PIP Digest

CCRA ACRC Canadian Cancer Research Alliance
Alliance canadienne pour la recherche sur le cancer

PIP PPP Patient Involvement in Cancer Research Program
Programme de Participation des Patients à la recherche sur le cancer

CANCER RESEARCH: Cancer Epidemiology 101

This PIP Digest provides an overview of cancer epidemiology and how this research advances our understanding of cancer risk and prevention.

Key concepts

- Epidemiological triad
- Types of epidemiological studies
- Pharmacoepidemiology

Related PIP Digests

- Research Studies: Assessing Evidence

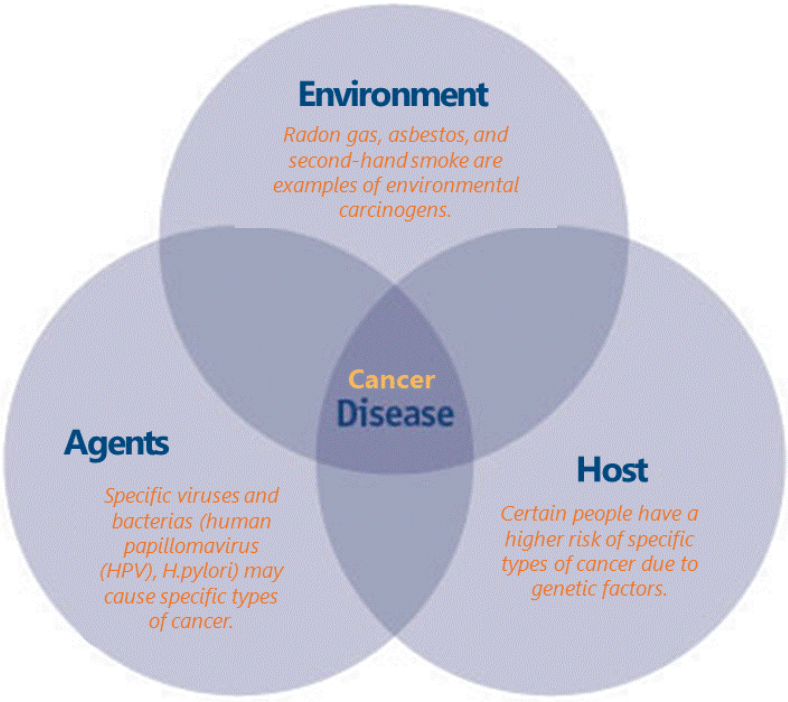
Epidemiology is the study of the patterns and causes and control of diseases, injury, and other health-related events and social problems in living beings—cancer epidemiology is a subset of this broader field. Cancer epidemiology identify events or risk factors that increase or decrease cancer incidence and ways that cancer can be prevented in groups of individuals. It is worth noting that many diseases in humans share similar risk factors.

Epidemiology is considered one of the cornerstones of public health in that the evidence generated by epidemiologists:

- identifies prospective areas that can be explored with further epidemiological studies or even by researchers from different scientific disciplines
- helps corral an evidence-base that can be used to inform the development of programmatic and policy interventions to prevent or reduce of health conditions, including cancer

The "epidemiological triad" is a convention commonly used to identify the key elements that are considered in epidemiological research. It consists of:

- "hosts," which are all the demographic and physical characteristics of the population or group being studied
- the "environment," which is defined in the broadest sense to include the physical, cultural, and psychosocial elements of the environment in which the hosts interact
- "agents," which are the risk or causative factors



Epidemiological triad of disease causation (cancer examples in orange)
Adapted from: *The Chief Public Health Officer's Report on the State of Public Health in Canada 2013.*

More recently, researchers have focused on how these factors – hosts, environment, and agents – may be different over a person's lifetime (known as life course epidemiology). For example, there may be very different consequences for a young child exposed to an environmental carcinogen than when the same person is exposed to that carcinogen at a later age.

Cancer epidemiological research's greatest claim to fame has been its studies showing the strong links between tobacco smoke and lung cancer. More recent efforts have focused on the role of diet and physical activity on cancer and how gene-environment interactions affect cancer incidence. Canadian researchers have played a pivotal role in this mounting global evidence-base.

Types of Data Used in Epidemiology

Epidemiologists use a variety of types of data in their research. They may use:

- clinical data (like data from one or more clinical trials)
- field data (like the climate data or other data about the natural environment as well as survey data such as the Canadian Community Health Survey, which collects information related to health status, how many people use the healthcare system, and factors that influence health status)

- registry data (like cancer registry data, which tracks new cancer cases and cancer deaths)
- health administrative data (like hospital discharge records and prescription drug utilization data)
- socioeconomic data (like census data, which tracks income changes and disparities among different groups living in Canada)

Epidemiologists may conduct experiments or undertake observational (non-experimental) research. A cohort study is one type of observational study which follows samples of the population over time. Some cohort studies, such as the National Survey of Health and Development in the UK and the Framingham Heart Study in the US have been running since the 1940s and have contributed immensely to our understanding of disease risk. Cohort studies require careful planning and resources to ensure that data can be collected, stored, and analyzed over many years.

The International HundredK+ Cohorts Consortium (IHCC) was recently established with the goal of creating a research platform of data for cohort studies from around the world. Assembling this "super-cohort" would leverage the global investment in cohort studies and provide a very rich data repository for further epidemiological research. (For more, see https://ihccglobal.org/.)

Pharmacoepidemiology is a specific branch of epidemiology (see sidebar) and has a great deal of relevance to cancer. For example, researchers in Canada have looked at how drugs prescribed for other health conditions may lower or increase the risk of cancer as well as how cancer-specific drugs may lead to other adverse health effects (like cardiotoxicity).

Spotlight on Pharmacoepidemiology

"Pharmacoepidemiology is the study of the utilization and effects of drugs in large numbers of people; it provides an estimate of the probability of beneficial effects of a drug in a population and the probability of adverse effects. It can be called a bridge science spanning both clinical pharmacology and epidemiology. Pharmacoepidemiology concentrates on clinical patient outcomes from therapeutics by using methods of clinical epidemiology and applying them to understanding the determinants of beneficial and adverse drug effects, effects of genetic variation on drug effect, duration-response relationships, clinical effects of drug-drug interactions, and the effects of medication non-adherence. Pharmacovigilance is a part of pharmacoepidemiology that involves continual monitoring, in a population, for unwanted effects and other safety concerns arising in drugs that are already on the market. Pharmacoepidemiology sometimes also involves the conduct and evaluation of programmatic efforts to improve medication use on a population basis."

From: https://www.hopkinsmedicine.org/gim/research/content/pharmacoepi.html

Key Initiatives

CanPath, Canadian Partnership for Tomorrow's Health (formerly known as The Canadian Partnership for Tomorrow Project (CPTP)) is Canada's largest population cohort study. It is designed to address key questions about what causes chronic disease and cancer. Over 330,000 Canadians aged 30-74 years have been recruited from its regional cohorts. For more information, see https://canpath.ca/.

CAREX Canada (CARcinogen Exposure) is a team of researchers and specialists with expertise in epidemiology, risk assessment, toxicology, geographic information systems, and knowledge mobilization. The purpose of CAREX Canada is to provide a body of knowledge about Canadians' exposures to known and suspected carcinogens, to support organizations in prioritizing exposures and in developing targeted exposure reduction policies and programs. For more, see https://www.carexcanada.ca/.

The **Continuous Update Project (CUP)** is an ongoing program that analyzes global research on how diet, nutrition and physical activity affect cancer risk as well as cancer survival. Data are continually refreshed and periodically synthesized in a series of reports. The data are used to inform numerous guidelines and policies regarding cancer prevention and survival. This project of the American Institute of Cancer Research was developed in collaboration with and is managed by the World Cancer Research Fund International. For more information, see https://www.aicr.org/research/the-continuous-update-project/.

The **Global Cancer Observatory** of the International Agency for Research on Cancer (IARC) provides a suite of data visualization tools to view estimates of the incidence, mortality, and prevalence of 36 specific cancer types and of all cancer sites combined in 185 countries/territories (including Canada) by sex and age group. For more, see https://gco.iarc.fr/today/home.

Check out these videos for more information about epidemiology.

- Medmastery. *Incidence and Prevalence - Everything you need to know.* (YouTube) July 29, 2016 [6:23 minutes] https://www.youtube.com/watch?v=cTp_ONVVrh8
- Risk Bites. *What is Epidemiology?* (YouTube) July 27, 2017 [7:20 minutes] https://www.youtube.com/watch?v=r9poHB-ldqk
- Let's Learn Public Health. *Epidemiological Studies - made easy!* (YouTube) May 5, 2017 [9:42 minutes] https://www.youtube.com/watch?v=Jd3gFT0-C4s

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