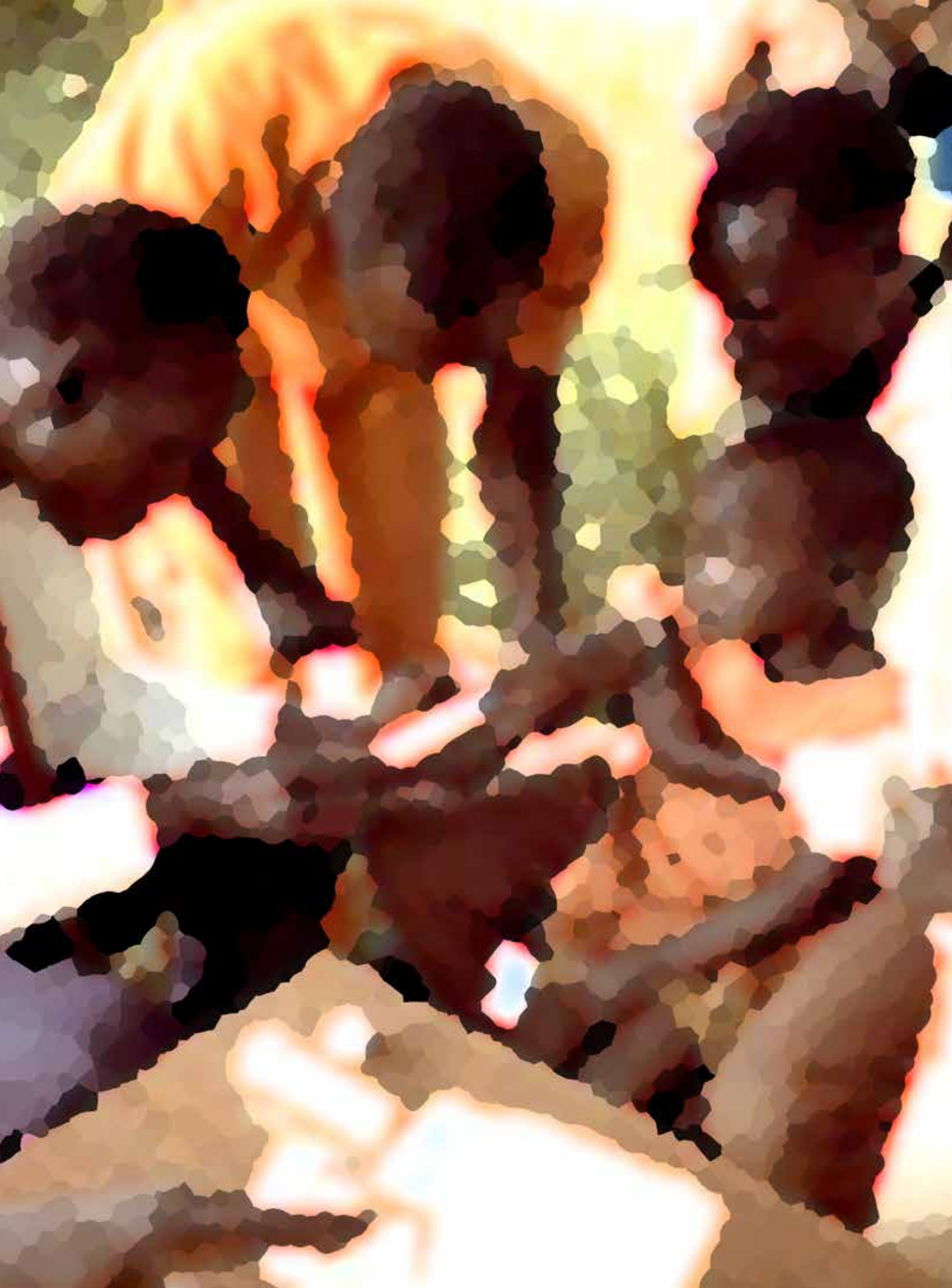

Section of Early Detection and Prevention (EDP)

Section head
Dr Rengaswamy Sankaranarayanan

Prevention and early detection, including screening and early clinical diagnosis, are major interventions in cancer control that decrease the burden of cancer and improve quality of life. The Early Detection and Prevention Section (EDP), composed of the Prevention and Implementation Group (PRI), the Quality Assurance Group (QAS), and the Screening Group (SCR), focuses on research activities that contribute to the development of resource-appropriate public health policies, approaches to quality assured cost-effective prevention programmes, and early detection strategies for the control of common cancers such as breast, cervical, colorectal, oral, oesophageal, and stomach cancers globally, with particular emphasis on low- and middle-income countries (LMICs). It is evident that prevention offers the most cost-effective long-term strategy for the control of cancer. As such, prevention initiatives within EDP include the development and implementation of safe, affordable, and effective vaccination schemes for human papillomavirus-related cancers, and the evaluation of the impact of *Helicobacter pylori* eradication on stomach cancer incidence and mortality. The focus of early detection research within the Section includes assessing new technologies and alternative screening approaches, as well as evaluating the impact of improved awareness and access to health care services for the early detection of major cancers such as breast, cervix, oral, and colorectal.

To achieve the above-mentioned objectives, the Section initiates and implements studies in collaboration with investigators in national cancer organizations, national health services, state health agencies, and other key groups within and outside the Agency. EDP works closely with international organizations such as the International Atomic Energy Agency and the Union for International Cancer Control to develop, implement, and promote effective strategies for preventing and controlling cancer in the context of national cancer control programmes. There is continued emphasis on developing, updating, and expanding training resources for cancer prevention and early detection initiatives in LMICs, and enhancing prevention and early detection services by contributing to the development of local health care systems within the context of our research studies. Our motto is not research unto research, but research to improve cancer prevention and early detection services in limited-resource settings.

Prevention and Implementation Group (PRI)

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The Prevention and Implementation Group (PRI) conducts studies to evaluate the efficacy, population impact, and feasibility of interventions aimed at the primary and secondary prevention of cervical, anal, oral, and gastric cancers, particularly in low- and middle-income countries where these cancers are common. In addition, we collaborate with public health institutions and governments to implement and evaluate effective interventions for cancer prevention. The main focus of PRI has been the development and implementation of safe and effective vaccines against human papillomavirus (HPV)-related cancers and the evaluation of the potential impact of *Helicobacter pylori* eradication on gastric cancer incidence and mortality. In addition, we are conducting a large-scale multicentre evaluation of methods to triage HPV-positive women in the context of cervical cancer screening and promoting the implementation of organized cervical cancer prevention and control programmes in Latin America and other areas of the world.

Cervical cancer studies in Guanacaste, Costa Rica

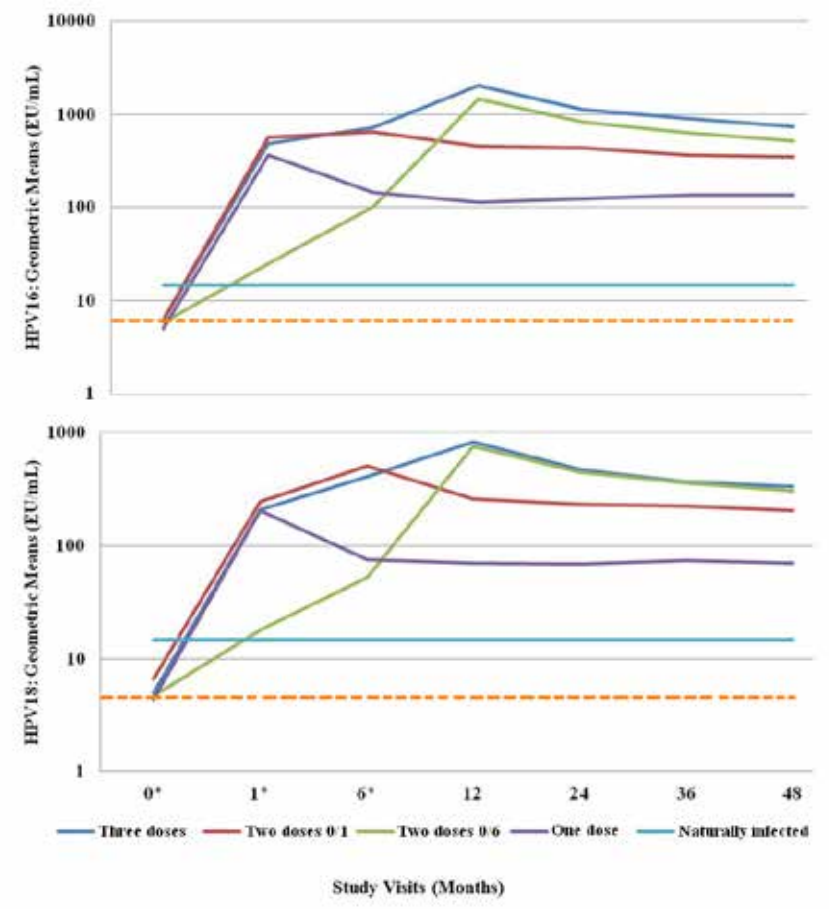
The Guanacaste Project (PEG) is a long-term collaboration with the United States National Cancer Institute (NCI) and Costa Rican researchers to investigate the natural history of HPV infections and associated neoplasia, in addition to new preventive strategies. The Costa Rica Vaccine Trial (CVT) is part of this effort. In 2004 and 2005, CVT recruited approximately 7500 women aged 18–25 to participate in a randomized controlled trial of the bivalent HPV vaccine (HPV 16/18) to evaluate its efficacy against cervical infections and cervical intraepithelial neoplasia (CIN2+). PRI previously published on the efficacy of the vaccine to prevent persistent cervical HPV infections with HPV 16/18 and phylogenetically related HPV types. We also reported on the impact of vaccination on cervical cytology screening, colposcopy, and treatment in the first 4 years after vaccination. Colposcopy referral and treatment were reduced by 21% (P = 0.01) and 45.6% (P = 0.08), respectively, among women with no evidence of previous exposure to HPV 16/18 at the time of vaccination (Rodríguez *et al.*, 2013). Furthermore, 4-year vaccine efficacy against 12-month HPV 16/18 persistent infection was similarly high among young women who received one dose, two doses, or the recommended three doses of the vaccine. We have now evaluated the magnitude and 4-year durability of immune responses to the vaccine after administration of one, two, or three doses. HPV 16/18 geometric mean titers (GMTs) were, respectively, at least 24 and 14 times higher among women receiving two doses of the vaccine and 9 and 5 times higher among those receiving one dose, compared with the GMTs among naturally infected women. The one-dose GMTs remained stable from month 6 through month 48 (Figure 1), raising the possibility that even a single dose of HPV virus-like particles will induce long-term protection (Safaeian *et al.*, 2013a).

Follow-up of the vaccinated cohort continues mainly to evaluate long-term protection (10 years), safety, immunogenicity, and HPV type-replacement.

Epidemiology and prevention of anal and oral HPV infection

At the 4-year visit in the CVT, we obtained anal specimens for HPV testing from sexually active women. We detected 22% of anal oncogenic HPV infection in this group of relatively young women with clear indication of an association with sexual activity, including anal sex (Castro *et al.*, 2012). Previously we reported on the efficacy of the vaccine to prevent anal HPV infection 4 years after recruitment. Current plans include long-term follow-up of anal HPV-positive

Figure 1. HPV 16 (top) and HPV 18 (bottom) specific antibody geometric means, by number of vaccine doses and study visit. *Vaccination period: 0/1/6 months. Solid lines represent HPV 16/18 specific geometric means. The line for the natural infection is from enrolment only and does not represent longitudinal samples. Dashed orange line is the laboratory-determined seropositivity cut-off (HPV 16 = 8 EU/mL; HPV 18 = 7 EU/mL). Source: Safaeian M *et al.* (2013a); reprinted by permission from the American Association for Cancer Research.



women with HPV testing, anal cytology, and anoscopy, to define the natural history of these infections and assess long-term efficacy.

In addition, PRI is investigating oral HPV infections and the efficacy of the bivalent vaccine to prevent them. We tested oral specimens from 5838 participants in the trial for α mucosal HPV types (SPF10/LiPA25 version 1). HPV infection was rare, and in the control arm (*n* = 2926) 1.9% of women had an oral α mucosal HPV detected, 1.3% had carcinogenic HPV, and 0.4% had HPV 16. HPV infection was predominately associated with sexual behaviour (Lang Kuhs *et al.*, 2013). Recently, we demonstrated for the first time a 93% efficacy of the bivalent vaccine to prevent oral HPV 16/18 infections 4 years after vaccination in the CVT (Herrero *et al.*, 2013). Follow-up is under way to investigate the natural history of these infections (Table 1).

Table 1. Protection against human papillomavirus (HPV) 16/18 infection by anatomical site in different cohorts[a] within the Costa Rica vaccine trial

Site	Arm	Number of women	Number of events	Rate per 100	Efficacy (95% confidence interval)
Cervix (incident 12-months persistent infection)	HPV	2635	8	0.3	91% (82–96)
	Control	2677	89	3.3	
Anus (prevalent infection ~48 months after vaccination)	HPV	1003	8	0.8	84% (67–93)
	Control	986	48	4.9	
Oral cavity (prevalent infection ~48 months after vaccination)	HPV	2910	1	0.0	93% (63–100)
	Control	2924	15	0.5	

[a] For the cervix, data are from the according-to-protocol cohort (protocol-compliant women negative for HPV at enrolment); for the anus, data are from the restricted cohort of cervical HPV negative and HPV 16/18 serology negative; and for the oral cavity, data are from the intention-to-treat cohort (all women vaccinated with HPV results). Table compiled from Herrero *et al.* (2013); Herrero *et al.* (2011). *Cancer Discov,* 1:408–419. http://dx.doi.org/10.1158/2159-8290.CD-11-0131 PMID:22586631; Kreimer *et al.* (2011). *Lancet Oncol,* 12:862–870. http://dx.doi.org/10.1016/S1470-2045(11)70213-3 PMID:21865087

Multicentre study of HPV screening and triage (ESTAMPA)

We have organized a group of Latin American investigators to conduct a large multicentre study including more than 50 000 women to evaluate multiple triage techniques among HPV-positive women. Women aged 30–64 years will be recruited at centres in at least seven Latin American countries and screened with an HPV test. All HPV-positive women and a sample of HPV-negative women will be referred for colposcopy, biopsy, and final diagnosis, with follow-up at 18 months. Visual, cytological, and molecular triage methods will guide the formation of specific strategies to select women requiring more intensive follow-up and treatment. Recruitment has begun in two sites in Colombia and is expected to expand shortly to Honduras, Paraguay, and Mexico and later to other countries in the region. An important objective of the study is to evaluate different strategies for implementation of organized cervical cancer screening in Latin America, as well as to provide extensive training (Figure 2) on the different aspects of the programme and transfer new technologies, including the use of molecular risk markers.

Figure 2. ESTAMPA study: cervical pathology training course participants, Instituto Nacional de Cancerología, Bogotá, Colombia, 5–7 September 2013. Photograph courtesy of Adrián Moreno.

Clinical trial of *Helicobacter pylori* infection in Latin America

We have completed the initial follow-up phase of our Latin American randomized clinical trial to evaluate efficacy of three different treatment regimens against *H. pylori* in seven centres in Latin America, conducted in collaboration with the South West Oncology Group of the USA. A total of 1463 *H. pylori*-positive participants aged 21–65 years were treated with different antibiotic regimes and observed between September 2009 and July 2011. The results of eradication at 6 weeks after treatment have been published, and we have now completed analysis of the 1-year follow-up data.

Recurrence risk was 11.5% (95% CI, 9.6–13.5%) at 1 year, and it was significantly associated with study site, non-adherence to initial therapy, and number of children in the household. Overall effectiveness at 1 year was 79% (95% CI, 77–82%) with no difference by treatment regime (Morgan *et al.*, 2013). Plans are under way to extend follow-up to investigate long-term *H. pylori* recurrence.

Medellin, Colombia, ASCUS trial

In collaboration with the University of Antioquia, we are participating in a randomized trial to evaluate different strategies for clinical management of women with atypical squamous cells of unknown significance (ASCUS) cytology. The trial is well under way with 2700 women recruited.

Support of HPV vaccination and screening programmes in Latin America

The National Screening Program of Argentina has implemented an HPV-based screening programme. In order for the first province to implement the programme (Jujuy), extensive political and educational meetings took place, guidelines and educational materials were developed, and laboratories were set up, among other things. A protocol to evaluate the acceptability and performance of self-collected specimens was recently completed, with excellent results that are now under analysis. Plans to extend the programme to new areas in the country are under way. The materials developed and the experience should be useful for other programmes in the region.

We have also participated in meetings with local authorities from Mexico, Costa Rica, Guatemala, Nicaragua, Chile, Colombia, Peru, and Paraguay and with the Network of Latin American Cancer Institutes, to promote implementation of new cervical cancer screening approaches and HPV vaccination programmes.

PRI is grateful to the following for their collaboration:

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Mr Douglas Puricelli Perin
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Several years are required to establish effective and affordable cancer prevention programmes across a country. Knowledge of how to assure the quality of such long-term efforts is essential if they are to achieve their potential impact in cancer control. The main goal of the Quality Assurance Group (QAS) is to expand and effectively disseminate such knowledge. This is achieved primarily through international collaborative projects that develop, update, and implement multidisciplinary quality-assurance guidelines for cancer screening, and through application of the lessons learned to other approaches in cancer control, such as primary prevention. Distribution of the guidelines is achieved through publications and training and through the exchange of experience and collaboration between programmes and countries. Our collaboration with WHO, the European Union (EU), and Participating States of the Agency plays a key role in these efforts.

The principal activities of QAS are conducted in the framework of international collaborative projects with large numbers of experts in a wide range of health care settings, primarily in high-income countries but increasingly also in low- and middle-income countries. Key projects during the biennium included the development and piloting of the first comprehensive training course of the European Schools of Screening Management; development and updating of the European guidelines for quality assurance in breast, cervical, and colorectal cancer screening; evidence-based updating of the European Code Against Cancer; and collaboration with the WHO, the International Atomic Energy Agency, the EU, and national health authorities in guideline development, implementation, and dissemination.

Guideline development and dissemination

In a project coordinated by QAS, the individual chapters of the European Guidelines for Quality Assurance in Colorectal Cancer Screening and Diagnosis (Figure 1) were published as open access articles in a high-profile peer-reviewed journal, Endoscopy, in 2012, and an overview with updates of key evidence was published in 2013 (von Karsa *et al.*, 2013a). More than 100 experts from 49 countries in four continents participated, primarily in Europe, but also in North and South America, Asia, and Australia.

Supplements to the fourth edition of the European Guidelines for Quality Assurance in Breast Cancer Screening and Diagnosis have been produced in a project coordinated by QAS and co-financed by the EU Health Programme (European Cooperation for Development and Implementation of Cancer Screening and Prevention Guidelines). The supplements deal with histopathology, physico-technical quality control, and digital mammography and were recently published by the European Commission (Figure 2). Supplements on HPV testing and vaccination have also been prepared for the second edition of the European Guidelines for Quality Assurance in Cervical Cancer Screening, with publication expected in the near future. This project was coordinated by QAS and co-financed by the EU Health Programme (European Cooperation for Development and Implementation of Cancer Screening and Prevention Guidelines). QAS has also participated in projects to update the WHO guidelines on cervical cancer prevention and to develop recommendations on breast cancer screening. Publication of the updated cervical cancer prevention guidelines is expected in 2014.

Figure 1. Cover of the European Guidelines for Quality Assurance in Colorectal Cancer Screening and Diagnosis. First edition.

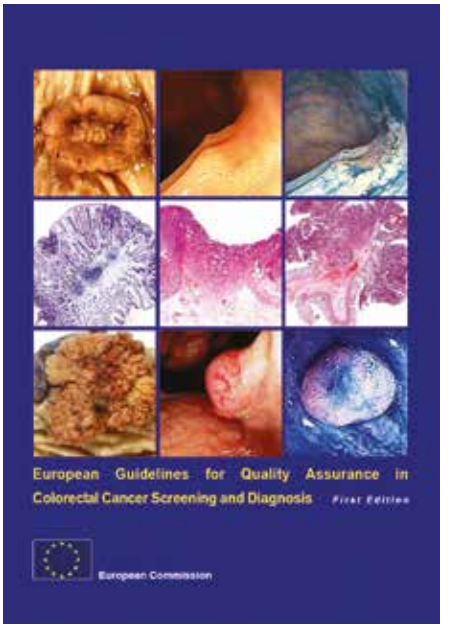
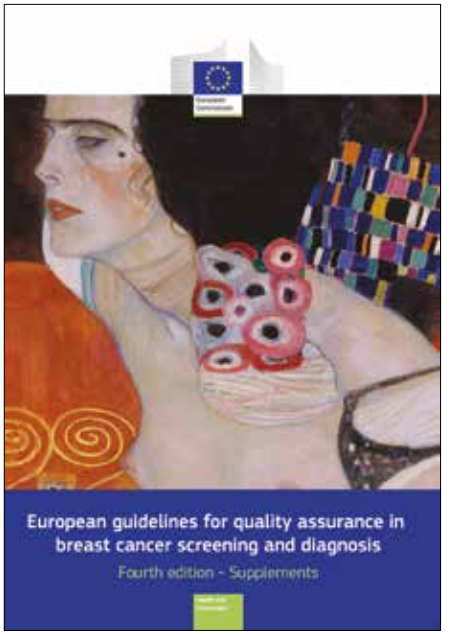


Figure 2. Cover of the European Guidelines for Quality Assurance in Breast Cancer Screening and Diagnosis. Fourth edition - Supplements.



In another project co-financed by the EU, QAS is updating the report on implementation of cancer screening in the EU, an essential tool for monitoring the progress and evolution of screening programmes. This update will include information on the extent to which key parameters in the European quality assurance guidelines are achieved. This will permit benchmarking and comparison of programme performance between EU Member States and countries in other regions of the world, which is important due to the increasing interest of other countries in establishing cancer screening programmes that fulfil the comprehensive European standards. For the same reason, recent publications of the Group explain the approach to programme implementation that has been most successful in Europe: international collaboration in coordinated planning, followed by feasibility testing, piloting, and phased rollout across the country, enabling the responsible authorities to control the pace of the implementation process and assure the quality of a programme as it unfolds (von Karsa *et al.*, 2012a; Lynge *et al.*, 2012; von Karsa and Arrossi, 2013). QAS has also participated in a comprehensive review of the performance of population-based breast cancer screening programmes in

Europe. The results were published in 2012 in eight articles in a supplement of the *Journal of Medical Screening*. They provide an authoritative appraisal of the balance between benefit and harm that shows that for every case of overdiagnosis, at least one breast cancer death is avoided (Paci, 2012).

Update of the European Code Against Cancer

Quality assurance of cancer screening programmes requires expertise in areas common to successful implementation of primary prevention programmes, such as the behavioural aspects of motivation, communication, and the reinforcement of activities designed to prevent cancer. Therefore, in collaboration with the IARC Section of Environment and Radiation, QAS is coordinating a project to revise the European Code Against Cancer (ECAC). The code was established as a package of recommendations for the general public that, if followed, should significantly reduce an individual's risk of developing cancer. The principal aim of the ECAC is to encourage lay people to take appropriate action. The fourth edition will therefore be worded in a manner that lay people can easily understand; other aspects of communication for the general public will also be taken into account. This is a collaborative effort involving the IARC Sections of Infections, Cancer Information, Monographs, Nutrition and Metabolism, and the Office of the Director, including the Communications Group, and all of the groups in the Section of Early Detection and Prevention (QAS, PRI, and SCR). Co-financing is provided by the European Partnership for Action Against Cancer, a current initiative of the EU Health Programme.

European Schools of Screening Management (ESSM)

The European Schools of Screening Management (ESSM), a network of reference and training centres, has been established in Europe. This network is developing and piloting comprehensive training courses for planning, implementation, quality assurance, and evaluation of population-based cancer screening programmes (Anttila *et al.*, 2013). The intent is to expand the ESSM network into a platform for direct collaboration between more and less developed countries as they implement cancer screening programmes, and ESSM is intended to become a model for other regional networks that collaborate with IARC. Decision-makers and professionals involved in the planning, implementation, or evaluation of cancer screening programmes in eight EU countries (Estonia, Latvia, Lithuania, Poland, Romania, Slovenia, Spain, and Sweden) and six non-EU countries (Albania, Croatia, Georgia, Morocco, Serbia, and Turkey) attended both of the 1-week modules of the course that were held at IARC in November 2012 and March 2013 (Figure 3). The training was conducted in close collaboration with a project led

Figure 3. Participants in Module 1 of the pilot course of the European Schools of Screening Management, 19–23 November 2012: Left to right, front row: Snežana Žujković, Maria Fernan, Loubna Abousselham, Luciana Neamtiu, Paola Armaroli, Ahti Anttila, Lawrence von Karsa, Jozica Maučec Zakotnik, Dunja Skoko-Poljak, Müjdegül Zayıfoğlu Karaca, Miriam Elfström, Daiga Santare, Kozeta Filipi. Second row: Rugile Ivanauskiene, Tracy Lignini, Mejreme Maloku, Isabelle Soerjomataram, Aleksandra Jaric, Yulia Panayotova, Isabel Portillo Villares, Elena Pérez Sanz, Melita Jelavic, Vaida Momkuviene, Kirstin Grosse Frie. Back row: Eero Suonio, Nereo Segnan, Giuseppe Salamina, Elvis Ahmedi, Sven Törnberg, Levan Jugeli, Stephen Halloran, Ondrej Majek, Andrzej Czuba, Arkadiusz Chil, Jolanta Kotowska, Piret Veerus, Stefan Lönnberg, Lennarth Nyström. © Roland Dray/IARC.

by the Italian Ministry of Health and supported by WHO headquarters and the WHO regional offices in Europe, the Middle East, and Africa, and the governments of France and Spain (Cancer Screening and Early Detection in Mediterranean Countries).

Collaboration with WHO in developing and implementing the global and European action plans on noncommunicable diseases (NCDs)

The head of QAS also served as rapporteur for the indicator on cervical cancer screening at the Regional Technical Consultation on NCD Surveillance, Monitoring and Evaluation convened by the WHO Regional Office for Europe in Oslo, Norway, in February 2012. The proposals and feedback provided at the meeting were used to shape the European contribution to the WHO Global Monitoring Framework for control of noncommunicable diseases (NCDs) and assisted in monitoring and evaluating the 2012–2016 Action Plan for implementation of the European Strategy for the Prevention and Control of NCDs. The results of the Oslo meeting were also considered in the development of regional targets and indicators under the umbrella of the European Health Policy, Health 2020. QAS collaborated with the WHO Regional Office for Europe in the preparation of the European Ministerial Conference on the Prevention and Control of NCDs that will take place in Ashgabat, Turkmenistan, in December 2013. The Ashgabat Declaration on the Implementation of the Global and European Actions on NCDs is expected to be adopted at the conference. The conference report will include an evaluation of early detection of breast cancer in Turkmenistan coordinated by QAS, the first such evaluation conducted in the country.

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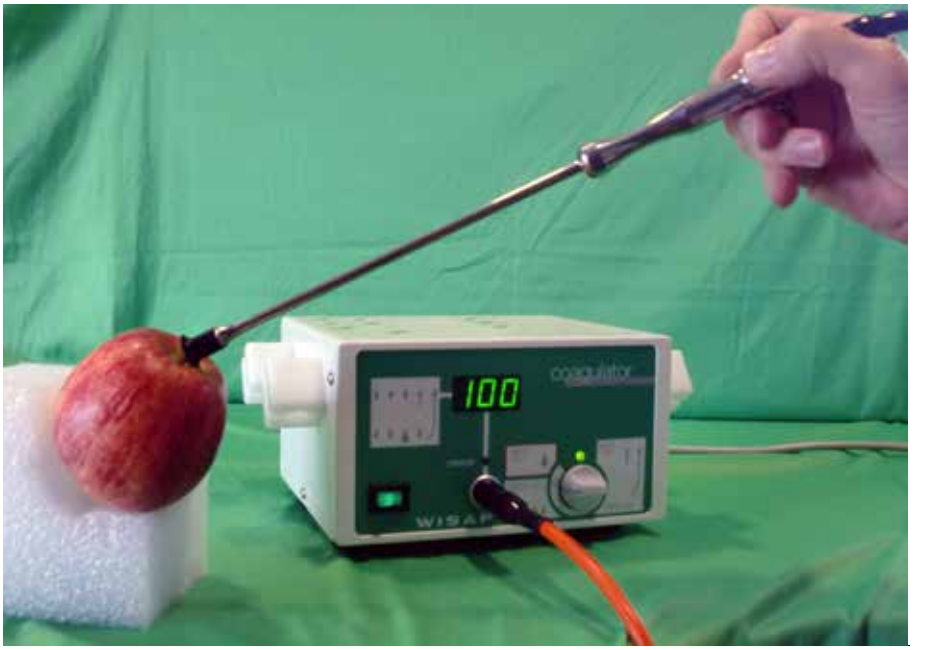
The objective of the Screening Group (SCR) is to evaluate the accuracy, effectiveness, and feasibility of a variety of early detection approaches and to accelerate the development of resource-appropriate screening, early diagnosis policies, and health care systems to reduce premature mortality from cancer and improve quality of life in low- and middle-income countries (LMICs). SCR conducts a variety of field studies to evaluate the performance characteristics, effectiveness, and service delivery aspects of early detection interventions for control of breast, cervical, colorectal, and oral cancers that could be scaled-up through routine health systems in LMICs. Also addressed are population and service delivery determinants that influence participation in early detection programmes, and the development of different training resources to catalyse and augment the training of personnel. The Group provides technical support to planning and implementing national early detection programmes in selected LMICs. A brief overview of major SCR studies, findings, and their impact on cancer control is provided below.

Cervical cancer prevention and screening

A variety of screening approaches for cervical cancer prevention were evaluated by SCR. With antiretroviral therapy, HIV-infected women live longer and therefore effective screening methods are needed to prevent cervical cancer, for which they are at high risk. We addressed the accuracy and clinical utility of visual screening with acetic acid (VIA), visual inspection with Lugol's iodine (VILI), Pap smear, and HPV testing in detecting high-grade cervical intraepithelial neoplasia (CIN 2 and 3) among 1128 HIV-infected women in Pune, India. Our results showed that sequential testing with VIA and VILI is the most feasible method until affordable HPV tests are available (Joshi *et al.*, 2013). The value of VIA and VILI in settings where HPV testing is not feasible was demonstrated in a large cross-sectional study (Deodhar *et al.*, 2012a). Affordable and effective treatment methods are vital for treating CIN 2 and 3 lesions. In a meta-analysis and field study, we demonstrated that cryotherapy results in an effective, safe, and acceptable treatment for CIN (Sauvaget *et al.*, 2013; Wesley *et al.*, 2013). We showed in another meta-analysis that cure rates exceeding 90% are achieved by cold coagulation treatment of CIN (Figure 1). Following a cross-sectional study to evaluate the performance of visual screening for cervical cancer, VIA and VILI screening services and treatment of CIN and early invasive cancer were sustained and scaled-up in Bamako and surrounding villages in Mali (Teguete *et al.*, 2012). Phase 1 of an organized Pap smear screening programme in Thailand during 2005–2009, involving approximately 5 million women aged 35–60 years, was evaluated. The feasibility of introducing organized cervical screening programmes through routine health services in higher middle-income countries, such as Thailand, was documented, and constructive suggestions for improving quality and coverage for the second phase during 2010–2014 were introduced (Khuhaprema *et al.*, 2012). We continue to provide technical support to national and regional screening programmes and initiatives in Angola, Argentina, Bangladesh, China, Congo, Guinea, India, Mali, Morocco, Nepal, Sri Lanka, and Thailand. SCR also continues to document cervical cancer incidence and mortality among the 230 000 women in the Osmanabad and Dindigul district cervical screening trials in India, addressing the impact of a single round of screening with HPV testing, cytology, or VIA and the risk of cervical cancer in more than 200 000 screen-negative women, in women who had treatment for CIN, and in women who defaulted treatment.

HPV vaccination is a major strategy for controlling cervical cancer by preventing persistent HPV infection. The use of less than three doses, if found effective, can substantially reduce HPV vaccine delivery costs and can accelerate the integration of HPV vaccination into national immunization programmes. In a multicentre clinical-trial-turned-observational-study in India, 4955 girls who received one dose (by default), 3963 who received two doses on days 1 and 60 (by default), 4920 who received two doses on days 1 and 180 or later (by design), and 4337 who received three doses on days 1, 60, and 180 or later (by design) are being followed up for immunogenicity, persistent HPV infection, and frequency of CIN caused by vaccine-included and -non-included HPV types. There have been no medically significant events related to HPV vaccination in this study. The immunogenicity after the two doses on days 1 and 180 or later was non-inferior to the three-dose regime; the immunogenicity among girls aged 15–18 years was non-inferior to that of girls

Figure 1. Simulating hands-on training in cold coagulation treatment using an apple and a cotton swab. © IARC/Evelyn Bayle and Krittika Guinot.



aged 10–14 years. The immunogenicity of one dose and of two doses on days 1 and 60 were significantly inferior to that of three doses over 6 months. Analysis of the 24- and 36-month plasma samples will be carried out in November 2013.

Breast cancer screening

In a randomized controlled screening trial involving 116 000 women in Trivandrum District, India, the second round of screening by clinical breast examination (CBE) is complete and the third round has been initiated. A total of 720 000 person-years have been accrued over 6 years. Interim results indicate significantly higher early detection in the intervention group: 21% and 46% of breast cancers are diagnosed in stage I and stages I and II compared with 13% and 35%, respectively, in the control group. However, there is no difference in breast cancer mortality between the two groups yet, indicating the significant impact of adequate treatment in preventing breast cancer mortality. A qualitative study addressing the factors influencing participation in the various levels of the screening trial has been initiated. A cross-sectional study comparing the diagnostic performance of mammography and near-infrared imaging in triaging women with breast lumps has been completed in Cheng Du, China; similar diagnostic accuracy of the two approaches was indicated. The diagnostic performance of tactile imaging in triaging women with breast lumps is currently under way in Thailand (Figure 2). The role of breast awareness in improving early detection of breast cancer and survival of breast cancer patients is currently being investigated in Mumbai and through routine health services among the general population in Coimbatore District, India. We reported a 5-year survival of 76% among an industrial cohort in Mumbai after improved awareness and adequate access to diagnostic and treatment services, which is 25 percentage points higher than reported breast cancer survival estimates in India (Gadgil *et al.*, 2012).

Oral cancer screening

Long-term results, after 15 years of follow-up, of the 192 000 participants in the randomized trial of oral visual screening in Kerala, India, showed a 25% reduction in mortality among users of tobacco or alcohol or both, a 38% reduction in oral cancer incidence, and an 81% reduction in mortality in those who complied with all four rounds of screening (Sankaranarayanan *et al.*, 2013a). The cumulative reduction in oral cancer incidence and mortality are shown in Figure 3. A detailed manual to guide primary care practitioners and health workers on early detection of oral cancer has been published (Ramadas *et al.*, 2013). We are currently evaluating the effectiveness of a "social marketing" programme to increase awareness for early detection in Sri Lanka.

Colorectal cancer screening

Along with the National Cancer Institute (Bangkok) and the Thai Health Authorities, we successfully implemented a pilot colorectal cancer (CRC) screening programme using immunochemical focal

Figure 2. Digital image, from a tactile imaging device, showing a firm round mass that was subsequently confirmed as neoplasia. Courtesy of Thanasitthichai Somchai.

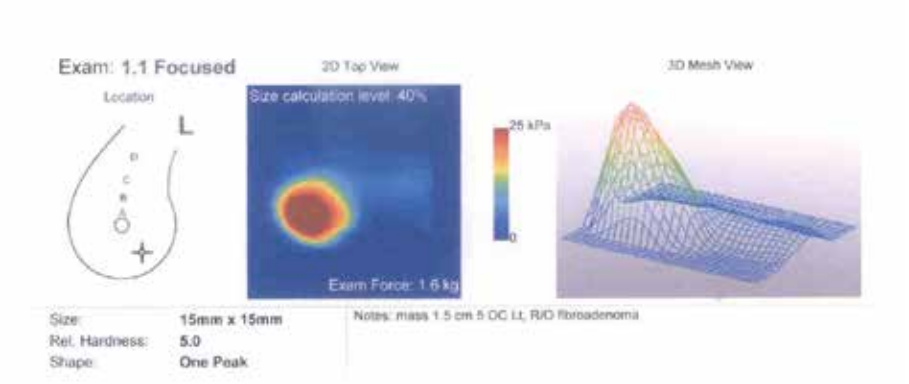
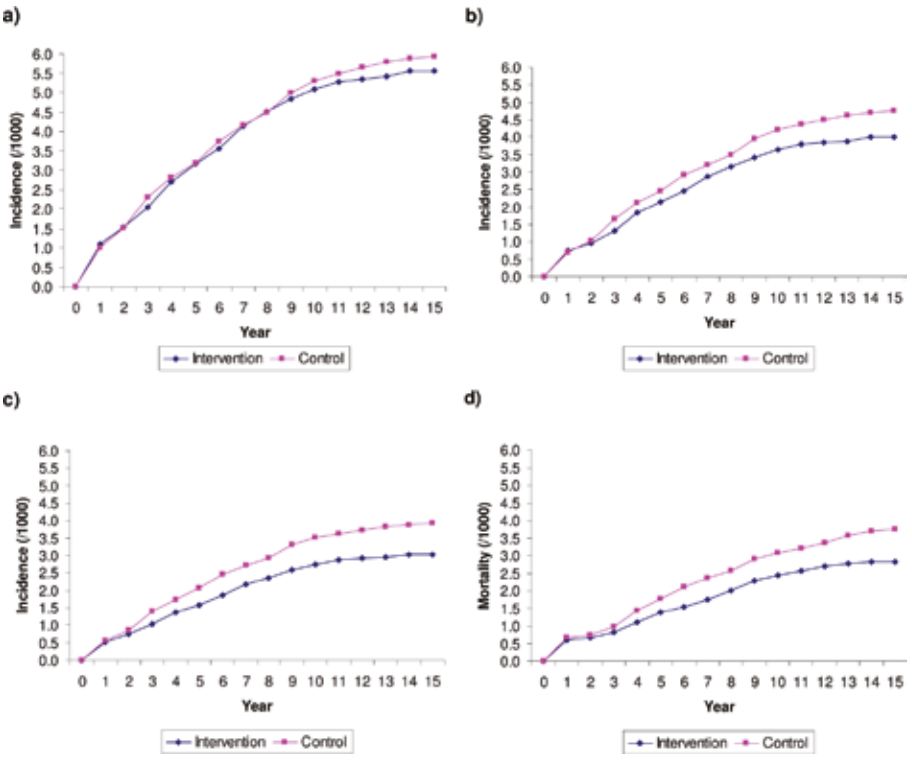


Figure 3. Cumulative incidence of (a) overall, (b) stage 2 or worse, (c) stage 3 or worse, and (d) mortality from oral cancer among individuals who used tobacco or drank alcohol, or both. Source: Sankaranarayanan *et al.* (2013a); reproduced with permission from Elsevier.



blood testing (iFOBT) and colonoscopy for test-positives through the routine government health services in Lampang Province, Thailand. Of the target population of 127 301 participants, 80 012 (62.9%) were screened using iFOBT. Participation was higher among women (67.8%) than men (57.8%) and lower in those aged 50–54 years than those aged 60–65 years. Of those screened, 873 (1.1%) were found iFOBT-positive; 627 (72.0%) screen-positive persons had a colonoscopy; 187 (29.8%) were diagnosed with adenomatous polyps, and 119 (63.6%) of them had advanced adenoma; and 30 (4.8%) were diagnosed with CRC, of which 53% (*n* = 16) had stage I disease. This project substantially improved the capability of local health services in colonoscopy, treatment of polyps and CRC, and histological assessment of colorectal neoplasia. The successful implementation of the pilot CRC screening, with satisfactory process and intermediate outcome measures, informed the feasibility of scaling up organized CRC screening through existing health services and paved the way for the government in Thailand to implement CRC screening more widely.

Figure 4. Colonoscopy in Lampang colorectal cancer screening programme in Thailand; a large bowel polyp is being removed during colonoscopy. © IARC/Rengaswamy Sankaranarayanan.

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