

Prevalence of Cancer Survivors in Switzerland

Matthias Lorez, Rolf Heusser and Volker Arndt
Foundation National Institute for Cancer Epidemiology
and Registration (NICER), c/o University of Zürich

Introduction

According to the latest available statistics from the Swiss cantonal cancer registries, over 38.000 new cases of cancer and around 16.500 cancer deaths occur per year in Switzerland [1]. However, incidence and mortality do not fully depict the burden of disease. Cancer is now considered a chronic disease which affects patient's life over years and many survivors continue to experience negative effects of cancer and/or treatment on their daily lives well beyond the completion of therapy [2-11].

Cancer prevalence is an important and useful measure of the burden of cancer in the community. It can be defined as the number of persons in a defined population who have been diagnosed with that type of cancer, and who are still alive at the point of examination (so called «cancer survivors» [National Coalition for Cancer Survivorship, 1986]). The transition from cancer patient to cancer survivor may be characterized by three different phases [12]:

- **Acute survival**
... begins with the diagnosis of the illness and is dominated by diagnostic and therapeutic efforts.
- **Extended survival**
... is a period during which a patient goes into remission or has terminated the basic, rigorous course of treatment and enters a phase of watchful waiting, with periodic examinations and «consolidation» or intermittent therapy. Psychologically, this time is dominated by fear of recurrence.
- **Permanent survival**
... is roughly equated with «cure», but the person who has come through a cancer experience is indelibly affected by it. Problems with employment and insurance are common for persons who have been treated for cancer and are ready to resume a full life. The long-term, secondary effects of cancer treatment on health represent another area in which permanent survivors are at risk.

Due to improvements in prognosis, efforts towards earlier detection and demographic aging, the number of cancer

survivors in Switzerland has been increasing from around 140.000 in 1990 to 290.000 in 2010 [13]. Projections from industrialized countries predict «a booming population of cancer survivors» for the next 10-20 years with the biggest growth rate among the elderly (age 65+ years) [14].

In this article we want to provide up-to-date cancer prevalence statistics estimating the burden of cancer in Switzerland for the year 2015 and examine trends in cancer prevalence by age, time since diagnosis and tumour site covering the period 2000 to 2015. Further prevalence statistics are available online at the NICER website at <http://www.nicer.org/en/statistics-atlas/>.

Methods

Anonymized cancer diagnoses from 1981 through 2010 were taken from the National Cancer Dataset managed by the Foundation National Institute for Cancer Epidemiology and Registration (NICER) for the purpose of national cancer monitoring in Switzerland. Data from 12 of the 16 Swiss cantons registering cancer up to diagnosis year 2010 were combined in this study to represent Switzerland: Zurich (ZH), Glarus (GL), Basel Stadt (BS), Basel Landschaft (BL), Graubünden (GR), Appenzell Ausserrhoden (AR), Appenzell Innerrhoden (AI) and St. Gallen (SG), Fribourg (FR), Ticino (TI), Valais (VS) and Geneva (GE). The cancer registries of Neuchâtel, Jura and Vaud did not provide survival information and Lucerne started cancer registration in 2010.

Complete prevalence was modelled using the PIAMOD approach [15]. In short, an age-period-cohort (APC) model was constructed with the logarithm of the incidence rates regressed on a polynomial with three variables: age at diagnosis, time period at diagnosis and date of birth. The degree of the best fitting polynomial was determined using χ^2 -tests. It also projected incidence rates out of the observation period into the past and future and assumed that both age and birth-cohort effects persist over the whole projection periods, whereas the period effect was the linear extrapolation of the observed period trend during 2007 to 2010.

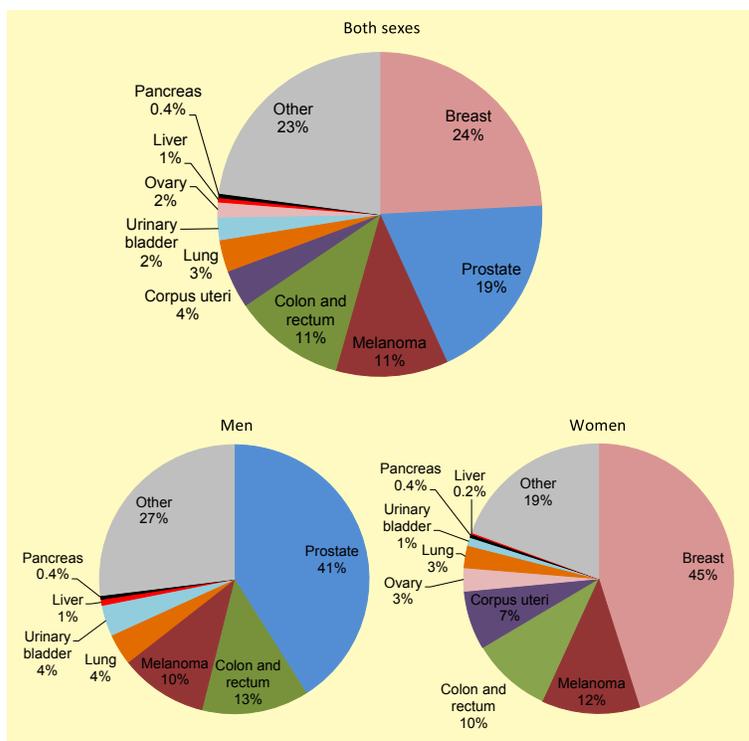
The PIAMOD method is implemented as part of the statistical software MIAMOD [16]. It allows estimation and projection of cancer prevalence by supplying sex-, age-, and calendar year-specific data for cancer incidence, relative survival, all-cause mortality, and population size.

Incidence data 1981 to 2010: Persons with multiple primary malignant cancer diagnoses in different sites were counted separately for each site-specific incidence. For per-

sons with multiple primary malignant diagnoses in a single site, we included only the first primary diagnosis. The estimate for all cancer sites combined excluded diagnoses for non-melanotic skin cancer and counted the first primary malignant diagnosis in a person's lifetime. Combined diagnoses of cantons registering cancer during individual calendar years were up-scaled based on the population covered to simulate complete registration from 1981 to 2010 for the pool of all 12 cantons. Up-scaling was specific for one-year age-groups, sex, year of diagnosis and cancer site.

Relative survival: the relative survival was calculated as the ratio of the observed survival of cancer cases and the expected survival of persons in the general population matching in age, sex and calendar year of death [17]. Expected cancer survival proportions were estimated using the Ederer II method applied to combined all-cause mortality tables for the cantons included in the present work [18]. For PIAMOD modelling, the simplifying assumption was used that future relative survival does not improve but remains the same as the latest available estimate (2010) and past survival was not worse but the same as the first available estimate (1981).

Fig. 1. Distribution of expected cancer survivors by tumour site in Switzerland (index date 31.12.2015). Included are all persons with malignant primary cancer except non-melanotic skin cancer. Both sexes combined (N=316'233 cancer survivors). Men (N=146'644 survivors). Women (N=169'589 survivors).



All-cause mortality: The official vital statistics (Swiss Federal Statistical Office, STAT-TAB; Alters-Kantonsstatistik, 1981-2010) provided number of deaths stratified by completed age, canton, year and sex. The numbers of deaths for the 12 cantons in the study were pooled.

<http://www.bfs.admin.ch/bfs/portal/de/index/infothek/onlinedb/stattab/01.topic.9.html> (last access 30.11.2012).

Populations at risk: population sizes at completed age (i.e. age at last birthday) for 1981-2010 as well as predictions for future populations 2011-2020 were available online (Swiss Federal Statistical Office, STAT-TAB). <http://www.bfs.admin.ch/bfs/portal/de/index/infothek/onlinedb/stat-tab.html>. For predictions, we employed the «middle» scenario for future growth (last access 24.6.2013).

Validation of modelled prevalence based on observed prevalence: we compared observed (counted) 5-year limited duration prevalence with modelled 5-year limited duration prevalence figures for index dates 2000-2010. We accepted the associated modelled complete prevalence estimate if absolute deviations were $\leq 10\%$ on average. In addition, we compared observed cause-specific mortality counts during 1995-2010 with model-generated cause-specific mortality figures. We accepted the modelled complete prevalence estimate if absolute deviations for mortality counts were $\leq 15\%$ on average. Applying both validation rules, we restrained from reporting estimates of complete prevalence for cancer of the liver and pancreas and replaced it with the 10-year limited duration prevalence based on observed (counted) alive cases. Complete prevalence for lung and prostate cancer is reported with a warning about possible underestimation.

The PIAMOD-derived complete prevalence estimates for combined cantons (ZH, GL, FR, BS, BL, AR, AI, SG, GR, TI, VS, GE) were extrapolated to whole Switzerland by upscaling modelled prevalence using sex and age-specific population ratios.

Further description of the methods used in this report can be found online at http://www.nicer.org/assets/files/statistics/prevalence/prevalence_estimation_methods.pdf.

Results

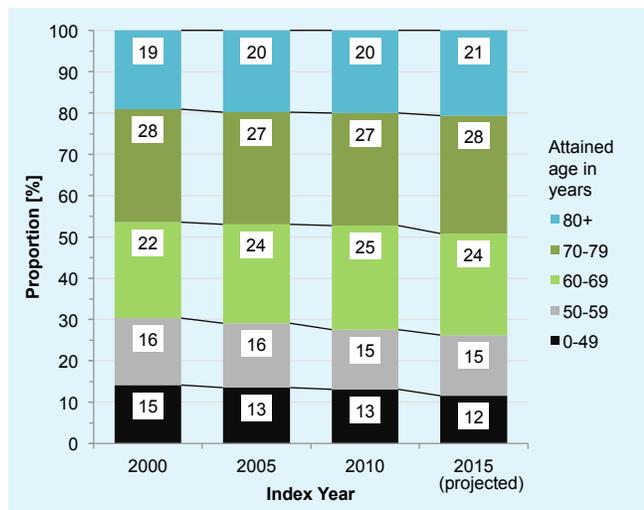
A considerable number of persons are estimated to live in Switzerland as of the end of 2015 with a past diagnosis of cancer: about 316'500 or 3.8% of the whole population (about 146'500 men and 170'000 women). About 60'200 (41%) of the afflicted men live with a past diagnosis

of prostate cancer and about 76'500 (45%) women with breast cancer (Fig. 1). The next most prevalent cancer diagnoses are for colon/rectum and melanoma (13% and 10% in men or 10% and 12% in women, respectively). About 4% of men with a history of cancer were diagnosed with lung cancer and also 4% with cancer at the urinary bladder. In women, 7% have uterine cancer, 3% ovarian cancer and 3% lung cancer. Other cancer sites are either below 1% prevalent or have not been studied individually in this report.

Almost half of all persons estimated to be prevalent for cancer in 2015 are older than 70 years of age (28% are 70 to 79 and 21% are 80 years and more), while 24% are in their 60s, 15% in their 50s and 12% younger than 50 years of age (Fig. 2). There were no large changes in the age-specific proportions if the expected situation in 2015 is compared with 2000. The group of prevalent persons at higher ages increased slightly but all changes are below 3% (Fig. 2).

For almost 40% of all persons estimated to be prevalent for cancer in 2015, their diagnosis would have been an event from a distant period of their lives, i.e. 10 or more years in the past (Fig. 3). For 24% the diagnosis would have occurred between 5 and 10 years, for 19% between 2 and 5 years in the past and 17% are facing a recent diagnosis from under 2 years in the past. If one compares the expected situation in 2015 with the year 2000, the main changes are the increase in proportion of long-term survivors (10+ years since diagnosis) by 8% from initially 32% and the reduction in proportion of those patients with a very recent diagnosis by 5% from initially 22% (Fig. 3).

Fig. 2. Distribution of cancer survivors in Switzerland by attained age at index date. Cancer survivors totalled 192'946 in 2000, 229'473 in 2005, 268'697 in 2010 and 316'233 in 2015.

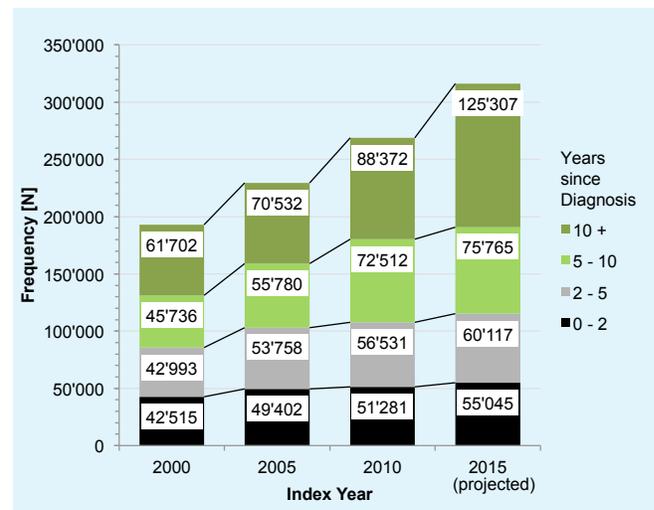


If the trends in number of prevalent persons in 2000 and 2015 are compared between different cancer localisations, the tripling of men and women alive with a history of hepatic cancer is most prominent (Fig. 4 and Tab. 1). Also the number of prevalent cases of pancreatic cancer more than doubled in men and women in this period. The same relative increase was seen for prostate cancer in men and lung cancer in women, while there is only a minor increase of 28% for lung cancer in men. Prevalent cases of melanoma about doubled for both sexes, with stronger increases in men compared with women. There is a 67% increase in cases of breast cancer in woman and about 50% increase for cancer of the large bowel in both sexes. Quite stable are the trends for urinary bladder cancer in both sexes and for uterine cancer in women.

Discussion

Based on data from 12 out of 16 cantonal cancer registries which, depending on calendar year, covered between 36 and 51% of the Swiss population, our estimates indicate there will be over 316'000 persons living with a history of cancer in Switzerland by the year 2015 (146'500 men and 169'500 women). The number of these so-called cancer survivors has been increasing in Switzerland like in many other countries during the last decades and it will continue to grow during the next years due to demographic aging, improved prognosis and enhanced diagnostics.

Fig. 3. Distribution of cancer survivors in Switzerland by time since diagnosis. The proportion of 10+ years cancer survivors has increased from 32% in 2000 to 40% in 2015, while the proportion of short- and medium-term survivors (0 to 5 years) has decreased from 44% in 2000 to 36% in 2015.



In particular the number of long-term survivors (i.e. those surviving cancer five and more years) has almost doubled during the period 2000-2015. While there is a growing body of literature on the physical, psychological, and social difficulties of cancer patients during the early years past diagnosis [9], little is known regarding the situation 10+ years past diagnosis [19]. As long-term survival has become a realistic perspective for many cancer patients, addressing health aspects relevant for long-term cancer survivors (such as quality of life, late effects, quality of follow-up care) will become more and more important during the next years.

Overall, cancer survivors represent around 4% of the population. Similar proportions have been reported from Germany [20], Italy [21], the United Kingdom [22], the Scandinavian countries [23], and the US [24, 25]. A closer look depicts that the proportion of cancer survivors in the general population increases rapidly with age: 0.7% among ages 0-49 years, 4.0% among ages 50-59, 8.8% among ages 60-69, 14.9% among ages 70-79, and 16.3% among ages 80 and more. This means that in the population of the elderly, one out of six has a history of cancer, and this experience might interfere with patient's care. For example, late effects of cancer and its treatment may be potentially dismissed in elderly as those symptoms could easily be attributed to advancing age or non-cancer comorbidities. In contrast, elderly survivors represent a vulnerable population because their history of cancer may shift attention away from important health problems unrelated to cancer. As a consequence, cancer survivors often do not receive the necessary care or attention to these important non-cancer issues, possibly because the focus is on cancer-related issue [26].

With respect to the distribution by tumour site, it is noteworthy that four sites alone account for two thirds of all

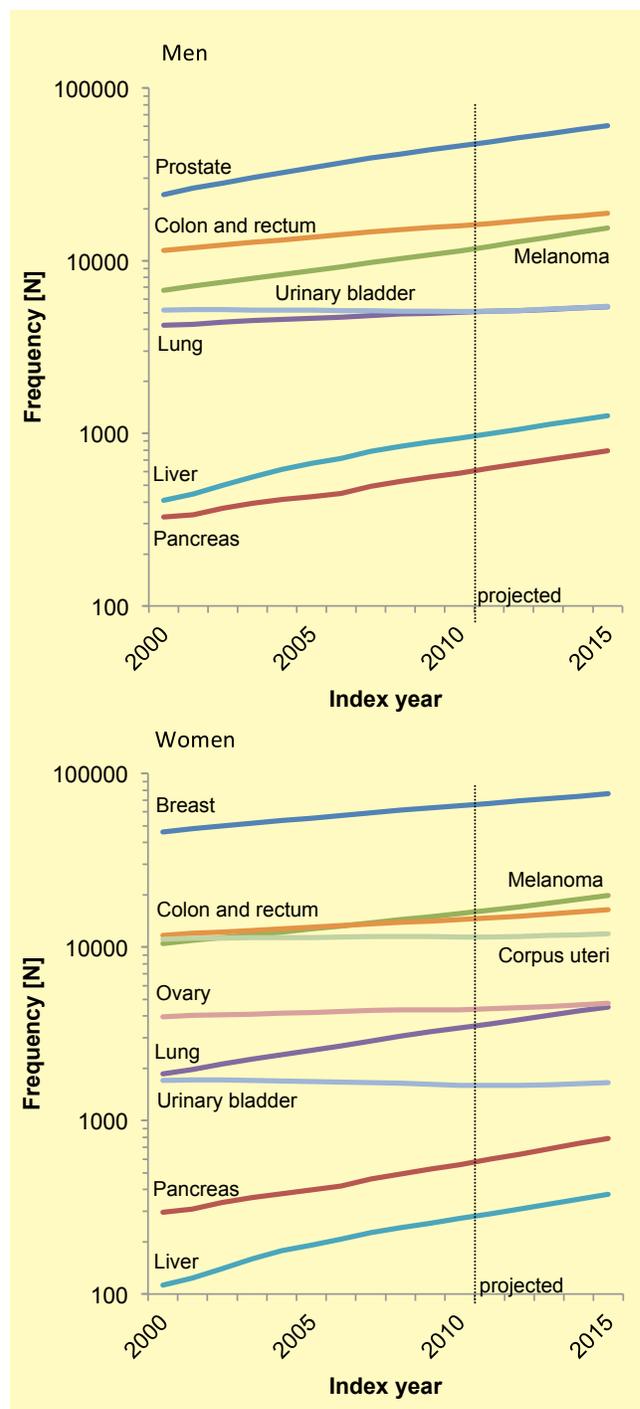


Fig. 4. Swiss cancer prevalence trends for major localisations. Top panel: men. Bottom panel: women.

Tab. 1. Trends in the number of persons alive with a past history of cancer for major localisations in Switzerland. Compared are the cancer burden at the index dates 31.12.2000 and 31.12.2015.

Cancer site	Complete prevalence					
	2000		2015 (projected)			
	Men	Women	Men	% of 2000	Women	% of 2000
Prostate	24115		60577	251		
Breast		45922			76488	167
Colon and rectum	11422	11622	18826	165	16365	141
Melanoma	6729	10467	15474	230	19870	190
Corpus uteri		11078			11942	108
Ovary		3957			4732	120
Lung	4225	1854	5389	128	4513	243
Urinary bladder	5169	1697	5434	105	1658	98
Liver	409	112	1265	309	375	334
Pancreas	327	296	791	242	788	266

cases: breast, prostate, melanoma, and colorectal cancer. The pattern is not unexpected given that these four tumour types represent tumours with high incidence and good prognosis, in general. However, in comparison to other countries, the high proportion of melanoma is striking, which is presumably due to the relatively high melanoma incidence in Switzerland as compared to other European countries. During the period 2000 – 2015, the number of prevalent cases increased in particular for person diagnosed with cancer of the liver (+215%), pancreas (+153%), prostate (+151%), and lung (+143% in females). Whereas the increase in prevalence of liver, pancreatic, and prostate cancer is mainly driven by higher detection rates due to increased use of diagnostic techniques (ultrasound, PSA testing) and to some part by improved prognosis due to better therapy, the sharp increase in female lung cancer mainly reflects the smoking epidemic in females at the end of the 20th century.

In summary, the number of cancer survivors has substantially increased during the past decades. With the baby boomer generation's entering their 60s, the burden of cancer, both in the early clinical as well as in the long-term survivorship phase will increase and challenge the health care system. Given the increasing numbers of long-term cancer survivors, addressing cancer survivors' needs becomes a high priority.

Nationwide data describing quality of life and health in adult long-term survivors in Switzerland are still lacking. Epidemiological cancer registries may serve as an optimal starting point for cancer survivorship research [11]. So far, registries are not allowed to contact survivors directly. It has to be awaited whether the new federal law on cancer registration, which will take into effect in 2017/2018, will facilitate cancer survivorship research via population-based cancer registries.

References

- NICER. *NICER Statistics*. 2014 [last access 21.09.2014]; Available from: <http://www.nicer.org/en/statistics-atlas/>
- Fossa, S.D., R. Vassilopoulou-Sellin, and A.A. Dahl, *Long term physical sequelae after adult-onset cancer*. *J Cancer Surviv*, 2008. 2(1): p. 3-11.
- Foster, C., et al., *Psychosocial implications of living 5 years or more following a cancer diagnosis: a systematic review of the research evidence*. *Eur J Cancer Care (Engl)*, 2009. 18(3): p. 223-47.
- Harrington, C.B., et al., *It's not over when it's over: long-term symptoms in cancer survivors – a systematic review*. *Int J Psychiatry Med*, 2010. 40(2): p. 163-81.
- Jansen, L., et al., *Health-related quality of life during the 10 years after diagnosis of colorectal cancer: a population-based study*. *J Clin Oncol*, 2011. 29(24): p. 3263-9.
- Khan, N.F., et al., *Long-term health outcomes in a British cohort of breast, colorectal and prostate cancer survivors: a database study*. *Br J Cancer*, 2011. 105 Suppl 1: p. S29-37.
- Koch, L., et al., *Quality of life in long-term breast cancer survivors - a 10-year longitudinal population-based study*. *Acta Oncol*, 2013. 52(6): p. 1119-28.
- Stein, K.D., K.L. Syrjala, and M.A. Andrykowski, *Physical and psychological long-term and late effects of cancer*. *Cancer*, 2008. 112(11 Suppl): p. 2577-92.
- Macmillan Cancer Support, *Long-term consequences of cancer and its treatment*. 2013.
- Macmillan Cancer Support, *Throwing light on the consequences of cancer and its treatment*. 2013.
- Thong, M.S., et al., *Population-based cancer registries for quality-of-life research: a work-in-progress resource for survivorship studies?* *Cancer*, 2013. 119 Suppl 11: p. 2109-23.
- Mullan, F., *Seasons of survival: reflections of a physician with cancer*. *N Engl J Med*, 1985. 313(4): p. 270-3.
- Herrmann, C., et al., *Cancer survivors in Switzerland: a rapidly growing population to care for*. *BMC Cancer*, 2013. 13: p. 287.
- Parry, C., et al., *Cancer survivors: a booming population*. *Cancer Epidemiol Biomarkers Prev*, 2011. 20(10): p. 1996-2005.
- Verdecchia, A., De Angelis, G., and Capocaccia, R., *Estimation and projections of cancer prevalence from cancer registry data*. *Statist. Med.*, 2002. 21: 3511-3526.
- De Angelis, G., et al., *MIAMOD: a computer package to estimate chronic disease morbidity using mortality and survival data*. *Comput. Methods Programs Biomed.*, 1994. 44: 99-107.
- Ederer, F., L.M. Axtell, and S.J. Cutler, *The relative survival rate: a statistical methodology*. *Natl Cancer Inst Monogr*, 1961. 6: p. 101-21.
- Ederer, F., and Heise H., *Instructions to IBM 650 Programmers in Processing Survival Computations*. Methodological note no 10, End Results Evaluation Section. 1959. Bethesda MD, National Cancer Institute.
- Lerro, C.C., et al., *A systematic review of large-scale surveys of cancer survivors conducted in North America, 2000-2011*. *J Cancer Surviv*, 2012. 6: p. 115-145.
- Bertz, J., et al., *Verbreitung von Krebserkrankungen in Deutschland. Entwicklung der Prävalenzen zwischen 1990 und 2010.*, in *Beiträge zur Gesundheitsberichterstattung des Bundes*. 2010, Robert-Koch-Institut: Berlin.
- De Angelis, R., et al., *Cancer prevalence estimates in Italy from 1970 to 2010*. *Tumori*, 2007. 93(4): p. 392-7.
- Maddams, J., M. Utley, and H. Moller, *Projections of cancer prevalence in the United Kingdom, 2010-2040*. *Br J Cancer*, 2012. 107(7): p. 1195-202.
- NORDCAN. *Cancer Incidence, Mortality, Prevalence and Survival in the Nordic Countries, Version 6.1*. [cited 2014 21.09.2014]; Available from: <http://www-dep.iarc.fr/nordcan.htm>.
- Howlander, N., et al. *SEER Cancer Statistics Review, 1975-2008 based on November 2010 SEER data submission, posted to the SEER web site, 2011*. 2011. 1.2.2014; Available from: http://seer.cancer.gov/csr/1975_2008/.
- Mariotto, A.B., et al., *Projections of the cost of cancer care in the United States: 2010-2020*. *J Natl Cancer Inst*, 2011. 103(2): p. 117-28.
- Cohen, H.J., *Cancer survivorship and ageing – a double whammy*. *Lancet Oncol*, 2006. 7(11): p. 882-3.

Correspondence:

Matthias Lorez, Rolf Heusser and Volker Arndt
 Foundation National Institute for Cancer
 Epidemiology and Registration (NICER)
 c/o University of Zürich
 Seilergraben 49, CH-8001 Zürich
matthias.lorenz@nicer.org