PROGRAM:	ERASMUS+
ACTION / SUBPROGRAM:	Key Action 2 / Strategic Partnerships
PROJECT TITLE:	"OSH+ for the European Agriculture sector - Stimulating growth in rural areas through capacity building for providers (and beneficiaries) of occupational medicine and OSH services"
Intellectual Output :	O5 "Course 2 Training Materials - Occupational Physicians"
Module:	16. Occupational cancer – practical aspects

16. Module 16: Occupational cancer – practical aspects

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16.1. Learning objectives

Knowledge objectives

- The trainee identifies sources of carcinogens at the workplace;
- The trainee explains the principles of occupational cancer diagnose;
- The trainee summarizes the principles of cancer prevention in agriculture;
- The trainee gives examples how to manage potential cases of occupational cancer.

Skills/attitudes related objectives

- The trainee recognizes adverse health effects of workplace exposure to carcinogens;
- The trainee recognizes and partially diagnoses cases of occupational cancer;
- The trainee finds reliable sources of information on carcinogen agents adverse health effects and prevention;
- The trainee advices the managers and workers on preventive measures related to carcinogen exposure in agriculture.

16.2. Glossary

Term	Definition
Carcinogen (IAPA 2007, Frank van Dijk, Inge Varekamp, Katja Radon, Manuel Parra, Glossary for Basic Occupational Safety and Health, 2011	A chemical, physical or biological agent that can cause cancer in humans or animals.
Incidence (Source: Cancer today IARC, Globocan 2012, http://gco.iarc.fr/today/help)	Cancer incidence is the number of new cancer cases arising in a specified population over a given period of time (typically 1 year). It can be expressed as an absolute number of cases within the entire population per year or as a rate per 100 000 persons per year (see Crude Rate and Age-Standardized Rate below). The cancer

	incidence rate provides an approximation of the average risk of developing a cancer. Incidence information is collected routinely by cancer registries.
Mortality (Source: Cancer today IARC, Globocan 2012, http://gco.iarc.fr/today/help)	Cancer mortality is the number of deaths due to cancer occurring in a specified population over a given period of time (typically 1 year). It can be expressed as an absolute number of deaths within the entire population per year or as a rate per 100 000 persons per year.
Prevalence (Source: Cancer today IARC, Globocan 2012, http://gco.iarc.fr/today/help)	The prevalence of a given cancer is the number of individuals within a defined population who have been diagnosed with that cancer and who are still alive at a given point in time (i.e. the survivors). Complete prevalence is the number of individuals alive, at given point in time, who have been diagnosed with the disease of interest, regardless of the amount of time since the diagnosis or whether the individual is still under treatment or is considered cured. Partial prevalence limits the number of patients to those diagnosed within a defined period of time in the past, and this is a particularly useful measure of cancer burden.
Age-Standardized Rate (Source: Cancer today IARC, Globocan 2012, http://gco.iarc.fr/today/help)	An age-standardized rate (ASR) is a summary measure of the rate that would have been observed if the population had a standard age structure. Standardization is necessary when comparing several populations that differ with respect to age because age has a strong influence on the risk of cancer. An ASR is a weighted mean of the age-specific rates; the weighting is based on the population distribution of a standard population. The most frequently used standard population is the World (W) Standard Population. The calculated incidence or mortality rate is then called the age-standardized incidence or mortality rate (W), and is expressed per 100 000 person-years. The World Standard Population used in GLOBOCAN was first proposed by Segia and then modified by Doll et al.b. The ASR (W) is calculated using 10 age groups: 0–14, 15–39, 40–44, 45–49, 50–54, 55–59, 60–64, 65–69, 70–74, and ≥ 75 years. The results may be slightly different from those computed using the same data grouped into the traditional 5-year age groups.
Crude rate (Source: Cancer today IARC, Globocan 2012, http://gco.iarc.fr/today/help)	Data on incidence and mortality are often presented as rates. For a specific tumor in a given population, crude rates are calculated simply by dividing the number of new cancers or cancer deaths observed during a given time period (typically 1 year) by the corresponding number of individuals in the population at risk. For

	cancer, the result is usually expressed as an annual rate per 100 000 individuals at risk.
Cumulative risk (Source: Cancer today IARC, Globocan 2012, http://gco.iarc.fr/today/help)	Cumulative incidence/mortality is the probability or risk of individuals getting/dying from the disease during a specified period. For cancer, it is expressed as the number of new born children (out of 100) who would be expected to develop/die from a particular cancer before the age of 75 if they had the rates of cancer observed in the period in the absence of competing causes.
Threshold Limit Values (Frank van Dijk, Inge Varekamp, Katja Radon, Manuel Parra, Glossary for Basic Occupational Safety and Health, 2011)	The airborne concentrations of a biological, chemical, or physical agent to which, it is believed. Nearly all workers may be exposed without experiencing any harmful effects. Because of individual susceptibility or through aggravation of a pre-existing condition, a small percentage of workers may experience discomfort or will even develop an occupational or work-related disease from exposure at concentrations or levels below the threshold limit value. TLV is a reserved term of the American Conference of Governmental Industrial Hygienists (ACGIH) and does certainly not represent a legal term. The term is, however, often used in occupational health as a more generic term for limit values. A number of specifications are important: 1. TLV-TWA (time weighted exposure limit) is presented as a time weighted average (TWA) exposure value, that is the time weighted average concentration or levels of a chemical or biological agent for an 8-hour day or a 40-hour week to which, it is believed, nearly all workers may be exposed, day after day, without experiencing harmful effects. 2. TLV-STEL (short-term exposure limit) presenting a short-term exposure value as the maximum airborne concentration of a chemical, biological or physical agent to which workers may be exposed provided that the exposure is for not more than 15 minutes and is not more often than four times in a work day. 3. TLV-C (ceiling exposure limit) presenting the maximum exposure to an airborne concentration of a chemical, biological or physical agent that should not be exceeded at any time.

16.3. Introduction. Statistical data. Definitions

Cancer epidemic become in the last years a major public health concern [9]. Actual predictions show that the labor force will rise to 3.5 billion by 2030. Increasing of the retirement age of active population, medicine therapeutic progresses, improving of health education, access at work, migration phenomenon, etc., are favorable factors for workforce increasing. That can make the workplace as a platform for prevention and early detection of cancer. The role of working conditions as a mean factor of social inequalities with regard to cancer becomes more and more aware.

Last years' statistical data show an increasing trend of cancer, in whole the world.

International Agency for Research on Cancer emphasizes that in 2012, worldwide, there were 14.1 million new cancer cases, 8.2 million cancer deaths, and 32.6 million people living with cancer within 5 years of diagnosis. In the less developed regions occurred 57% (8 million) of those new cancer cases, 65% (5.3 million) of the cancer deaths, and 48% (15.6 million) of the 5-year prevalent cancer cases.

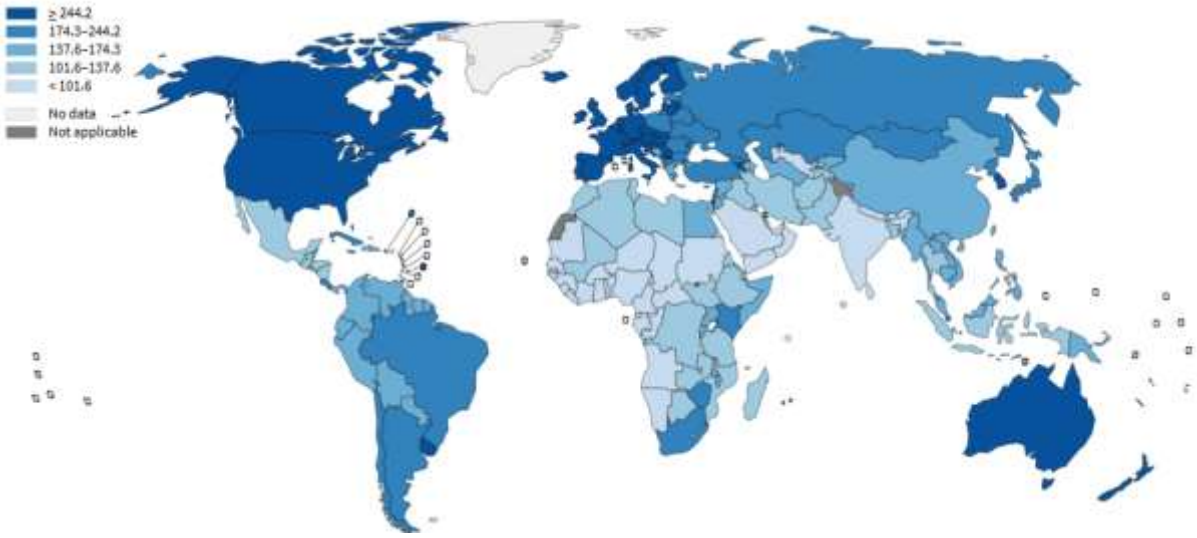

Figure 1. Estimated age-standardized rates (World) of incident cases, both sexes, all cancers excluding non-melanoma skin cancer, worldwide in 2012 (Data source: GLOBOCAN 2012, Graph production: IARC (http://gco.iarc.fr/today), World Health Organization, International Agency for Research on Cancer 2017)

In according with GLOBOCAN, estimated age-standardized rates of incident cases, both sexes, all cancers excluding non-melanoma skin cancer in AGROSH+ project countries were: in Bulgaria –234.8, in Greece- 163.0, in Ireland – 307.9 and in Romania – 224.2. The overall age-standardized cancer incidence rate in the world is almost 25% higher in men than in women, with rates of 205 and 165 cases per 100 000 person-years, respectively [24].

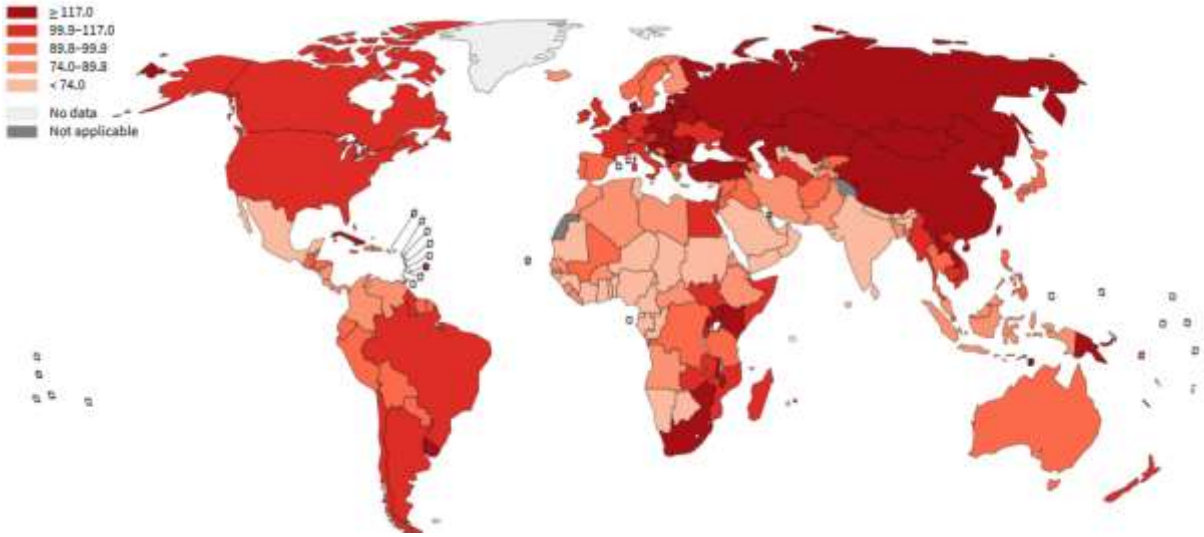

Figure 2. Estimated age-standardized rates (World) of deaths, both sexes, all cancers excluding non-melanoma skin cancer, worldwide in 2012 ((Data source: GLOBOCAN 2012, Graph production: IARC (http://gco.iarc.fr/today), World Health Organization, International Agency for Research on Cancer 2017)

The values of estimated age standardized rates of deaths were in Bulgaria – 120.5, Greece-98.6, Ireland – 108.4, Romania – 127.1; higher value in Romania possible shows a late-stage diagnosis of cancer when treatment is inefficient.

Next figures (3-10) show the three parameters (incidence, mortality and 5-year prevalence) in EU-28 and in the four AGROSH+ countries.

Figure 3. Estimated incidence, mortality and 5 year prevalence: both sexes, EU-28

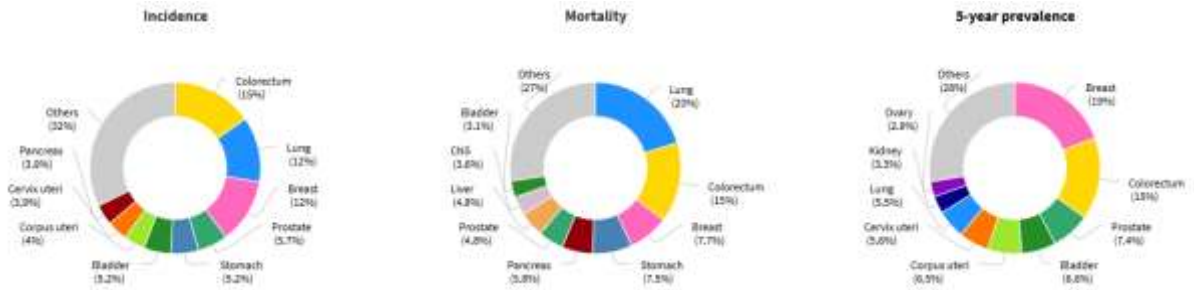

Figure 4. Estimated incidence, mortality and 5 year prevalence: both sexes, Bulgaria

Figure 5. Estimated incidence, mortality and 5 year prevalence: both sexes, Greece

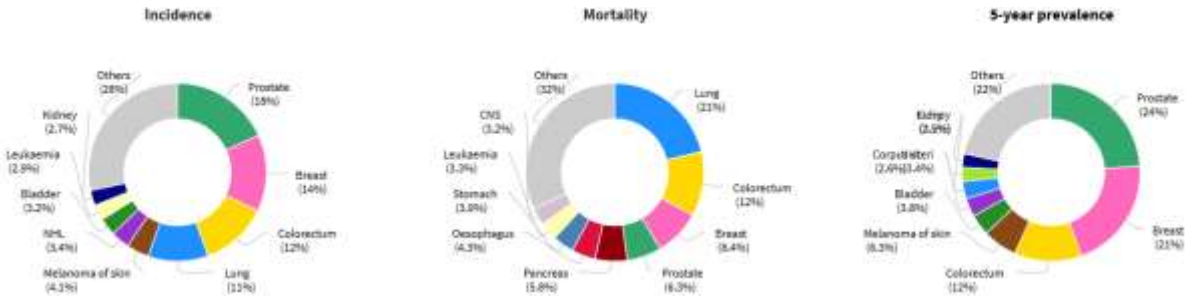

Figure 6. Estimated incidence, mortality and 5 year prevalence: both sexes, Ireland

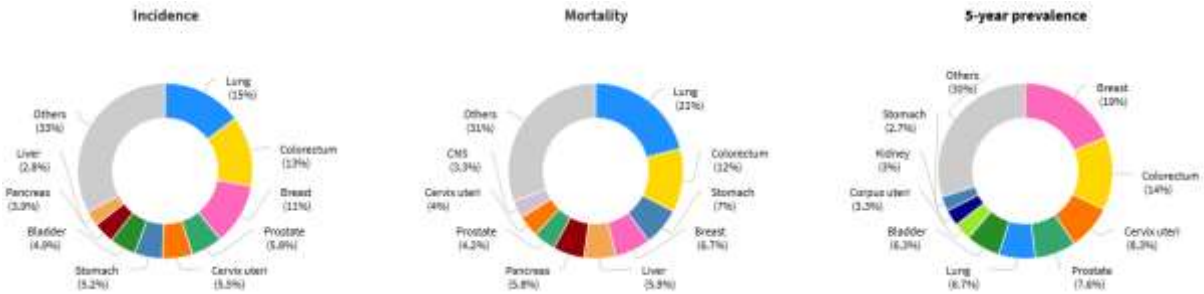

Figure 7. Estimated incidence, mortality and 5 year prevalence: both sexes, Romania

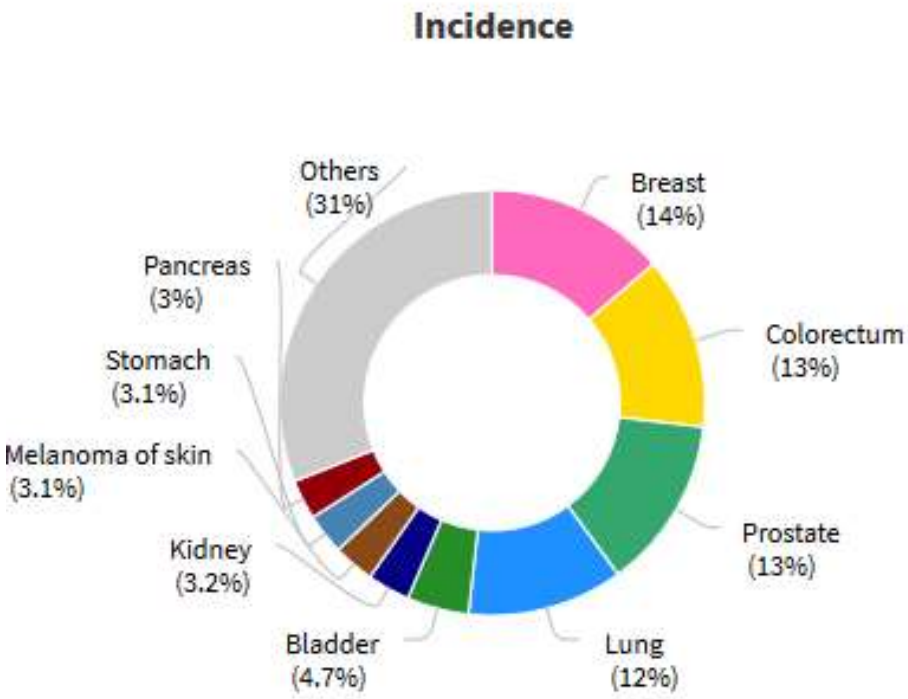

Figure 8. Estimated incidence: both sexes, EU-28

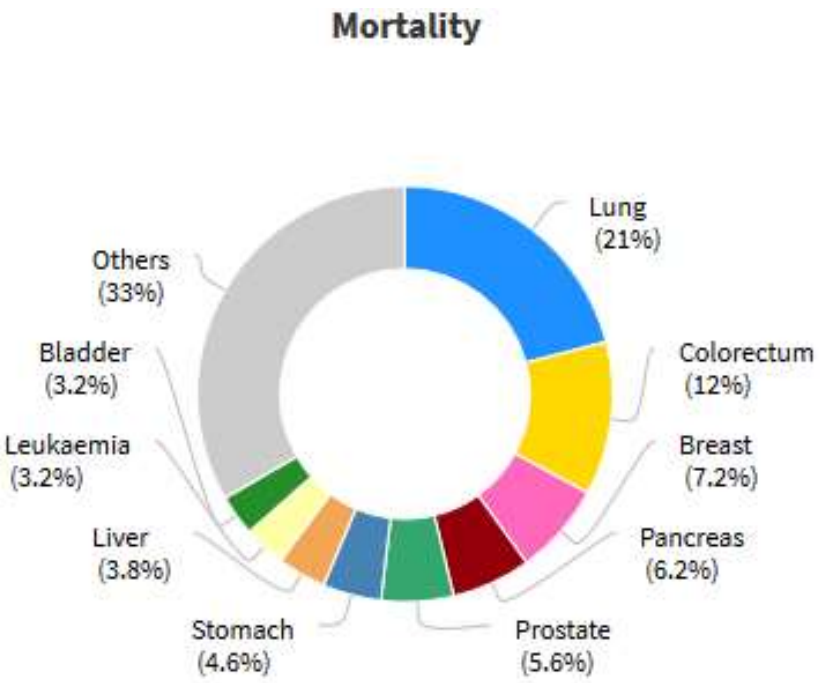

Figure 9. Estimated mortality: both sexes, EU-28

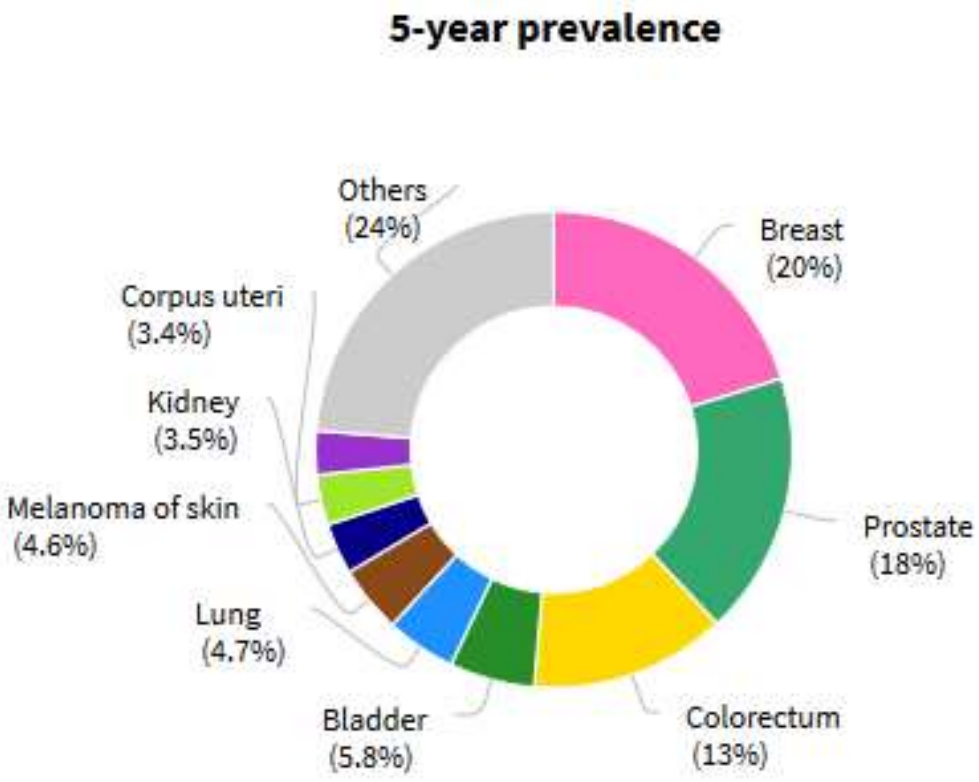

Figure 10. Estimated 5 year prevalence: both sexes, EU-28

Ago 25 years, the European Union adopted the first global directive for improving the workplace prevention of work-related cancer [9].

According to Eurostat (The statistical office of the European Union, Production of toxic chemicals, by toxicity class, Total production of chemicals, 2011), yearly, over 30 million tons of carcinogenic, mutagenic and reprotoxic substances (CMRs) are produced in Europe [17].

Cancer is defined as a large group of diseases that can affect any part of the body [1]. It consists in a sum of heterogeneous diseases having many anatomic and molecular subtypes. For each of them are necessary a specific diagnostic and a specific management of the case [1]. Other common terms used are neoplasms and malignant tumors.

Characteristic for cancer is the rapid production of abnormal cells which can grow into neighbor tissues, and can conduct at metastasis. The major causes of death from cancer are metastasis [1].

WHO adopted a color code for the most frequent forms of cancer, under location.

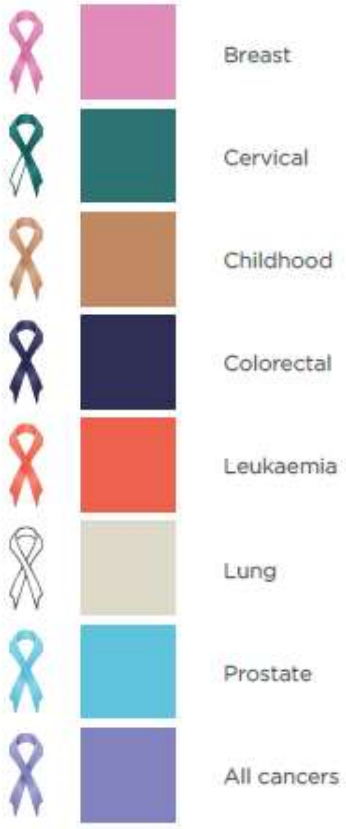

Figure 11. Cancer color codes *Source: WHO list of priority medical devices for cancer management, WHO Medical device technical series, World Health Organization 2017*

Cancer represents the leading cause of death worldwide [2,3], killing more people than HIV/AIDS, malaria and tuberculosis combined (Fig. 12). After Jemal et al., the estimation is about a 70% increase of cancers in only two decades [3] with the number of global cancer deaths projected to increase by 45% in the period 2007 - 2030.

Cancer mortality will increase 78% and its incidence 70% by 2035 [9], as Jukka Takala shows.

Worldwide, the five most common sites of cancer diagnosed among men in 2012 were: lung, prostate, colorectal, stomach, and liver cancer. Among women in 2012 they were: breast, colorectal, lung, cervix, and stomach cancer [1].

16.3. Occupational cancer. Etiology. Early diagnosis

The International Labor Organization (ILO) estimates that occupational cancer causes 666,000 deaths by globally every year, double that of occupational accidents. In the EU28, 102,500

deaths take place each year, representing twenty times the number of occupational accidents [9].

In according with WHO Classification, cancer is the biggest killer at work in high income countries, including the EU [9].

Five leading risk factors causing approximately one third of all cancers are: high values of body mass index, a low intake of fruit and vegetable, insufficient physical activity, tobacco use and alcohol use [1]. The most important risk factor which causes almost 22% of global cancer deaths and 70% of global lung cancer deaths is the use of tobacco [1,2]. In low- and middle-income countries some viral infections such as Hepatitis B and C viruses (HBV/HCV) and Human papillomavirus (HPV) represent the cause for up to 25% of cancer cases [1].

Actual situation, like growing life expectancy and gradual reduction of other causes of death, such as communicable diseases and injuries, are favorable factors for the increasing of cancer cases and occupational cancer mortality [9].

The 10 most important occupational carcinogens count for around 85% of all occupational deaths.

Work exposures cause cancers that have a high case mortality rate, such as lung cancer. Lung cancer counts for 54-75% of all occupational cancer [9].

Occupational exposures cause 5.3–8.4% of all cancers and among men 17–29% of all lung cancer deaths, according to best estimates of epidemiological studies [9].

Asbestos accounts for 55–85% of lung cancer and causes other cancers and asbestos-related diseases. Asbestos exposure and its effects could have been prevented in the past [9]. Of the 102,500 occupational cancer deaths in the EU28, asbestos causes between 30,000 (old estimate), and 47,000 [9] every year. The numbers are still rising.

Each year, especially in low- and middle-income countries new WHO figures indicate that 8.8 million people die from cancer. The cancer diagnose is put too late, in advanced stages, even in countries with modern services and optimal health systems. To treat them successfully is very difficult, and often impossible [7].

"Diagnosing cancer in late stages, and the inability to provide treatment, condemns many people to unnecessary suffering and early death," says Dr Etienne Krug, Director of WHO's Department for the Management of Non communicable Diseases, Disability, Violence and Injury Prevention.

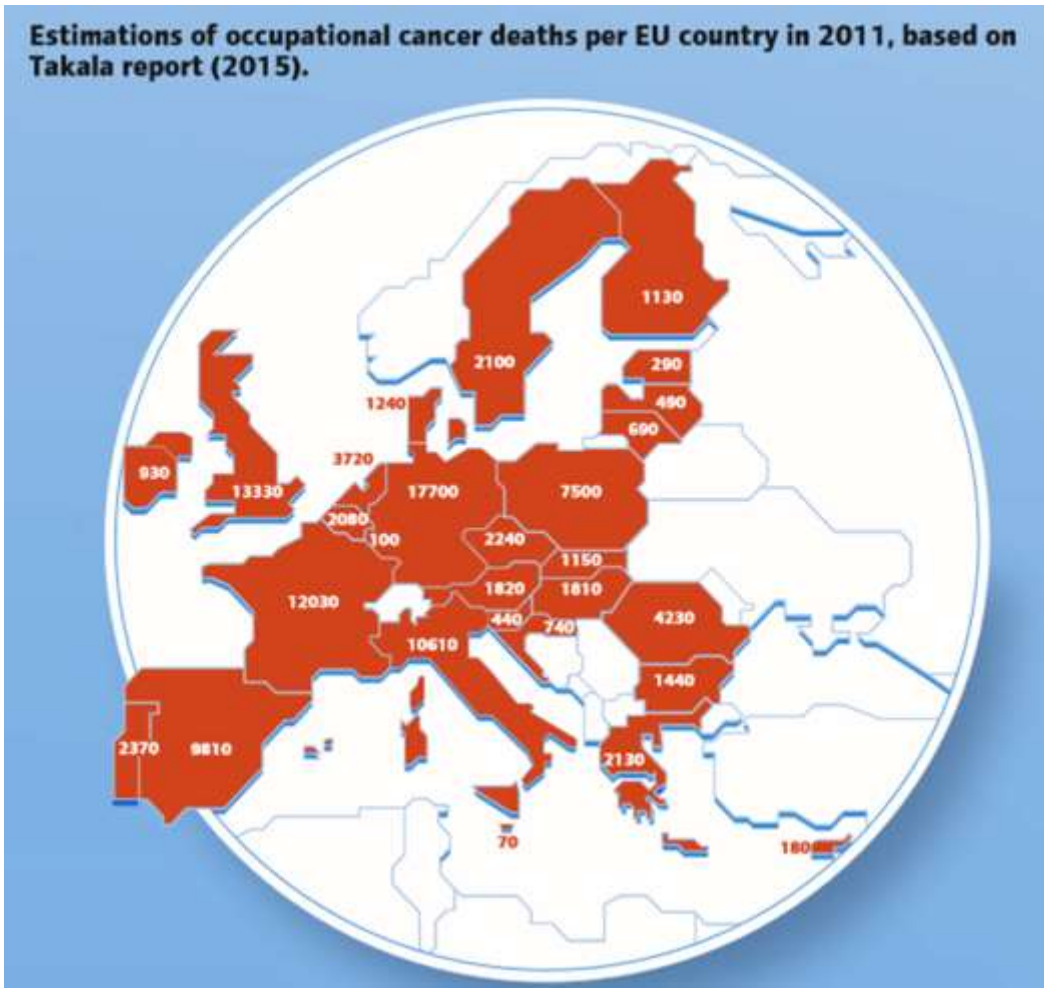

Figure 12. Estimation of occupational cancer deaths per EU country in 2011, based on Takala report (2015)

Implementing ***WHO's new guidance for early diagnosis of cancer*** will permit prompt and adequate treatment, especially for breast, cervical, and colorectal cancers. Is expected an increase of the number of cancer survivors. The meantime, costs to treat and cure patients with neoplasms will decrease. It is expected that all countries will apply WHO's new Guide to cancer early diagnosis [8].

In the ***early diagnosis*** there are three important steps [8]:

- Awareness of cancer symptoms in general population and, when these arise, people must be encouraged to seek care.
- Investment in state of the art equipment's for health services, their strengthening and appropriate training of health workers to be able to conduct accurate and timely diagnostics.

- For cancer patients, the access at safe and effective treatment, including pain relief, must not been limited by personal or financial hardship.

Having lower abilities to provide access to effective diagnostic services, challenges are greater in low- and middle-income countries. Here the access at laboratory tests, imaging and pathology, but also at appropriate level of referral services, as keys for early detection of cancers and early stage treatment, is lower than in developed countries. These countries must prioritize basic, high-impact and low-cost cancer diagnosis and treatment services. There are recommended programs to reduce the patients' payment from their own pockets. Costs can influence people to renounce at medical care and lower addressability.

Early detection in incipient stages permits lower duration, less aggressively and cost of the treatment, higher survival expectancy and a better quality of life. People can work and support their families.

1.16 trillion USD was estimated, in 2010, the total annual economic cost of cancer (healthcare expenditure and loss of productivity. In high-income countries performed studies have shown that treatment for early diagnosed cancer patients are 2 to 4 times less expensive than treating people diagnosed with more advanced stages of cancer.

By 2030 the agreed target is to reduce by one third premature deaths from cancers and other non-communicable diseases (NCDs). That can be achieved by universal health coverage, financial risk protection, quality and accessible essential health-care services, and, for all, access to safe, effective, quality and affordable essential medicines and vaccines. Improving environmental health and reducing social inequalities can also help reduce the cancer burden.

For 1 in 6 deaths, cancer is responsible. Prevention, strengthening early-stage cancer diagnosis and screening, providing basic treatment for all, palliative and survivorship care can help countries to better control of cancer. These can be introduced in a national cancer control plan (NCCP), which includes cancer registries and is founded on integrated, people-centered care [WHO global strategy on people-centred and integrated health services. Geneva: World Health Organization; 2015 (http://www.who.int/servicedeliverysafety/areas/people-centred-care/global-strategy/en/)

Diabetes, cardiovascular, chronic lung diseases and cancers, are known as non-communicable diseases (NCDs). They were responsible for 70% of the world's deaths in 2015 (40 million from total 56 million deaths). More than 40% of the people who died from a NCD were under 70 years [11].

The most cost-effective public health strategy in NCDs control is prevention [10].

Early diagnosis consists in the early identification of cancer in symptomatic patients [8].

Cancer screening seeks to identify unrecognized (asymptomatic, pre-clinical) cancer or pre-cancerous lesions in an apparently healthy target population [8, 10]. Cancer early diagnosis and screening are both important components of comprehensive cancer control. Resource and infrastructure requirements, impact and cost are totally different in early diagnosis and cancer screening [8].

People who have symptoms and signs consistent with cancer are the target group for early diagnosis, which main objective is to identify the disease at the earliest possible stage. That permit the correct diagnosis and early, promptly treatment, frequently in a curable stage. Survival and quality of life can be improved, in early diagnosis of cancer. Its steps are [8]:

- Step 1: awareness of cancer symptoms and accessing care;
- Step 2: clinical evaluation, diagnosis and staging; and
- Step 3: access to treatment, including pain relief.

In screening activities the target group is an entire population, apparently healthy, asymptomatic, that is evaluated for unrecognized cancer or pre-cancer. For screening are used specific tests, as HPV assay, examinations, imaging, as mammography, and different procedures that can be applied rapidly and accessed widely by the target population. Usual, the majority of tested individuals are negative for the tested disease.

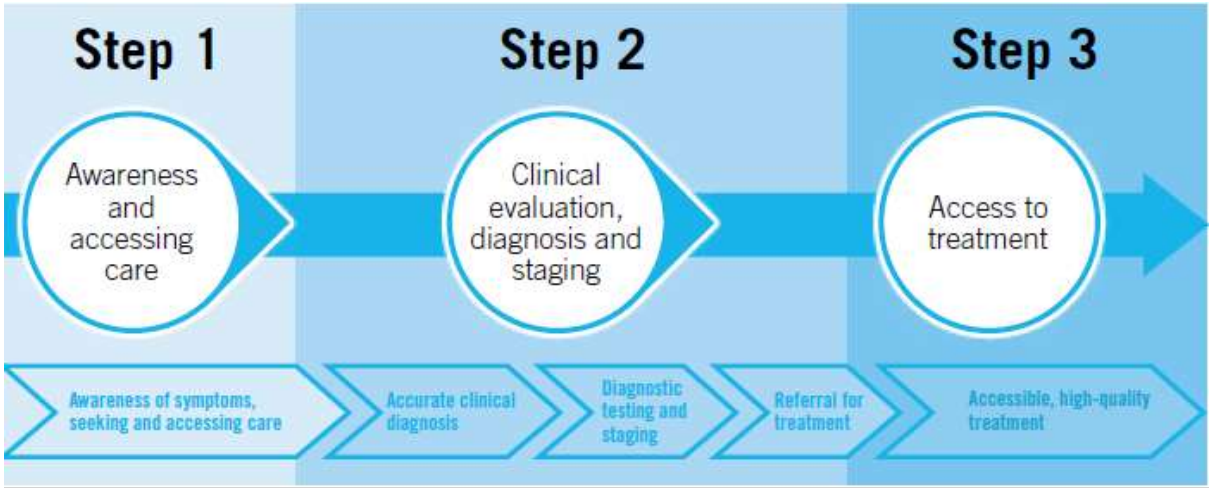

Figure 13. Essential elements of cancer early diagnosis [8]

To reduce delays in care, avoid loss to follow-up and optimize the effectiveness of treatment are necessary less than 90 days, from symptom onset to initiation of treatment [10]. There are variations influenced by health system capacity and cancer type. It is important that

cancer care be delivered in optimal time. In table 1 are emphasized, in parallel, the key elements of early diagnosis and cancer screening.

Table 1. **Key elements of early diagnosis and screening** [8,13]

Parameter	Early diagnosis	Screening programme
Volume of participants	Limited to those with symptoms suspicious for cancer	Entire target population (can be 50–100 times higher number of participants than early diagnosis)
Test	Diagnostic tests only for those with symptoms	Screening test for an entire target population **AND** diagnostic test for those who screen positive[a]
Health system requirements	Facilities and human resources for timely clinical diagnosis, pathology, radiology, staging, access to prompt treatment	Health system requirements for early diagnosis **AND** significant additional resources for inviting and testing an entire target population **AND** additional diagnostic tests for all people who screen positive with recall mechanism **AND** systematic evaluation
Training and human resource needs	Health-care providers to identify symptoms and signs of early cancer and diagnose, stage and treat cancer	Providers needed for early diagnosis **AND** additional providers, pathologists and/or biomedical laboratory scientists to perform test and interpret results
Public awareness	Attention to signs and symptoms to obtain prompt medical evaluation	Attention to signs and symptoms of cancer **AND** participation in screening programme
Follow-up care	Referral mechanisms to ensure treatment is accessible and affordable	Complex process that includes call–recall mechanism and counselling Increased responsibility for screening programme to ensure follow-up care of screen positive participants
		Increased risk of loss to follow-up
Potential benefits	Reduction in stage of disease at diagnosis When linked to treatment reduction in mortality generally evident in three to five years	Potential reduction in incidence in target population if precursor detected and treated by screening (e.g. cervical and colorectal cancers) Reduction in stage of disease at diagnosis in target population (generally earlier stage than early diagnosis) Reduction in mortality when screening delivered effectively and linked to treatment, but not for many years (often >10 years)
Potential for harm	Low: testing limited to only those who have signs and symptoms	Potentially high as test applied to an entire target population[b] Generally, most who screen positive will not have cancer or precancerous abnormalities, but require additional tests and procedures that can potentially lead to complications, psychological distress and utilization of resources Some may be overdiagnosed and overtreated
Applicability and current scientific evidence	Accepted core component of health services to improve timely diagnosis of cancer Relevant for all settings, especially those with weaker health systems	Benefits documented in high-resource settings for limited number of cancers (e.g. cervical, breast) Evidence of harms and significant costs in high-income countries Benefits and harms in LMICs not well established except for cervical cancer screening[c]

At different levels of cancer case management can occur delays in timely diagnosis and treatment access. These potential barriers are presented in figure 14, and potential interventions to strengthen to early diagnosis, in figure 15.

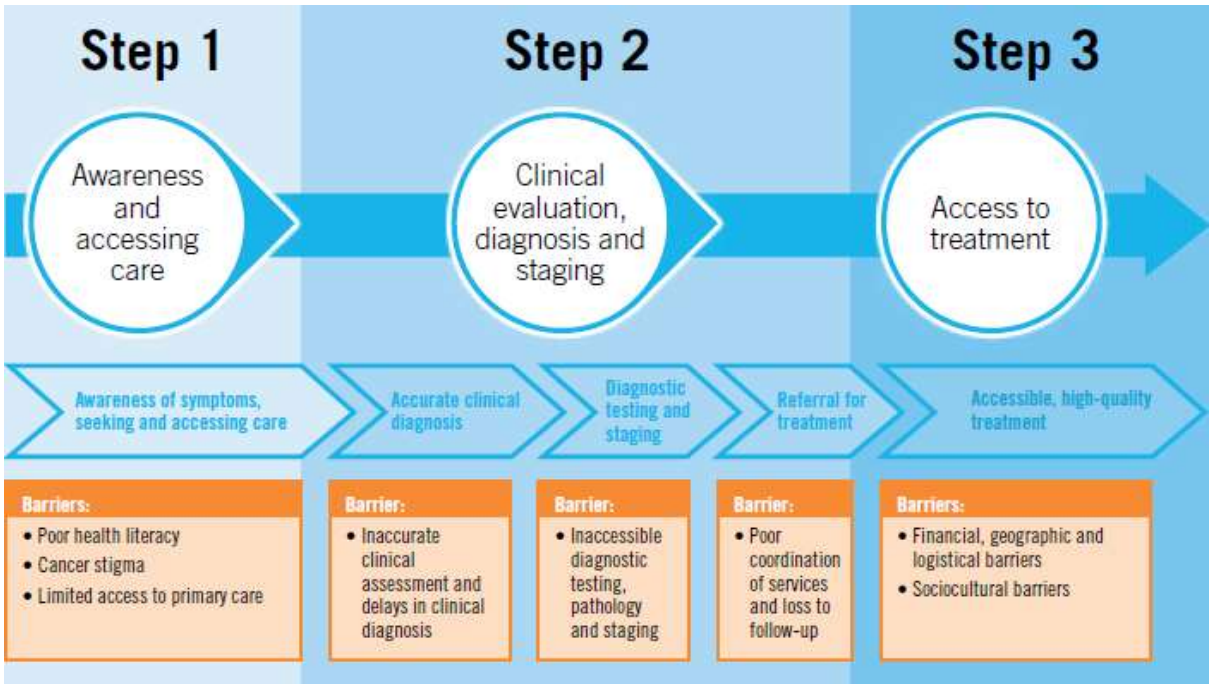

Figure 14. Common barriers to early diagnosis [8]

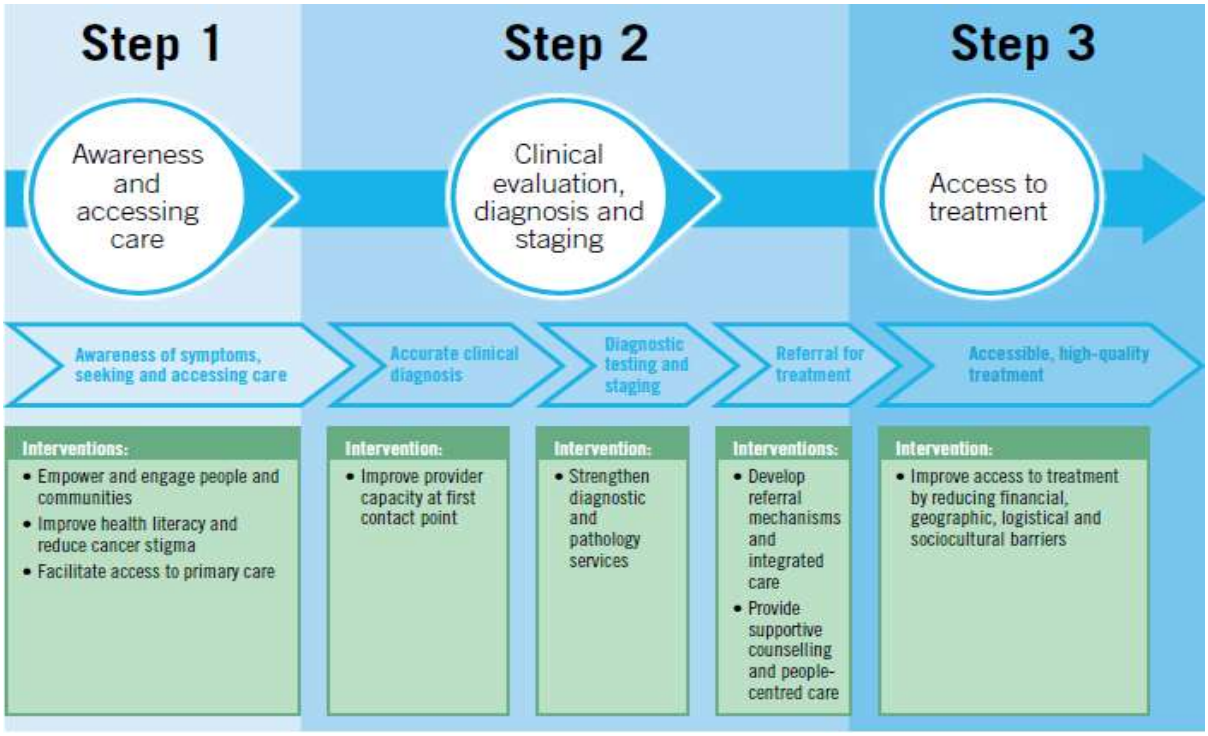

Figure 15. Potential interventions to strengthen to early diagnosis [8]

16.4. Cancer and work. Carcinogens in agriculture

Cancer is the first cause of work-related deaths in the EU. 53% of annual occupational deaths are attributed to cancer.

Every year some 102,500 people die in the EU as a consequence of occupational cancer [14]

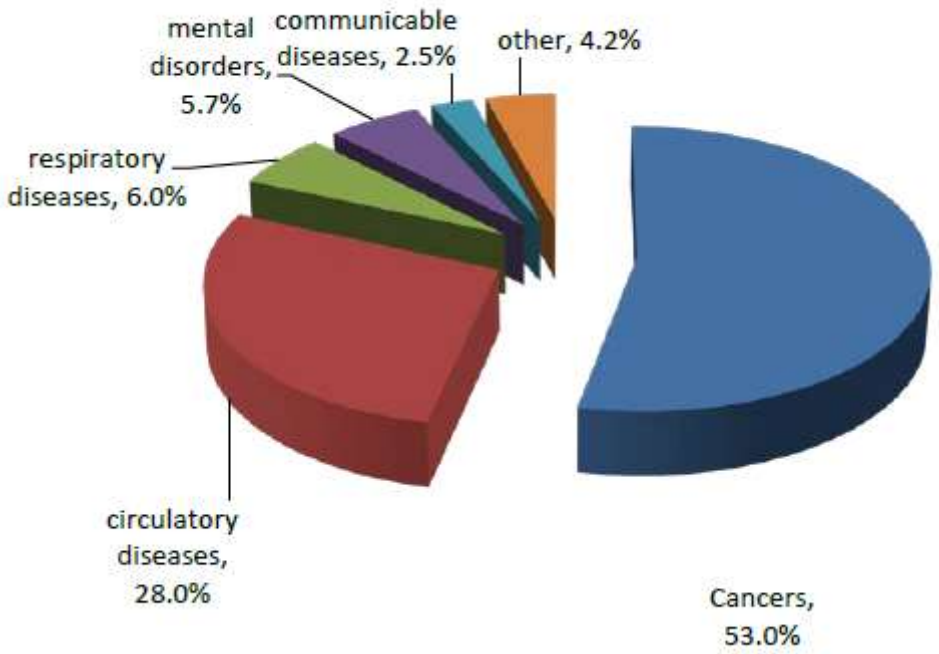

Figure 16. Work-related annual deaths in the EU28 and other developed countries

Work-related cancer is caused or worsened by occupational agents, factors and conditions [17]. Cancer can affect any human organ. There are described over 200 different cancers and three recognized mechanisms:

a) mutagenesis (genome, DNA damaging, epigenetic alterations, inhibition of tumor suppressor genes and activation of oncogenes);
b) promoting cell proliferation;
c) promoting the progression to malignancy by somatic and/or genetic changes;

The study of occupational cancer implies epidemiological and animal studies, in vitro methods and 'in silico methods' (computer simulations).

A carcinogen means any risk factor or condition that could cause cancer or contribute to its development, including physical, biological, organizational, and psychosocial factors [17].

IARC Monographs classify carcinogenic agents in five groups (Table 2). The lists are in permanent changing, in according with new data and scientific evidences.

Table 2. Carcinogenic Agents Classified by the IARC Monographs, Volumes 1–118

Group	Carcinogenic characteristics	Agents 'number
Group 1	Carcinogenic to humans	120
Group 2A	Probably carcinogenic to humans	81
Group 2B	Possibly carcinogenic to humans	294
Group 3	Not classifiable as to its carcinogenicity to humans	505
Group 4	Probably not carcinogenic to humans	1

The European Union classification of carcinogens is contained in the CLP (classification, labeling and packaging) Regulation (CE) 1272/2008, in line with the Globally Harmonized System (GHS) scheme. It consists of:

- category 1: substances known (1A) or presumed (1B) human carcinogens,
- category 2: suspected human carcinogens.

Occupational exposure limits (OELs) are tools for assessing and monitoring workers' exposure to hazardous chemical agents. They were used in all industrialized countries to prevent adverse effects on the health of workers exposed to hazardous chemicals.

The OEL can be defined as the concentration of a substance, most often in the working atmosphere, to which workers may be exposed repeatedly (working life duration) or acutely (short time exposure) without any adverse effects on their health or that of their descendants at any time.

Measured concentration of a hazardous substance in the atmosphere of the workplace is compared to its OEL. That permits to assess the risks for exposed workers and to select appropriate measures to manage that risk and to check the effectiveness of implemented risk management measures at the workplace.

Agrochemicals use in agriculture requires rigorous control to prevent possible health consequences for employers, workers and the general population. One of the long term health effects (chronic) is cancer [6].

In European countries and in most North American states is required cancer testing for ***pesticides***. It should be extended to other parts of the world. Many chemicals with proved carcinogenicity are no longer registered in these countries, and are being withdrawn elsewhere. Leukemia, non-Hodgkin's lymphoma and multiple myeloma have been associated with professional exposures to pesticides, particularly herbicides. Organophosphate insecticides exposure is associated with leukemia, non-Hodgkin lymphoma, soft tissue sarcoma, pancreatic cancer and genitourinary tumors [6,26]. Epidemiological evidence suggests an association between lung cancer and pesticide exposure. Fumigants such as methyl bromide are known to be genotoxic and have produced cancers in laboratory animals [6]. Thyroid cancer among female farmers in European Nordic countries was reported by A. Blair [29].

The first 12 compounds covered under the Stockholm Convention on ***Persistent Organic Pollutants*** (POPs), 2001 are aldrin, chlordane, dieldrin, endrin, heptachlor, hexachlorobenzene, mirex, toxaphene, polychlorinated biphenyls, DDT, PCDD (dioxin) and PCDF (furans). These chemicals can cause cancer and birth defects and may disrupt immune and reproductive systems [6].

Pesticides skin exposure, even when wearing gloves, is important for greenhouses workers and for wine-growing activities, where identical exposure levels were measured.

Exposure to sun's rays, especially ultraviolet (UV) radiation affects the skin and eyes. There is an increased risk of skin cancer, cataracts, premature skin wrinkling and lesions. Sunny summer days and the reflection of snow-covered surfaces between 10 and 14 hours represent the most harmful conditions for skin cancer and irreversible skin damages, especially for unprotected agricultural workers [6].

Some ***biological agents*** may cause cancer. Workers can be affected directly (hepatitis, Helicobacter Pillory), or indirectly, via toxic substances produced by biological agents (*endotoxins, aflatoxins*). One of the most frequent food-contaminating *mycotoxins* is *Ochratoxin A*, a toxin produced by *Aspergillus ochraceus, Aspergillus carbonarius* and *Penicillium verrucosum* [6]. The exposure can occur in animal-feed production, in waste management, food production, handling agricultural foodstuff (nuts, grain, corn, coffee), in brewery/malts activities, composting plants, and horticulture [6].

Endocrine disruptors (EDCs). The use of pesticides in agriculture, at different stages, put in discussion the endocrine disruption effect. Are at risk workers in pesticide production plants, farmers and agricultural workers; staff working in greenhouses, orchards and vegetable plots;

gardeners; maintenance workers, people involved in disinsectisation, wood preservation, the handling of treated wood, etc. Pesticide molecules or their breakdown products impact on the hormone system. The body responds to their presence as if they were hormones, as such they may trigger actions (normally triggered by hormones) that affect organ development at particular stages (pregnancy, fetus, young persons, and children) [1,6]

Agricultural workers are exposed both, at work and, like the general population, through food and air pollution. A European study analyzed pesticide residues found in the hair of agricultural workers, identifying 33 different substances, including herbicides and fungicides. Some of them were substances which have since been banned, such as HCH (hexachlorohexane) or DDE (a DDT metabolite) [6].

Breast, endometrial, ovarian, testicular, prostate, and thyroid cancers have been increasing over the past 40-50 years, caused by EDC, after Bergman and all. Occupational exposure to pesticides, PCBs (polychlorinated biphenyls), and arsenic are the cause of prostate cancer [6].

Nanomaterials started to be used in agriculture, especially for plant protection and production; preliminary studies show the potential of nanomaterials in improving seed germination and growth, plant protection, pathogen detection, and pesticide/herbicide residue detection [27]. Long-term animal studies with intratracheal instillation, performed with nanostructured carbon black, aluminum oxide, aluminum silicate, titanium dioxide (hydrophilic and hydrophobic) and amorphous silicon dioxide, resulted in tumors, induced by all tested nanomaterials. Micro-sized fine particles also caused tumors, but the potency of the nanomaterials was calculated as five - tenfold higher (volume basis (EU-OSHA - European Agency for Safety and Health at Work, Workplace exposure to nanoparticles) [17,29]. Some types of carbon nanotubes may lead to asbestos-like effects [28].

Work organizational factors may also cause cancer, according to the Nordic Occupational Cancer Study (NOCCA), based on a large cohort study that of the entire working populations in censuses in Denmark, Finland, Iceland, Norway and Sweden [17,29]. *Socioeconomic status* (lifestyle) was described as a risk factor for skin melanoma by Martinsen [20]. A German study revealed an increased risk of testicular cancer for people with specific socioeconomic status and/or sedentary life style, technicians and related professionals and clerical support workers. (Yousif, L. and all) [15].

Sedentary work was recognized as favorable factor for colorectal cancer. Boyle and all performed a population-based case-control study of colorectal cancer in Western Australia in 2005-2007. It seems that long-term sedentary work may increase the risk of distal colon cancer and rectal cancer.

Atypical working time – includes weekend work, night work and shift work. Shift work and night work are associated with negative consequences for health and well-being, such as

increased risk of cardiovascular disease, fatigue, reduction in the quantity and quality of sleep, anxiety, depression, gastrointestinal disorders, increased risk of miscarriage, low birth weight and premature birth, and cancer (Harrington, 2001). Exposure to light at night has been suggested as a contributing cause of breast cancer (hormone-related disease: night-time melatonin levels and reproductive hormone can be involved) [17].

16.5. Prevention. Treatment, rehabilitation, returns to work

To make an efficient prevention of occupational cancers is necessary to recognize the carcinogenic agent, to know the levels of exposure in different occupations, jobs and working tasks.

Workers are usually exposed at a sum of risk factors. The recognition of a specific cancer as attributable to occupational exposure is a high challenge. It is essential to identify all the workplace carcinogens, to know their health effects and to apply the latest findings to determine carcinogenic factors.

Technical, organizational and personal solutions can be applied and/or combined to control the exposure.

The replacement of carcinogens by harmless or less harmful agents/factors is essential. Use of efficient exhaust systems, encapsulation, and other measures to avoid the risk must be added.

Work under carcinogenic agents is prohibited. Exceptions can be granted only under very strict conditions, in legal limits.

An attentive surveillance of the working environment, where appropriate, must be assured.

Risk assessment must be attentive performed.

A tight medical supervision of exposed workers is necessary, also after the cessation of their assignment.

Occupational cancer treatment is assured by specialists in oncology.

Workers who have suffered work-related cancer must be protected from re-exposure to the same risks or other carcinogens. Special measures must be taken, including workplace adaptation, protective equipment, etc. Working conditions must be adapted to their actual physical and psychological abilities. Especially the first days after the return to work are crucial for the workers' health evolution and occupational future. Enterprises should be prepared to

adapt working conditions to the specific conditions at an early stage or, they can offer a new, protected workplace, if the old one remains dangerous.

16.6. Cancer Registries

The European cancer cases are unitary reported in a national cancer register. The European Network of Cancer Registries (ENCR) promotes collaboration between cancer registries, defines data collection standards, provides training for cancer registry personnel and regularly disseminates information on incidence and mortality from cancer in the European Union and Europe [23].

ENCR was established within the framework of the Europe Against Cancer Programme of the European Commission. It has the following objectives:

- improve the quality, comparability and availability of cancer incidence data,
- create a basis for monitoring cancer incidence and mortality in the European Union,
- provide regular information on the burden of cancer in Europe,
- promote the use of cancer registries in cancer control, health-care planning and research.

In Romania, the Ministry of Health (MS) Order no. 2027 of the 26th of November 2007 designed a new organizational framework for the cancer registration activity, by establishing regional cancer registers for each of the 8 development regions of the country and by coordinating their procedures of alignment to the standards and recommendations of the European Network of Cancer Registries (ENCR) and of the International Agency for Research on Cancer (IARC) from Lyon.

16.7. Conclusions

Cancer is a growing pathology with severe consequences for individuals and for the society.

Many cancers are linked to work. Some associations between exposure at work and cancer are not yet elucidated.

It is difficult to establish the link between working conditions and cancer, due to the long latency period between exposure and cancer manifestation.

It is necessary to focus resources on the identification of occupational carcinogens and on the adequate protection of exposed workers.

Prevention is the safest and most economical measure to stop the disease and to decrease its consequences.

Agriculture remains a complex sector of activity with a multitude of risk factors for occupational cancer.

16.8. Recommendations

Recognition of cancer risk and its correct management must be done at all levels.

Its early recognition and appropriate prophylactic and therapeutic intervention is necessary to save lives, to improve the quality of life, to maintain active the patient.

It is necessary to educate agricultural workers, stakeholders involved in agriculture, general population which is living in the rural environment, about cancer, early detection, importance of the screening, necessity of proper protection, including through workplace health promotion.

It will be a gain to introduce occupational exposure data in the Cancer Registries for the correct evaluation of cancers' etiology and efficient primary prevention.

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