph.D. (Institute of Biostatistics and Analyses at the Masaryk University)
Ing. Milan Blaha, Ph.D. (Institute of Biostatistics and Analyses at the Masaryk University)
RNDr. Tomáš Pavlík, Ph.D (Institute of Biostatistics and Analyses at the Masaryk University)
Mgr. Jakub Gregor, Ph.D. (Institute of Biostatistics and Analyses at the Masaryk University)
RNDr. Jan Mužík, Ph.D. (Institute of Biostatistics and Analyses at the Masaryk University)
doc. RNDr. Ladislav Dušek, Ph.D. (Institute of Biostatistics and Analyses at the Masaryk University)

Published by MasarykUniversity in 2013

1st edition, 2013.

Printed by Tiskárna Helbich, a.s.,Valchařská 36, 614 00 Brno

Graphic design and typesetting: Radim Šustr, DiS. (Institute of Biostatistics and Analyses at the Masaryk University)
Typesetting with Skolar PE by David Březina (Rosetta Type Foundry)