MINI-REVIEW

Prevention and Early Detection of Occupational Cancers - a View of Information Technology Solutions

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Abstract

Thousands of people die each year from cancer due to occupational causes. To reduce cancer in workers, preventive strategies should be used in the high-risk workplace. The effective prevention of occupational cancer requires knowledge of carcinogen agents. Like other areas of healthcare industry, occupational health has been affected by information technology solutions to improve prevention, early detection, treatment and finally the efficiency and cost effectiveness of the healthcare system. Information technology solutions are thus an important issue in the healthcare field. Information about occupational cancer in information systems is important for policy makers, managers, physicians, patients and researchers; because examples that include high quality data about occupational cancer patients and occupational cancer causes are able to determine the worker groups which require special attention. As a result exposed workers who are vulnerable can undergo screening and be considered for preventive interventions.

Keywords: Cancer - occupational disease - prevention -early detection of cancer -treatment

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Introduction

From the past to now, the health of people threatened by risks associated with environmental and occupational factors which can result in a wide range of diseases from allergies and non-malignant chronic diseases (Dobashi, 2012; Agrawal et al., 2014; Das, 2014) to cancers, and even gene mutations (Harris, 1970; Balamuralikrishnan et al., 2012). However, among them, cancers have a more dramatic prevalence than others. Perhaps because, occupational exposures are one of the most important factors in incidence of cancers such as bladder (Shakhssalim et al., 2010), prostate (Doolan et al., 2014), leukemia (Mosavi-Jarrahi et al., 2009; Balasubramaniam et al., 2013), non-Hodgkin lymphoma (Balasubramaniam et al., 2013), breast (Ekpanyaskul et al., 2010), stomach (Li et al., 2012), sarcomas of bone, lung, liver, thyroid, melanoma, mesothelioma, nasal cavity, paranasal sinus, larynx (2011b), and brain and other central nervous system, colon, kidney, ovarian, pancreatic, rectal, testicular cancers (Clapp et al., 2005). It is estimated that, approximately 2% to 8% of all cancers are thought to be due to occupation (Yang, 2011). Reports indicate that global provenance of neoplasms is increasing. According to GLOBOCAN latest report, there were 14.1 million new cancer cases, 8.2 million cancer deaths and 32.6 million people who living with cancer (within 5 years of diagnosis) in 2012 worldwide. Almost 57% (8 million) of new cancer cases, 65% (5.3 million) of the cancer deaths and 48% (15.6 million) of the 5-year prevalent cancer cases occurred in the less developed regions (Globocan, 2012).

In this situation, there are several challenges for occupational cancer control. For example we don't know exactly what the proportion of all of reported cancers are related to occupational cancers. This may be due to lack of accurate information about patients or the complexity of proving occupational association with cancer occurred in one patient. Other challenges are difference of occupational cancers in the implementation of prevention strategies, proper time and methods for early detection with non-occupational.

Beyond medical advances, this paper outlines the effects of IT solutions to improve and accelerate the prevention and early detection of occupational cancers.

Prevention and Early Detection of Occupational Cancer

If the WHO's global target of a 25% reduction in deaths from cancer and other non-communicable diseases in people aged 30-69 years is to be achieved by 2025 (referred to as25 × 25), we will need not only more effective prevention (to reduce incidence) but also more effective health systems (Allemani et al., 2014).

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From the opinion of researchers focusing on strategies of primary prevention (includes awareness about cancers and risk factors such as carcinogens and avoiding exposure to them) and secondary prevention (early detection) should be a priority for countries to cancer control (Azadmanjir et al., 2015). In this regard, should be noted that, WHO's International Agency for Research on Cancer (IARC) has classified 107 agents, mixtures, and exposure situations as carcinogenic to humans (WHO, 2011). So, on the one hand, for occupational cancers control, avoiding exposure to occupational carcinogens and environmental factors is the important in primary prevention (Kye et al., 2015). According to experts, unlike lifestyle-associated cancers, occupational cancer is in principle fully avoidable through legislation leading to exposure-reducing measures (Gustavsson, 2014). Others stated that prevention and safety methods can prevent from incidence of occupational cancer (Davoodi et al.; Safdari et al., 2009).

Some countries have taken substantial steps in this regard. For instance, Directive 2004/37/EC of the European Parliament and of the Council, on the protection of workers from the risks related to exposure with carcinogens or mutagens at work sets out, a number of preventive measures to eliminate or minimize work-related exposures to chemical carcinogens and mutagens (Brussels, 6.6.2014). In addition, the evaluation of European Union health and safety strategy 2007-2012 identified that focus on occupational cancer prevention is critical to occupational disease prevention. So the commission has adapted a new EU strategic framework for health and safety at work 2014-2020 (Brussels, 23.9.2014). WHO recommended that other strategies primary prevention, such as education, risk communication and industrial hygiene practices also considered as vital steps in global control of occupational cancers (Zare Sakhvidi et al., 2014).

On the other hand, unfortunately, the researchers announced that occupational cancers have significantly increased in recent years, basically because of their long latent period (Rim, 2013) that defined as the time interval between first exposure to a carcinogen and the point at which the risk of the cancer first increases (Rushton, 2014). Therefore, early detection must be more considered as secondary prevention.

IT Solutions for Prevention of Occupational Cancer

Electronic-based Occupational Cancer Registries

To setting preventive policies for work safety and health in the workplaces, estimating the burden of occupational cancers is essential (Straif, 2012). But, since late 1970, determine of the incidence rate of cancer due to occupational exposure was one of the important scientist challenges. (Mosavi-Jarrahi et al., 2009)

For accomplish this, authorities will need to accurate and timely information (Mohammadzadeh et al., 2013) about cancer types, the pattern of their prevalence in different geographical regions, occupational cancers with highest priority and common characteristics of involved patients to be able to identify high risk occupations, vulnerable groups and occupational hazards.

One thing is known that cancer registries are the best solution to estimate of the global cancer burden, and to gather, analyze, and publish incidence and survival data at national or regional level (Peters et al., 2015). Then, occupational cancer registry represents a fundamental tool for that purpose (Straif, 2012). The main purpose of occupational cancer registry is production of high quality information for users (Massari et al.2010). Surveillance system to reporting occupational cancers should be include the nature of the occupational hazards in the workplace, the health requirements of the work, and the health status of the working population concerned (ILO, 2013). Enough knowledge about number of workers with occupational exposures is essential. In 1995, EU in the CAREX project provides an estimation of the number of EU workers with exposure to the carcinogens (Kauppinen et al., 2000; Setton et al., 2011; Peters et al., 2015). Some other example of occupational cancer registries includes Finnish Register of Workers Exposed to Carcinogens (ASA Register) (Kauppinen et al., 2003), the Italian Information System for Recording Occupational Exposures to Carcinogens (SIREP) (Crosignani et al., 2006) and the German ODIN Register (Radek, 1998).

IARC's in the guideline about Cancer Registry Development emphasis to promote high-quality data collection and cancer registration in low-income and middle-income countries(Bray et al., 2014). Unlike paper-based registries, electronic-based registries have advantages such as updated and high quality data rapid access and retrieval and quick calculation of statistical indicators for early detection of high-risked groups (Mohammadzadeh et al., 2013).

Education and self-care

IT-based education approaches improves patient's awareness, communication between patients and providers or among patients, responsibility of health care system and providers and self-care (Demiris et al., 2008; Adams, 2010). In condition that all people use information and communications technologies such as internet and mobile networks, solutions include health portals, tele-consulting systems and health social networks can help to increase public awareness of occupational cancers and education on self-care strategies that people can apply themselves for cancer prevention. Moreover, availability of electronic workers databases can be a powerful base to develop call centers by which notify them to screening services and programs through Small Message System or E-mail.

Monitoring of exposure to carcinogens

In the other hand because the mechanism causing and influencing the carcinogenic process are still poorly understood, information technology can use for discover of the relationship among occupational exposure and occupational cancer (Kuhl and Lißner, 2015). Occupational exposure in the work place can be evaluated using various methods (Ekpanyaskul et al., 2010).For example information system should incorporate estimates of exposure levels, in order to better serve hazard surveillance, quantitative risk and burden assessment,

and to set prevention priorities; such as WOODEX, TICAREX, Matgéné, FINJEM and CAREX Canada (Kuhl and Lißner, 2015).

ITA for Early Detection Of Occupational Cancer

Bayesian-Network based systems

Bayesian methods offer a good framework to integrate subjective judgment and available data for decision making (Vadali, 2010). At the beginning, Ramachandran and Vincent (1999) proposed applying a Bayesian probabilistic framework to expert judgment in occupational hygiene (Ramachandran and Vincent, 1999).

These systems are a type of statistical models that can compactly represent complex probability distribution; and use in order to monitor, diagnose and make predictions about diseases, all under the presence of uncertainty (Choi et al., 2011).Bayesian Systems estimates the correlation among occupational exposure rate and occupational cancer. The Bayesian imputability method provides an explicit way to quantify the causal relationship (Vandentorren et al., 2006).

Expert systems

One of the solutions for the field of occupational health professional's access to quality information about the risks and hazards associated with the disease, and other information using an online expert systems (Rhebergen et al., 2011). Expert systems are important to provide accurate information about the diagnosis and the provision of emergency medical services.(Mateo et al., 2007)

Expert systems are the most popular products of artificial intelligence that applied for solve problems by simulating the human behavior of experts; and use in different areas of medicine. For this purpose, expert opinions are collected through tools such as questionnaires, next expert's knowledge with respect to the objectives of the system translate to logical language; and then has been structured through the construction of production rules (Junkes-Cunha et al., 2014). Expert systems have benefits such as making expertise more accessible, relieving experts from routine task and providing the useful way for expert to develop and test ideas and theories.(Thomas, 1989)

The goals of expert systems for occupational diseases could include the following: a) Development of guidelines for retrospective evaluation of historical exposures in the workplace. b) Provide exposure criteria as a part of diagnostic features for compensable occupational disease c) Recognition, treatment and anticipate of occupational diseases (Burdorf and Swuste, 1999). This systems should be accessible, complete, user friendly, easy to handle, relative and applicable (Rhebergen et al., 2011).

ITA for Treatment of Occupational Cancer

Electronic health record

Because Almost 1/3 of all cancer and Most of the exposure risks for occupational cancer are preventable; (Commission, 2010; 2011a) The early detection, prevention and determine the effectiveness of treatment need access to accurate, comprehensive and timely cancer data (Mohammadzadeh and Safdari, 2014). One of the new technologies in the competitive environment of health is Electronic Health Record (EHR), which have an important role in increasing the effectiveness of health services, support decision-making and management. EHR is a main core in order to achieve best practice (Ghazisaeedi et al., 2014).

If occupational cancer EHR includes the complete and high quality data, it provides benefits such as: improve the quality, safety and efficiency of care and reduce health disparities, the involvement of patients and their families in health care, Improve care coordination, Improve Public Health and Guarantee protection for personal health information. In general, occupational cancer EHR lead to the conscious diagnosis, more-focused health plans and directed guidance to return to work (RTW) (Socias, 2013).

Conceptual models

Conceptual models are a conceptualization, simplification, or abstraction of reality. Conceptual models help to representing information for sharing, in surveillance activities (Richesson and Turley, 2003). In occupational disease a conceptual practice model can use to occupational therapy practice for activities such as assessments and intervention procedures to guide clinical practice. Conceptual models with Occupation-based do not present guidelines for application in specific populations or for specific disabilities but attempt to explain why the profession works as it does, And help to assessment the effectiveness of intervention and procedures (Leyshon, 2008; Désiron et al., 2013). Due to the chronic nature of occupational cancers use of conceptual practice models in this area can lead to early detection, treatment, and help the person return to work (RTW) (Désiron et al., 2013).

Conclusion

As most people need updated knowledge about occupational health, physicians in order to continue effective patient's treatment need to have a strong knowledge infrastructure such as information technology (Hugenholtz et al., 2009; Rhebergen et al., 2010). During the last decade, the field of occupational therapy as the most medical areas affected by technology and the use of Information and Communication Technology (ICT) (Cason, 2014). However mentioned IT provides effective solutions for health and safety promotion, better prevention and efficient treatment in the field of occupational cancer.

Continuous worldwide surveillance of cancer survival should become both an indispensable source of information for cancer patients and researchers and a stimulus for politicians to improve health policy and health-care systems. Monitoring programs and their consequent prevention strategy planning must include IT solutions for the monitoring of carcinogenic risks in the workplace or measurement of exposure levels in workers; identify the best patterns for early detection and diagnosis of occupational cancers.

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