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Chapter

The Role of Registration in Cancer Control and Prevention

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Abstract

Cancer is one of the major causes of morbidity and mortality in the world, with 18.1 million new cases and 9.6 million deaths, and an estimated prevalence during the last 5 years of 43.8 million persons with the disease, according to 2018 World Health Organization (WHO) report. Disparities between developed and developing countries have been documented—nearly 57% of cancer cases (8 million) and 65% of cancer deaths (5.3 million) occurred in developing countries. Although more cases are detected in countries with a high or very high human development index, mortality rates are similar in both low-to-middle-income countries and high-to-very high-income countries. The global picture of the impact of cancer worldwide can only be calculated from registry data, which allow for estimations of the burden of cancer for different geographic areas, as well as for the fundamental role in cancer control and prevention.

Keywords: Cancer, registration, population, bioinformatics, prevention, control

1. Introduction

Noncommunicable diseases (NCDs), including cancer, are the leading causes of preventable and premature death, killing 40 million persons each year and accounting for about 70% of all deaths globally. Some 15 million of those deaths include people between 30 and 69 years of age, and more than 80% of these premature deaths occur in low-income and middle-income countries (LMIC); thus, NCDs are important and growing causes of health inequalities and inequities [1, 2].

Cancer remains a huge and leading cause of morbidity and mortality worldwide, with an annual incidence of 18.1 million new cases, and it is the second most common cause of death globally, accounting for an estimated 9.6 million deaths in 2018.

The burden of cancer is rising globally, but not equally; the greatest impact of cancer and the fastest increase in the cancer burden over the coming decades is projected to be in LMIC [3].

Controlling cancer is a multifaceted issue that requires multimodel solutions; one of the main solutions is the establishment of a cancer-control plan to overcome the growing cancer burden. The World Health Organization (WHO) defines the national cancer control plan (NCCP) as a public health program designed to reduce the incidence and mortality of the disease through the systematic and equitable implementation of evidence-based strategies for prevention, early detection, treatment, palliation,
Cancer registration is the priority issue for data-based evidence, which is essential for determining the cancer burden [2].

The burden of cancer is solely measured by cancer registration through the collecting of information on new cases (incidence). Cancer incidence by type has been included as a core indicator in the WHO-Global Monitoring Framework for the Prevention and Control of NCD, and the latter was reaffirmed at the recent 70th World Health Assembly [4, 5].

Cancer registration is much more than an epidemiological center; the surveillance of cancer incidence is quite different due to the complexity of cancer, which is not a single disease but rather a distinct entity that varies biologically, clinically, and epidemiologically. Many cancers are complex and heterogeneous in their characteristics, with hundreds of histological and biological subtypes. Given the diversity of cancer types in different geographic areas, it is necessary to base cancer-control activities on customized, individualized cancer profiles obtained through cancer registries, since each area has different circumstances and needs [6, 7].

Cancer registries provide the cancer-information patterns essential for planning and evaluating health services for the prevention and control of cancer. These registries comprise the main issue in terms of the effectiveness of health systems, public health interventions, and survivorship in order to assess treatment effectiveness, as well as for the primary prevention, early detection, screening, and treatment of cancer. Hence, cancer registration plays an essential role in the planning and evaluation of effective control and prevention policies [8].

2. Cancer registration

The cancer burden is rising globally, exerting a significant strain on populations and health systems at all income levels. The increasing number of cancer cases observed during the last decades is due in part to the epidemiological transition that took place worldwide, resulting mainly from the net growth of the population, the aging effect, and changing fertility rates, increased longevity, and changing lifestyles [9–11].

The differing cancer profiles in individual countries and between regions indicate marked geographic diversity, due to the distribution of patterns that implicate environmental determinants, lifestyles, occupation, physical activities, and other cancer risk factors. Variations in the prevalence of cancer risk factors influence the different cancer profiles between the different geographic areas because these factors are generally present in different magnitudes across different populations. For instance, infection-related and poverty-related cancers are common in developing countries, whereas in high-income countries, the cancer profile is most often associated with lifestyle. However, the cancer burden is greatest in low- and middle-income countries (LMIC), where approximately 75% of cancer deaths occur and where the number of cancer cases is rising most rapidly [10–13].

Global cancer control has been a growing priority for the authorities; for instance, WHO, in a joint effort with the World Health Assembly, the United Nations Agenda (UN), and local authorities, have made a commitment to global cancer control through the Global Cancer Plan on the Prevention and Control of NCD, in the 2030 United Nations Agenda for Sustainable Development Goals (SDG). One of the most important cutting-edge actions taken is that of the 2017-World Health Assembly
Resolution 70.12 on cancer prevention and control. This is an integrated approach that ensures access to treatment and care, palliative and survivorship care, and comprehensive data collection through robust cancer registries, because the incidence by cancer type is a core indicator of progress within the WHO-Global Monitoring Framework for NCD [1, 4, 12]. Accordingly, short- and long-term recommendations for tackling the rising cancer burden include the implementation of the national cancer control plan (NCCP). Thus, strategies for addressing the global cancer burden must be tailored to the local reality; the strategy must account for a country’s most frequent cancer type and be tackled according to the country’s available resources. Hence, to allocate resources properly, accurate and comprehensive cancer registries are essential for providing information on the cancer burden in the country. Therefore, all of the decisions involved must be based on the best available evidence and accurate epidemiological data addressed within the national cancer control plan [2, 12].

Cancer registries collect data on cancer cases over time. The main purpose of the cancer registry is to collect data continuously and systematically and to classify information on all cancer cases from various data sources in a defined area, in order to produce statistics for providing a framework for assessing and controlling the impact of cancer on the community, through estimating the current cancer burden, examining recent trends, and predicting their probable future evolution. The scale and profile of cancer can be evaluated in terms of incidence and mortality, but other dimensions are often considered, including prevalence, person-years-of-life-lost, and quality- or disability-adjusted life years. An appraisal of the current situation provides a framework for action, and cancer-control planning should include the establishment of explicit targets, which permits the success or otherwise of the interventions to be monitored [14, 15].

Cancer registration can be described in five central processes—1) identification: For a clear meaning of the definition and classification of each case included, the data should be standardized to facilitate data comparability; 2) collection: For each cancer case, essential information such as patient data, tumor, and bases of diagnosis must be included; 3) coding: The standardization of the nomenclature and the coding for each cancer case should provide an enabled database for comparison between different geographic areas and ease-of-analysis; 4) capture: Due to a large amount of processed information in a cancer registry, it is recommended to use a data-processing program in order to capture data and to store information, and 5) analysis and report: The analysis of the data in registries should periodically provide information on the cancer burden in a specific population. The report should include background information on the registry, registration procedures, catchment population, degree of data completeness and validity, methods of analysis, and findings (Figure 1) [16].

The statistical information produced by cancer registries could be used in different fields, including the following—etiological investigation; primary prevention (evaluation of cancer-control programs); secondary prevention (evaluation and monitoring of screening and early-detection programs), and tertiary prevention (survival analysis) and service planning, in a manner that benefits individuals as well as society as a whole [15].

2.1 Types of cancer registries

According to WHO, we could describe three different types of cancer registries—pathology-based; hospital-based, and population-based. The roles of the three types
of registries are different and complementary. The first two types serve important administrative and clinical functions, but only the population-based registry provides an unbiased profile of the present cancer burden and how it changes over time. Thus, population-based cancer registries (PBCR) play a unique role in planning and evaluating population-based cancer-control actions aimed at reducing the cancer burden. Thus, PBCR is considered the gold standard, (Figure 2) [14]. These registries are described briefly as follows:

a. **Pathology-based Cancer Registry (PthBCR)**. It collects information on neoplasms of in situ and malignant behavior from one or more pathology laboratories. Pathological data represents a potentially excellent source of case ascertainment and offers the prospect of increasing the validity of diagnosis and the accuracy of the information recorded on morphology. However, the information from PthBCR is utilized mainly for administrative laboratory purposes and represents an incomplete and skewed cancer profile, which is essentially determined by the types of tissues that the laboratory can process. Consequently, that reliance by a cancer registry on pathology data alone may lead to the loss of detail on the subsite, the registration of rare tumors, and the failure to identify cases of recurrence.

b. **Hospital-based Cancer Registry (HBCR)**. It collects information on patients with cancer treated at one or more hospitals. The main purpose of such registries
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DOI: http://dx.doi.org/10.5772/intechopen.101331

is to contribute to the care of patients by providing readily accessible information on subjects with cancer regarding the treatment they receive and the outcome. Information from HBCR is employed mainly for administrative purposes, for reviewing clinical performance, and for prioritizing hospital resources. In addition, HBCR facilitates the monitoring of health programs and allows for the detection of the patterns or frequencies of different types of cancer treated in the hospital, as well as the monitoring of the outcomes of treatment, survival rates, quality of life, and adverse treatment effects, and also supply a convenient source of patients for clinical and epidemiological studies. Information sources for HBCR include out-patient clinics, anatomopathology laboratories, hematology laboratories, nuclear medicine laboratories, autopsy and death-certificate offices, and departments of surgery, oncology, radiotherapy, chemotherapy, imaging, endoscopy, etc. HBCR provides an incomplete and skewed cancer profile because they are determined by the population treated at a specific medical center, clinic, or hospital.

c. Population-based Cancer Registry (PBCR). These registries are concerned with collecting data on all new cases of cancer occurring in a well-defined population, and with being able to distinguish between residents of the area and those from outside the area. The key feature of the PBCR is the use of multiple sources of information on cancer cases. Information sources for PBCR are public and private—hospitals; cancer centers; medical offices; out-patient clinics; anatomopathology laboratories; hospice centers; hematology laboratories; nuclear medicine laboratories; imaging detection clinics; endoscopy detection clinics; chemotherapy and radiotherapy clinics; civil registry offices (death certificates); and health insurance offices. Hence, this strategy in PBCR facilitates the identification of as many as possible of cases diagnosed among the residents of the area defined by the registry. This procedure permits the identification of the same cancer case from different sources. This is regardless of whether the information on the same cases is received from several sources; indeed, this feature comprises a quality control that may be employed to evaluate success in case finding, as long as duplicate registries are avoided.

PBCR provides a more reliable cancer profile for estimating population indicators; therefore, these registries play an important role in cancer epidemiology, permitting the estimation of incidence rates by tumor location, age, gender, and other factors. Through patient tracking, it is possible to estimate cancer survival, which provides a useful indicator of this disease in the community. This method is also an affordable and efficient resource for enrolling cases for intervention and for cohort and case–control studies. Additionally, PBCR can identify geographical and temporal changes by means of the estimation of trends [15].

Additionally, the expanded role of PBCR in health systems includes the following—a) assessing differences in cancer incidence and mortality in order to address inequality in cancer prevention and care utilizing the assessment of variations in cancer frequency between different geographic areas, according to the ethnic origin, occupation, and sociodemographic status; b) monitoring the effect of primary cancer-prevention campaigns by assessing trends in cancer frequency; c) monitoring the effectiveness of cancer treatment and that of screening programs; d) planning the future needs of cancer services employing projections of cancer frequency with assumed trends in risk factors and intervention.
2.2 Procedures and quality control

In cancer registration, the quality of the data is more important than the quantity, especially for certain features and due to the large number of data produced every day. In general, medical databases possess heterogeneity, but in particular, cancer is a complex and heterogeneous disease, with hundreds of histological and biological subtypes, while on the other hand, it affects a wide range of ages, from those of children to the elderly and involves the complexity of biological variation by ethnicity. Thus, the quality-controlled data produced by the cancer registry are valued as far more effective.

Collecting information in cancer registration can be active or passive; in general, the majority of registries utilize a combination of both methods. The active procedure involves visiting the sources of information, reviewing these, and abstracting the information into a special format by the cancer-registry staff, while the passive procedure relies upon routine notifications from hospitals, laboratories, and death records; thus, the registry may periodically receive abstracts, notifications, or databases [8, 16].

Depending on utility, purpose, logistics, and budget, the cancer registry must collect essential information on the patients, the tumor, the source, and additional information. It is recommendable that each domain contains the following information in as complete a form as possible; 1) **Patient information**: Full name, age, gender, birthplace, address, identification number (if applicable, because some countries use a unique ID number), and ethnic group; 2) **Tumor information**: Incidence date, primary tumor site (topography), laterality (if applicable), morphology, behavior, the base of diagnosis, and date of death (if applicable); 3) **Information source**: Hospital, clinic, and laboratory name or number (the place where the cancer was diagnosed), and 4) **Other details**: It is recommended that these be collected, depending on the capacity and applicability of the registry, such as the following—biomarkers; genomic information; disease stages; treatment information (surgery, radiation, chemotherapy, hormone therapy, and immunotherapy), and outcomes such as vital status (alive, dead, or lost to follow-up) [14, 17].

**Patient Information**: Identification items such as name, gender, and date of birth are important to avoid multiple registrations of the same patient or the tumor, in order to obtain follow-up data and record linkage. The patient’s address is essential for establishing residence status. Data on ethnicity is important in populations containing diverse ethnic groups.

**Tumor Information**: Incidence date is primarily the date of the first histological or cytological confirmations of the malignancy, as this is a definite, consistent, and reliable point in time that can be verified from records. If this information is not available, the date should be taken of the first diagnosis by the physician, or the date of the first pathological report, or the date of death, if no information is available other than that the patient died or if the malignancy is discovered at autopsy.

Since cancer is not a single disease, but instead a complex and heterogeneous one with hundreds of histological and biological subtypes, it is thus recommended that the cancer registry use the International Classification of Diseases for Oncology (ICD-O) to code the tumor. The ICD-O is a multi-axial classification of topography (site of primary tumor), morphology (histological type), behavior (benign, borderline, in situ, malignant), grading (differentiation), and bases of diagnosis (information on how the tumor was diagnosed, by means of a clinical history only, or by exploratory surgery, laboratory, biomarkers, autopsy, imaging (X-ray, ultrasound,
etc.), or anatomopathologically). The topography of the tumor is the most important data item recorded and provides the main basis for the tabulation of registry data.

**Information Source:** For purposes of future checking, it is important for the registry to collect data on the sources of the cancer case-finding, for instance, name of the physician, hospital, laboratory, biopsy number, etc. This additional information will help to trace the medical records of the patients.

**Recommendations.**

*a) New record:* For new cancer cases, it is recommendable to use a unique registration number for each patient. If the patient has more than one primary tumor, a different number is given to each tumor in order to facilitate the consultation, operation, management, and analysis. One key challenge is to store the patient’s identifiable data, which is mandatory for safeguarding the patient’s privacy; for each patient, personal information data, including name and national identification number (ID), and personal sensitive data such as addresses, phone number, and gender, must be unidentified. All of the databases should contain a security framework to provide authentication, authorization, and to audit the systems.

*b) Multiple tumors:* If there are several records for the same patient, the most appropriate primary tumor by topography, morphology, and incidence date must be determined. The second primary tumor is defined as a new record on an individual who has already been recorded.

*c) Duplicate tumor:* When matching by name, allowance must be made for errors in spelling (the phonetic spelling of names or errors due to the illegibility of hospital records). The strategy is to match first by name, then by age, gender, address, and diagnosis, to ensure that it is a real duplicate. If there is no match, it is a new patient who should be registered as a new record [14, 16].

Cancer registration is not only a system for the classification and the coding of neoplasms. It also requires a clear definition of what constitutes a cancer case, the definition of the date of incidence, and the rules for dealing with multiple primary cancers, including the need to differentiate between a new case of primary cancer and the extension, recurrence, or metastasis of an existing one. Therefore, trained personnel and adherence to international standards for registering cancer cases are necessary.

Because data collection by the different registries around the world may vary according to local needs and the availability of information, the value of cancer-registry information depends on producing reliable and comparable national and international cancer data; hence, cancer registry must adopt and follow rules for coding, data-quality standards, and procedures. The International Association of Cancer Registry (IACR), the International Agency for Research on Cancer (IARC), and the Global Initiative for Cancer Registry (GIRC) have produced guidelines and recommendations regarding the data items collected [14, 18].

The Global Initiative for Cancer Registry Development (GICR) was launched and is coordinated by IARC, with its main purpose being to support local planning and reduce the cancer-registration disparities between low- and middle-income countries by building local and sustainable infrastructure through regional centers of expertise-denominated IARC regional hubs. Over the last few years, IARC has established regional hubs for cancer registration in Africa, Asia, and Latin America. These hubs provide a set of local activities in a given country for increasing data quality, coverage, and utility in terms of cancer-control proposes, through technical guidance, training, advocacy, data collection, analysis, and promoting cancer research by identifying topics of common interest to the community that directly contribute to cancer control, thus fostering collaborative cancer research across countries [14].
According to IARC, cancer registries should be able to furnish some objective indication of the quality described in the following four dimensions—

**a) Comparability:** Because one of the main topics of cancer registries is the comparison of statistical results, the standardization is required of practices concerning the classification and coding of new cases and regarding consistency in definitions of incidence, such as rules for the recording and reporting of multiple primary cancers occurring in the same patient. WHO published the International Classification Diseases of Oncology (ICD-O) as a standard for classifying and coding cancer as follows;

**b) Exhaustivity:** It defines the degree of the population covered by the registry; in particular, PBCR should, by definition, register every single case that occurs in its catchment population. On the other hand, for the case ascertainment, there are certain methods to determine the degree of completeness of registration, such as comparison with death certificates and cancer-registry records;

**c) Validity:** It defines the accuracy of the work of the staff with the accuracy of recorded data that are greatly enhanced by consistency checks carried out at the time of data entry. Data validity can be assessed in several ways, such as the proportion of cases with microscopic verification of diagnosis, a very useful index, because it may represent the incompleteness of data collection, and such as re-abstracting and re-coding a sample of cases to assess validity data.

**d) Opportunity:** It defines the trade-off between data timeliness and the extent to which the data are complete for reporting. Timeliness depends on the time during which the registry can collect, process, and report complete and accurate data. Methods such as a delay model estimate the undercount at the time of reporting, which gives an indication of the degree of completeness relative to other registries [19, 20].

### 2.3 Prevention and control

Accurate information on cancer burden is important in establishing priorities and targeting cancer-control activities. PBCR forms an essential part of rationale programs of cancer control. The annual number of incident cancer cases (new cases) provides an indication of the resources needed for primary treatment, and the number of prevalent cancer cases (new and old cases) describes how many individuals are in need of regular long-term follow-up [15]. Therefore, cancer-registry data can be utilized in a wide variety of areas of cancer control, ranging from etiological research through primary prevention, health-care planning, and patient care. Consequently, prevention, screening, and early detection entertain overlapping goals—either that of avoiding cancer altogether or treating it when the odds of success are at their highest. Thus, prevention can be primary when avoiding the effective contact of a carcinogenic agent with a susceptible target person. Prevention is secondary when stopping the disease from the beginning by the detection of a precursor lesion at an individual patient's check-up, or through population screening, while it is tertiary when it includes strategies to promote the early detection of second primary cancers, as well as follow-up and treatment-related complications in cancer survivors.

#### a. Primary prevention

Prevention is implemented in two ways—a) by the avoidance, interruption, or abatement of carcinogenic exposure, and b) by vaccination, such as that of hepatitis B virus (HBV) or papillomavirus (VPH) or by dietary chemoprevention (increasing vegetable intake). Hence, cancer registries can play an important role in monitoring and evaluating the effectiveness of primary prevention. For instance, trends in the incidence of cancer can be related to changes over time in exposure to cancer risk factors. Therefore, public-health initiatives
such as reducing smoking, curbing obesity, and improving cancer screening and vaccination rates could be furthered by targeting messages to the person at risk of cancer or those with susceptibility to cancer, based on cancer-registry information. Cancer-registry information can also be employed for monitoring occupational groups of individuals at risk for exposure to various carcinogens or even to promote health-care education that influences behavior or social influences or directly on patients [15, 21].

b. **Secondary prevention**. Prevention by screening or early detection involves the use of tests to detect cancer before the appearance of signs or symptoms. The value of early detection lies in the possibility of detecting cancer when it is still localized and more easily curable. Cancer registries can play an important role in the evaluation and monitoring of screening programs aimed at detecting preinvasive conditions; in some cases, the disease can be detected in a premalignant state, for instance, dysplasia of the cervix or stomach, and adenomas of the colon. Cancer-registry information has been used in routine data-based studies to examine trends in disease rate in relation to screening frequencies within a population and to compare disease rates between different populations with the coverage offered by their screening programs. The benefits of secondary prevention include the possibility of simpler and less expensive treatment, as well as less pain and disability [15, 22].

c. **Tertiary prevention**. Tertiary prevention includes the ongoing surveillance, care, and rehabilitation of patients with cancer, the early detection of second primary malignancies, and other treatment-related complications in cancer survivors. Tertiary prevention should reduce risk factors for second malignancies and for other long-term complications. Although more persons are living longer after an initial diagnosis of cancer, environmental and lifestyle risk factors, treatment modalities, and the underlying genetic basis of many cancers predispose survivors to develop second primary malignancies. Other complications that have recently become more evident are long-term adverse effects from chemotherapy that require assessment and early management, these effects include cardiotoxicity, neuropathy, ototoxicity, renal failure, and the development of osteoporosis in women with hormone-dependent malignancies. Cancer registries can play an important role in providing survival-analysis data that are useful in the evaluation of cancer care in the area covered by the registry, in that all cancer cases will be included regardless of the type of treatment they may have received. Time trends in survival are useful to assess the extent to which advances in treatment have exerted an effect on the population. Cancer survival is a key index of the overall effectiveness of health services in the management of patients. Differences in survival have prompted or guided cancer-control strategies [15, 23].

2.4 From the manual to the bioinformatics era

The approach of recording information on all cancer cases in defined communities dates from the first half of the twentieth century, and there has been a steady growth in the number of cancer registries. Prior to past decades, data from tumors and patients were collated via a manual process; consequently, this led to a limited variety, slow procedure, and low accuracy. In manual cancer registries, the incoming documents were checked against an index, this index generally with information recorded on cards
and arranged alphabetically by name. Each index card would contain the complete case information. With the beginning of computer technology and the increasing number of computerized data sources for cancer registries, the traditional operation changed, moving from paper to digital-data sources, and with the introduction of electronic medical records, it currently generates gigabytes of information per day [16, 18].

Perhaps the biggest change and the most relevant innovation in health-care data is related to information technology (IT), which is a multidisciplinary area that combines software bioengineering, electronics, and computer science. These technological advances can also improve cancer registration by integrating electronic medical records, linkage with data sources, digital monitoring, and new diagnostic technologies, which at present produce an unprecedented quantity and diversity of routine electronic data. Cancer-registry databases are often combined with other electronic health records, such as laboratory results, vital signs (imaging files, radiography), physician notes, etc., because patients may receive cancer care at multiple services within a clinic or hospital, both public or private, within a region or geographic area. Consequently, the amount of data collected and stored digitally is growing exponentially, and it is critical for the adoption of new IT is critical to attend to this large amount of data in order to acquire a more comprehensive and accurate picture of the cancer burden [24].

Particularly, the cancer-registration database should provide several functionalities, such as patients’ information, medical records, analyses, and reports. WHO launched CanReg software, an open-source tool developed by IARC especially designed to input, store, check, and analyze population-based cancer-registry data. CanReg software is updated with checks on consistency according to the international guidelines as follows—age-incidence-birth place; age-site-histology; site-histology; behavior-site; behavior-histology; and basis of diagnosis-histology. CanReg5 is available in the Chinese, English, French, Portuguese, Russian, and Spanish languages and can be downloaded free of charge from the International Association of Cancer Registries (IARC) [14].

Advancing data-processing technologies and bioinformatics are of paramount importance in understanding Big Data in cancer registration. Bioinformatics uses advanced mathematical algorithms and technological platforms to store and transform data into an interpretable format. Recently, there has been an increased usage of virtual repositories or “data clouds” to link and improve access; additionally, the cognitive computing of “artificial intelligence” and machine learning are gaining in popularity [25]. The use of new cutting-edge disciplines to generate and analyze data is a trend that has evolved between traditional medicine and precision medicine.

a. **Big Data:** Usually, this has been used to develop systems to organize and compile large-scale datasets that cannot be captured, managed, or processed by common software tools. Currently, Big Data is characterized by the 5V as follows—

1) **volume:** Big Data is large in size, containing many data records of multiple subjects; these include diagnostic work-ups such as clinical, radiological, and pathological and treatment data, and surgery, systematic therapy, radiotherapy, response, and complications;

2) **variety:** Big Data comprises an enormous variability in data types and include several given data types such as weight, laboratory results, etc. Many different data types enrich the quality, and usefulness and challenges regarding whether their heterogeneity warrants standardization;

3) **velocity:** Big Data possesses two velocity aspects—a) to create at an increasingly high speed, and b) to be computed relatively rapidly;
4) **veracity**: Incorrect data values or missing data undermine the ability to draw acute statistical conclusions on the distribution of values and the relationship between data elements, and **5) value**: Setting up a data infrastructure to collect and interpret data is only worthwhile if it enables the generation of data-derived conclusions or measurements based on accurate data that can truly lead to measurable improvements or impacts on cancer healthcare [26, 27]. However, the potential of Big Data remains to be discovered for cancer registration, especially in LMIC, because medical Big-Data mining continues to face challenges, mainly due to that in these countries the hospital electronic medical-records system is missing or is poor in openness, scalability, and budget.

b. **Data Mining**: This can search for potentially valuable knowledge from a large amount of data, mainly divided into data preparation, data mining, and the expression and analysis of results, processed with methods in terms of the structure, storage, design, management, and application of the database. The purpose of the emergence of data-mining technology is not to replace traditional statistical-analysis technology but is the extension of the statistical-analysis methodology. Data-mining methods can be divided into the following two categories that can be applied in cancer registration—descriptive and predictive. Descriptive patterns characterize the general nature of data, including association analysis and cluster analysis, while predictive patterns are summarized on current data, including classification and regression [27].

c. **Artificial Intelligence**: This paradigm represents a novel frontier and innovative tools for cancer control. Current epidemiological research in conjunction with cutting-edge informatics technologies produces data mining and artificial intelligence (AI). Artificial intelligence is conventionally defined as the ability of a computer system to perform acts of problem solving, reasoning, and learning, and, among all of the latter, independent learning is the most important ability, as it mitigates the need for human intervention to continually enhance the performance of the system for it to work more efficiently with increased reliability and timeliness [28, 29].

3. **Conclusion**

Given the diversity of cancers in different geographic areas, it is necessary to base cancer-control activities on customized cancer profiles obtained through cancer registration.

Global figures of the burden of cancer across the different geographic areas are made possible by cancer-registry data. The most efficient method for addressing the cancer challenge is by means of the development and implantation of a cancer-control plan whose core indicator is the cancer registry.

Cancer-registry statistical results could be used in different fields. These include etiological investigation, primary prevention (evaluation of cancer-control programs to avoid carcinogenic exposure and vaccination), secondary prevention (evaluation and monitoring of screening and early-detection programs), and tertiary prevention (evaluation of care and rehabilitation in cancer survivor patients, the impact of changes over time, and survival analysis), for the benefit of individuals as well as of society as a whole.
The technological revolution of recent years is an unprecedented event that has impacted the health-care field, and consequently, cancer registration.

Acknowledgements

The author wishes to express her gratitude to the Merida Population-Based Cancer Registry.

Conflict of interest

The author declares no potential conflict of interest.
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