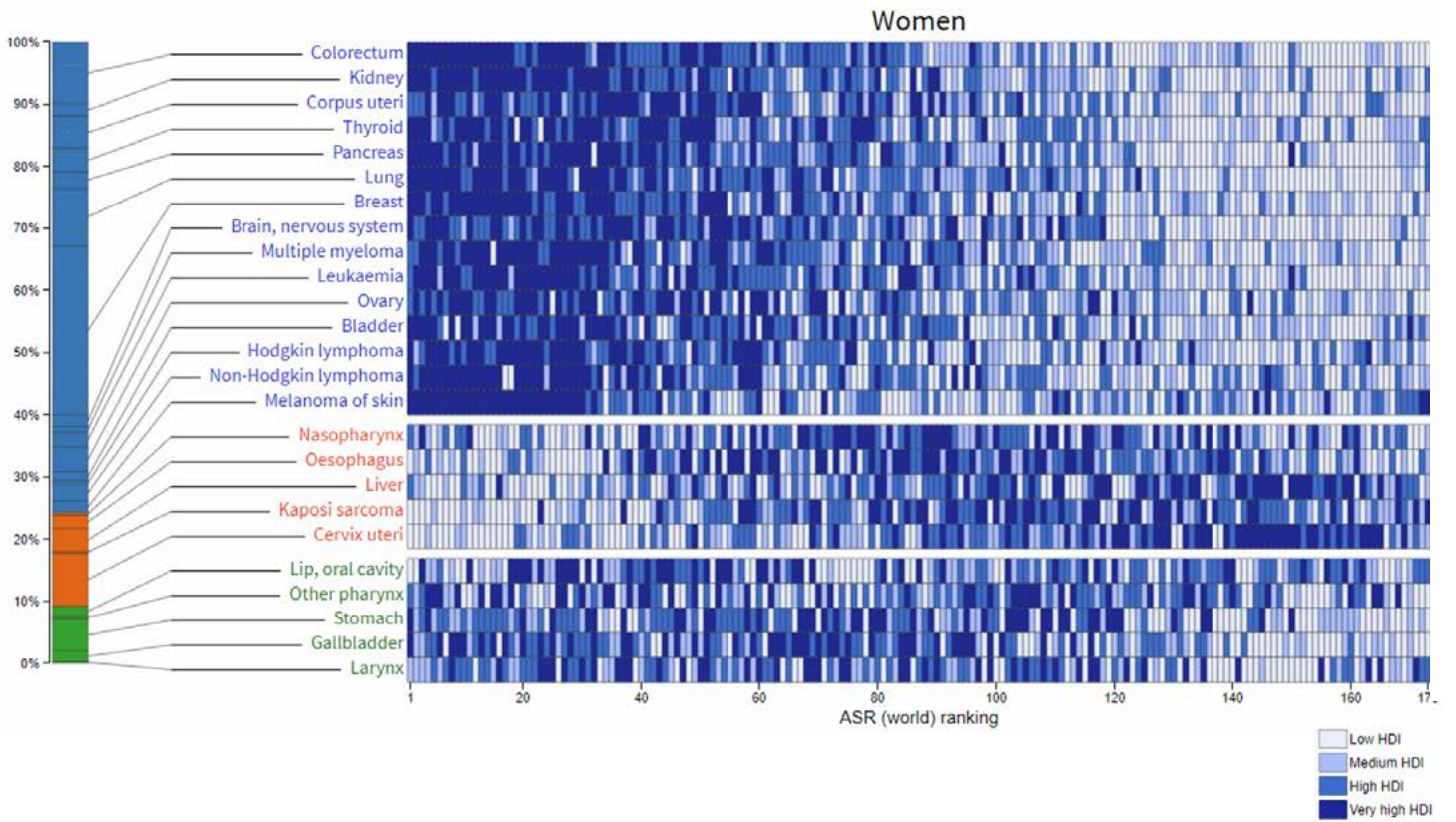


Cancer and HDI heatmap

Profiling The Diversity Of Cancer According To Human Development

Sex Female Male **Clustering** Off On **Color** HDI Area **Country**



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The global number of new cancer cases per year is predicted to double during the next two decades, to 29.4 million by 2035. During the course of this century, cancer will become the leading cause of death worldwide and the single most important barrier to further gains in life expectancy. There is a growing disparity in the cancer burden, with the greatest increases in incidence projected to occur in many lower-resource countries that are undergoing major social and economic transitions. This is matched by an equivalent inequity in the availability of reliable surveillance data to inform cancer control programmes. From a global perspective, currently only one in three countries have high-quality

population-based cancer registries (PBCRs) to disseminate cancer incidence and survival statistics, and only one in five countries can report medium- or high-quality national mortality data to the World Health Organization (WHO).

It is in this rapidly evolving landscape that the Section of Cancer Surveillance (CSU) operates. CSU is responsible for the systematic and ongoing collection, analysis, interpretation, and dissemination of global cancer data and statistics for cancer control action. The 2016–2017 biennium has provided unprecedented opportunities to further develop a comprehensive and truly global programme via collaborations

with multidisciplinary partners. Highlights from three highly complementary core areas of activity are described here.

CANCER REGISTRY SUPPORT AND COLLABORATION

CSU's long-standing collaborative relationships with PBCRs worldwide — members of the International Association of Cancer Registries (IACR; <http://www.iacr.com.fr>) — remain vital to improving the quality and use of registry data. CSU provides the secretariat and, among its functions, co-develops the annual international meeting of the IACR; the 38th annual meeting was held in Marrakesh in 2016, and the 39th was

held in Utrecht in 2017. There have been efforts to fully align the activities of the IACR, as the professional society of registries worldwide, with those of the IARC-led Global Initiative for Cancer Registry Development (GICR; <http://gicr.iarc.fr>).

The GICR is a partnership of international and national agencies committed to working collaboratively to increase the quality and availability of cancer incidence data in low- and middle-income countries (LMICs). Local reference centres – IARC Regional Hubs – assist in the planning and development of PBCRs through targeted support, training, advocacy, and networking. The Hubs are now operational across defined regions of Africa, the Americas, and Asia that comprise 85% of the world’s population and more than 150 countries. The sixth Hub is being established in the Pacific Islands, after a financial contribution from the Australian Government.

The GICR is expanding its strategic goals of global coordination, regional support, and country leadership to increase Hub capacity and accelerate delivery of targeted actions. The knowledge has enabled the selection of GICR Partner Countries – a designation of sufficient evidence of commitment

Figure 1. Participants in the International Atomic Energy Agency (IAEA)–WHO–African Cancer Registry Network (ACFRN)–IARC course held in Accra, Ghana, in December 2016, as part of the work of the Global Initiative for Cancer Registry Development (GICR). © IARC/ Freddie Bray.



to a joint action plan to increase the availability, quality, and use of cancer data. Signed agreements with IARC are used to formalize the collaboration and to monitor progress. To strengthen support to countries, Hubs have been identifying organizations that can provide assistance. This has resulted in three new IARC–GICR Collaborating Centres for the Mumbai Hub region, each focused on a set of complementary

activities: the National Cancer Institute of Thailand, the National Cancer Center Japan, and the National Cancer Center in China. In 2016–2017, site visits to 19 countries were conducted by experts to assess opportunities to improve the level of cancer registration; 19 GICR-led or GICR-affiliated courses were delivered, and 23 new agreements were signed, and others are in development (Table 1; Figure 1).

Table 1. Global Initiative for Cancer Registry Development (GICR)-affiliated activities in 2016–2017, by region: site visits conducted, courses delivered, and formal agreements signed

Region ^a	Site visits ^b [total: 19]	Courses [total: 19]	Agreements [total: 23]
Africa	Burundi; Sierra Leone; Swaziland [3]	Libreville, Gabon (March 2017); Accra, Ghana (December 2016); Eldoret, Kenya (February 2017 and March 2017); Marrakesh, Morocco (October 2016) [5]	Benin; Côte d’Ivoire; Ethiopia; Kenya; Malawi; Mali; Mozambique; Seychelles; Uganda; United Republic of Tanzania; Zimbabwe [11]
Asia	Afghanistan; Azerbaijan; China; Iraq; Japan; Kazakhstan; Republic of Korea; Libya; Sri Lanka; Turkmenistan; Viet Nam [11]	Mumbai, India (November 2016); Yogyakarta, Indonesia (May 2016); Erbil, Iraq (April 2016); Almaty, Kazakhstan (April 2016); Bishkek, Kyrgyzstan (November, 2016); Kuala Lumpur, Malaysia (March 2016); Yangon, Myanmar (June 2017); Moscow, Russian Federation (September 2017); Obninsk, Russian Federation (September 2016); Colombo, Sri Lanka (March 2017); Izmir, Turkey (September 2016) [11]	Bhutan; China; Cyprus; Japan; Jordan; Malaysia; Myanmar; Thailand; Turkey [9]
Caribbean	Bahamas; Barbados [2]	Providenciales, Turks and Caicos (June 2016); Washington DC, USA (November 2016) [2]	Trinidad and Tobago [1]
Latin America	Belize; Brazil [2]	Quito, Ecuador [1]	Panama; Paraguay [2]
Pacific Islands	Fiji [1]	—	—

^a Classified into continents according to IARC Hub involvement.

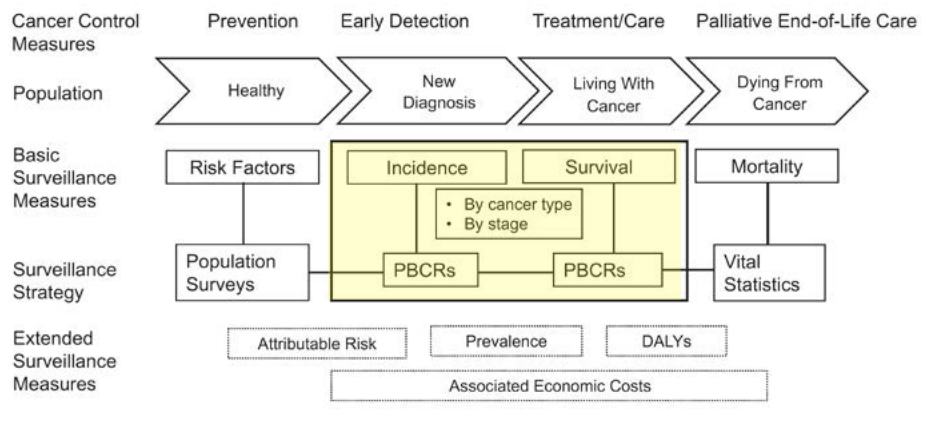
^b Designates initial country visits only, as of 1 January 2012.

To meet the growing demand for technical training, the GICR has widened the use of local experts and technology through its Knowledge Transfer and Training programme. The GICRNet uses a “train the trainer” model to form a network of experts to serve as a resource to registry staff in each Hub region. Masterclasses on CanReg5 and coding and staging practices were held at IARC in 2016 and 2017, respectively, and 30 GICRNet experts were trained.

Many of the activities are jointly developed with the IACR. They include: enhancement and training in the use of CanReg5, IARC’s open-source tool to support collection of cancer registry data; the production of “Essential TNM”, a simplified version of the tumour–node–metastasis (TNM) staging system, to help registrars to code stage using available clinical information; and the development of a much-expanded and updated third edition of the definitive textbook for registries, *Cancer Registration: Principles and Methods*, which is scheduled for publication in 2018.

To advocate the centrality of PBCRs in cancer control and support their integration into surveillance systems for noncommunicable diseases (NCDs), a position paper clarified similarities and differences between surveillance

Figure 2. Measures and strategies for cancer surveillance at the population level. DALYs, disability-adjusted life-years; PBCRs, population-based cancer registries. Figure reprinted from Piñeros et al. (2017b).



systems for communicable diseases and NCDs, and proposed an expanded framework for cancer surveillance (Figure 2) (Piñeros et al., 2017b).

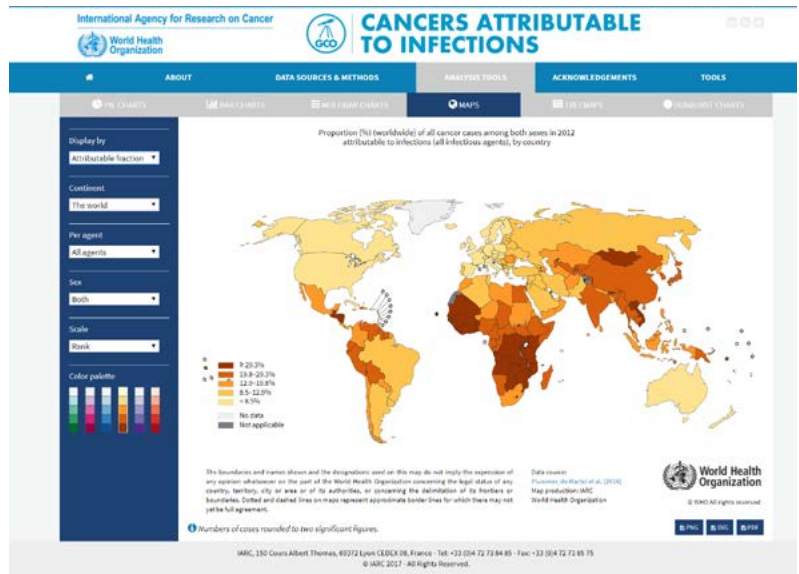
GLOBAL CANCER INDICATORS

The guiding principle in developing global estimates in CSU remains to validate estimates against local recorded data of high quality where they are available, and where such data are not available, to pursue in-country investments in cancer registration through the GICR, where feasible. The Global Cancer Observatory (GCO) was launched in 2016 to showcase an expanding range

of indicators developed through CSU flagship projects, and increasingly via specific research studies. The GCO, which makes use of data-driven technology, has four subsites (Figure 3).

The GLOBOCAN database, built on the data from cancer registries worldwide, permits cancer statistics to be available at the national level through the GCO’s Cancer Today subsite. A validation study comparing GLOBOCAN estimates with high-quality recorded national incidence data in Norway emphasized the utility of trends-based estimation approaches and population-based data to accurately estimate incidence (Antoni et al., 2016).

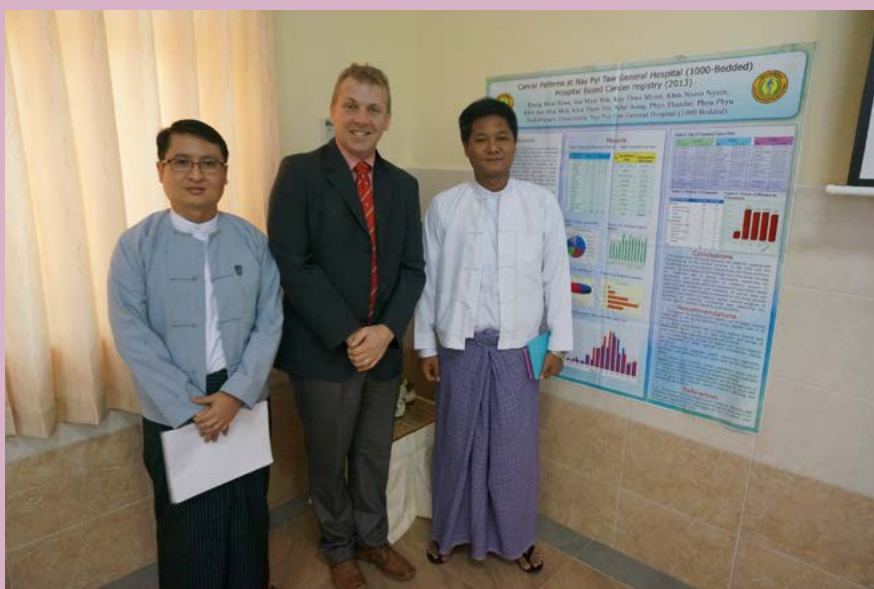
Figure 3. Screenshots of (left) the four subsites of the Global Cancer Observatory (GCO; <http://gco.iarc.fr>); (right) a global map from the GCO’s Cancer Causes subsite showing the proportion of cancers attributable to infections in 2012. © IARC.



Case study of capacity-building through the Global Initiative for Cancer Registry Development (GICR): Myanmar

GICR phases	Key activities by year	IARC partners ^a
1 COUNTRY ASSESSMENT <ul style="list-style-type: none"> Review cancer and vital registries to determine opportunities Identify local leaders 	2014 <ul style="list-style-type: none"> Discussions with local contacts on needs – leading to a course on basic cancer registration in Yangon Installation and customization of IARC CanReg5 software Agreement with the Ministry of Health and Sports (MoH) to launch pilot cancer registry, Nay Pyi Taw General Hospital 	<ul style="list-style-type: none"> Myanmar MoH IARC Mumbai Hub National Cancer Institute, Thailand International Association of Cancer Registries
2 SITE VISIT <ul style="list-style-type: none"> Establish the basis for an implementation plan Meet with stakeholders to provide recommendations 	2015 <ul style="list-style-type: none"> ImPACT Mission to review cancer control services in Mandalay, Nay Pyi Taw, and Yangon Debriefing with senior MoH staff to refine recommendations 	<ul style="list-style-type: none"> International Atomic Energy Agency World Health Organization United Nations Interagency Task Force
3 DIRECTED SUPPORT <ul style="list-style-type: none"> Establish the IARC Hub as the first point of contact Coordinate opportunities with other partners for efficiency Promote accountability via a signed agreement and the use of a monitoring framework 	2016 <ul style="list-style-type: none"> Engagement with surveillance leaders to establish a plan for PBCR, Myanmar Cancer Control Leadership Forum Elaboration of cancer registry plan, including costing and milestones at the National Cancer Control Programme Meeting Nay Pyi Taw PBCR staff selected as IARC “50 for 50” Programme 2017 <ul style="list-style-type: none"> IARC–MoH Collaborative Research Agreement finalized Delivery of a national training course Revisions to CanReg5 to include new fields and local language Nay Pyi Taw PBCR staff training at IARC Summer School 	<ul style="list-style-type: none"> National Cancer Institute, USA National Cancer Center Japan
4 GENERATE EVIDENCE <ul style="list-style-type: none"> Implement quality improvement methods Publish data from the cancer registry Communicate results for cancer control action 	2018 (PLANNED) <ul style="list-style-type: none"> Mentorship exchange with GICR–IARC Collaborating Centres Initial data quality review of Nay Pyi Taw PBCR Networked version of CanReg5 system to other centres – Mandalay, Yangon, and Taunggyi Assessment of feasibility for the implementation of PBCRs in other regions of the country 	<ul style="list-style-type: none"> Union for International Cancer Control

PBCR, population-based cancer registry.
^a Listed in chronological order by involvement.



Mr Les Mery with Dr Kaung Myat Shwe and Dr Soe Myat, supporting the development of a cancer registry in Nay Pyi Taw, Myanmar. Courtesy of Kaung Myat Shwe.

New estimates are being developed for release in early 2018 based on *Cancer Incidence in Five Continents*, Volume XI (CI5-XI) alongside survival data from SURVCAN-3 (see below). GLOBOCAN 2018 will have an increased granularity of data available, with estimates for 35 cancer entities, and will include uncertainty intervals that take into account the quality of the source information.

Publication of the electronic version of CI5-XI was timed to coincide with the 39th IACR annual meeting, in October 2017. Key challenges in the compilation of CI5-XI were the ever-expanding number of data sets received, as well as legal issues of confidentiality affecting registries' ability to submit their data. An abridged CI5-XI will be disseminated in early 2018, and further development of the GCO's Cancer Over Time subsite will refocus attention on the enormous value of the underlying data in descriptive epidemiological research.

There has been an expansion of the range of indicators available. The estimation of population attributable fractions (PAF) has become a key tool in assessing the potential for prevention. Interactive tools for visualizing the global cancer incidence attributable to obesity and infections in 2012 were launched on the GCO's Cancer Causes subsite.

The third iteration of *International Incidence of Childhood Cancer* (IICC-3; <http://iicc.iarc.fr/results>) was launched on International Childhood Cancer Day 2017. As with CI5, the series provides high-quality recorded data built on long-standing registry collaborations worldwide. IICC-3 comprises data on cancer incidence in children and adolescents (ages 0–19 years) from 309 cancer registries. An accompanying article showed that leukaemia was the most common cancer in children younger than 15 years, making up almost a third of childhood cancers diagnosed in 2001–2010; tumours of the central nervous system ranked second, and lymphomas ranked third (Steliarova-Foucher et al., 2017).

DESCRIPTIVE EPIDEMIOLOGY OF CANCER

CSU seeks to document global variations in incidence, mortality, and survival as well as the changing magnitude and transitional nature of cancer profiles worldwide. Recently, emphasis has been placed on assessing cancer trends relative to other major NCDs (Figure 4) (Cao et al., 2017) and on the economic impact of cancer as a leading cause of premature death. More broadly, there are efforts to disseminate additional surveillance indicators of relevance to cancer control policy both in high-impact peer-reviewed journals and on the GCO website.

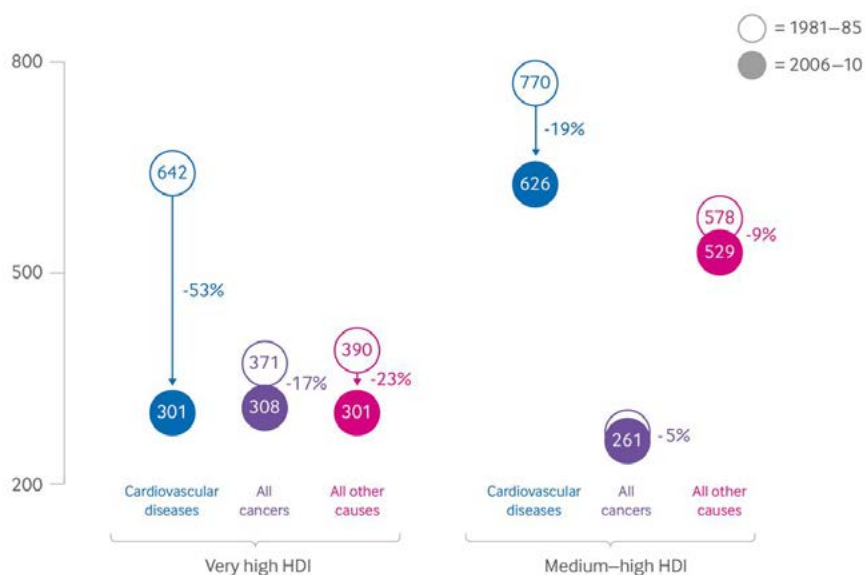
Descriptive studies provide critical insights into the changing cancer patterns, the underlying determinants, and priorities for cancer control. Invited chapters on the global cancer burden were provided for *Holland-Frei Cancer Medicine, 9th Edition* (Ferlay et al., 2017) and the *International Encyclopaedia of Public Health, 2nd Edition* (Bray and Shield, 2017). A diverse set of peer-reviewed articles included an assessment of women's cancers (Ginsburg et al., 2017), a surveillance profile of Peru (Piñeros et al., 2017a), and registry status requirements in the Eastern Mediterranean region (Kulhánová et al., 2017) and in Latin America and the

Caribbean (Bray and Piñeros, 2016). A commentary assessed the evolving landscape of cancer (Bray, 2016).

The relationship between the incidence of 27 cancer types and the Human Development Index (HDI) level (Fidler et al., 2016) and the association between HDI and colorectal cancer incidence rates (Fidler et al., 2017) have been reported. There are ongoing efforts to better understand the impact of cancer in specific age ranges, with a recent global assessment of cancer among young adults published in *The Lancet Oncology*; a similar exercise looking at cancer profiles among the elderly is in preparation.

Cancer-specific reports provide insight into the differing distribution of known risk factors and can generate novel hypotheses regarding putative factors. Highlights included the global estimation and epidemiological assessment of the subsites of oral cavity and pharyngeal cancers (Shield et al., 2017) and global projections of oesophageal cancer incidence by histological subtype in 12 countries (Arnold et al., 2017a), liver cancer incidence in 30 countries, and pancreatic mortality in the 28 Members States of the European Union (Ferlay et al., 2016). Efforts to quantify the long-term impact of cervical screening in six

Figure 4. Changes in age-standardized (world) mortality rates per 100 000 people in adults aged 40–84 years between 1981–1985 and 2006–2010 due to cardiovascular diseases, all cancers, and all other causes of death in men and women combined, by Human Development Index (HDI) level. Figure reproduced from Cao et al. (2017). © Cao et al., 2017.



Baltic, central, and eastern European countries, where there is rising incidence and almost no screening, showed that an effective launch of screening from 2017 could prevent almost 180 000 new cervical cancer diagnoses by 2040 (Vaccarella et al., 2016). An age-period-cohort analysis of kidney cancer in 16 populations worldwide reported attenuations in period-specific increases in incidence rates, hinting at changing imaging practice and a possible mitigation of overdiagnosis (Znaor et al., 2017). An assessment of incidence of cancers of the brain and the central nervous system revealed a 5-fold difference between the highest rates (mainly in Europe) and the lowest rates (mainly in Asia) (Miranda-Filho et al., 2017).

The GCO's Cancer Causes subsite incorporates recently published results for the global PAF for infections (Plummer et al., 2016) and for solar radiation, and will soon include those for the global PAF for alcohol consumption. More detailed overviews of important cancer risk factors include an ongoing analysis of 10 major risk factors in the Eastern Mediterranean region. An assessment of 24 risk factors and their impact on cancer in France in 2015 is being performed with 70 local experts. The first paper on the impact of alcohol consumption reveals that 8% of all cancers in France are attributable to excess consumption.

Benchmarking cancer survival estimates provides a relative measure of health system effectiveness, in part reflecting the extent of early diagnosis and adequate treatment of patients. In 2016, SURVMARK-2 and SURVCAN-3 were launched to provide up-to-date cancer survival statistics worldwide

Figure 5. During the IARC Summer School module on Cancer Survival Methods for Cancer Registries held in Lyon in June 2017, Dr Rajaraman Swaminathan lectured to participants on methods for active follow-up of patients with cancer. © IARC/Roland Dray.



(<http://survival.iarc.fr/Survcan/en/>). SURVMARK-2 focuses on 21 jurisdictions in six high-income countries to assess underlying reasons for survival differences in countries with similar health systems via in-depth stage-specific assessments of coding and registry practices. Supporting the sustained development of cancer registries, the SURVCAN-3 project expands the global coverage of high-quality survival statistics to more than 70 cancer registries in LMICs, which have submitted their data for initial quality review; formal agreements have been established with registries to support the collection of complete follow-up and develop local expertise in survival methods. The second IARC Summer School module on this topic was held in Lyon in June 2017 (Figure 5).

To document the complexity of health transitions requires a *populations within populations* approach, whereby more granular data can be informative, as evidenced by the recent assessment of survival patterns among Indigenous populations (Moore et al., 2016a). The first World Indigenous Cancer Conference was held in 2016 as a partnership with the Menzies School of Health Research, Australia (<http://www.wiccnetwork.org>), and a network bringing together Indigenous groups, researchers, and governments under the umbrella of the World Indigenous Cancer Consortium (WICC) is being developed. Recent work has focused on cancer surveillance (Tervonen et al., 2017a) and cancer epidemiology (Tervonen et al., 2017b) in the Pacific Islands, with a view to linking this to the Hub developments.