CHAPTER 8

ENVIRONMENTAL ISSUES AND CANCER

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ENVIRONMENTAL ISSUES AND CANCER

The prevailing model of carcinogenesis holds that cancer cells arise from the accumulation of many small alterations in the DNA of normal cells. These alterations, or mutations, can be inherited or newly created. When certain alterations are combined, a cell and its progeny can begin to grow in an abnormal, uncontrolled fashion that is the hallmark of cancer. Other inherited and environmental influences can come into play and while these are not mutations, they are no less critical in determining whether or not a cell and its progeny progress to cancer. Some factors appear to prevent cancer, while others promote it. Thus, a central concept in our understanding of cancer is that it does not arise from a single event, but results from many changes and influences on a cell.

The list of environmental factors that can influence the development of cancer is diverse, particularly when we consider the environment in its broadest sense. Potential cancer-causing agents are present in our diets, tobacco smoke, alcohol, home and workplace environments, outdoor air, water, soil, sunlight, certain infectious agents, and some medical therapies. Physiological factors, including hormones and exercise, can also influence the development of cancer. Our inherited factors are also diverse. They are responsible for individual differences in the structure and function of proteins that activate and deactivate chemical substances, repair DNA, control cell growth, and foster immunity. Inherited variations in these proteins are common in the population.

For a single individual, it is impossible to determine with confidence the multiple factors that promoted his or her cancer. However, population studies have revealed patterns and suggest specific factors that increase risk for groups of people. Based on various studies, it appears that environmental factors such as tobacco, diet, infections, occupational exposures, etc., are involved to some degree in 75% to 90% of cancers, both alone and in combination with inherited factors.[1,2] In the United States, it has been estimated that tobacco is a contributor in approximately 30% of cancers, dietary factors 35%, infections 10%, occupational exposures 8%, natural sources of ionizing radiation 2%, and chemical pollution 2%.[3,4,5] While the accuracy of these estimates remain a matter of significant debate, they do indicate a substantial target for prevention.

Since environmental physical and chemical factors are known to play a role in the development of some cancers, it may be possible to prevent some cancers by alter-

ing exposures to these factors. Exposures to harmful agents can be reduced, or even eliminated, by avoiding the creation and release of cancer-causing agents, removing them from one's surroundings, and by changing personal behaviors. It is helpful to know where exposures are greatest, and what behaviors and susceptibilities put people at greatest risk, in order for cancer prevention efforts to be most efficient. Some of the most powerful evidence for widespread environmental carcinogen exposure points to cigarette smoke. The extent to which voluntary and involuntary exposure to cigarette smoke can be controlled is a complex issue, and another chapter has been devoted to this subject. Also, emerging evidence suggests that there are environmental factors that are protective, including some dietary choices, physical activity, and other modifiable behaviors. Positive choices and the environmental conditions that encourage them are part of a comprehensive strategy to reduce environmental cancer risk.

The following discussion and recommendations focus primarily on environmental agents over which we have relatively limited personal control. Cancer prevention strategies for these agents need to be established at the national, state, and/or county level. Cancer prevention opportunities for factors that are more easily addressed on an individual basis, such as tobacco use, diet, physical exercise, and ultraviolet radiation, as well as policy changes are discussed in other chapters of this report.

Identifying the Link Between Cancer and Environmental Exposures

Current Approaches

While animal studies provide strong evidence that chemicals and radiation can cause cancer, identifying these agents as causative factors in human cancers is not a simple task. This is due in part to the many factors that interact to cause cancer, the time that must elapse between exposure to an environmental agent and the development of detectable cancer, lack of information regarding the extent of exposure, the lack of basic information regarding the cancer-causing potential of many agents, and the rare occurrence of some cancers. Many of the links between cancer and environmental exposures to date have been made through occupational studies for which at least some data were available on exposures to specific agents for defined worker populations. Community-based cancer surveillance is currently developing as a tool to identify environmental and occupational causes of cancer, however, it is one of the most difficult challenges in public health.

Community-based cancer surveillance studies

Cancer surveillance studies rely on the availability of good data, which can come from several sources. One of the best sources is the database maintained by the Maryland Cancer Registry. Other sources include Vital Records, occupational data collected by companies, unions, and insurance companies, and data from published studies around the world.

One difficulty in community-based cancer surveillance is that some types of cancers are very common, while others are quite rare. Given the large and complex picture of cancer occurrence in communities, accurate data on cancer cases are an irreplaceable asset. Thus, the Maryland Cancer Registry works closely with hospitals, doctors, health care provider systems, and state and local health departments to identify each and every cancer case that occurs in the state. It is a challenge to record the correct diagnosis, document where and when treatment has occurred, verify the vital status of the patients, and check the accuracy of the demographic and residential data reported by the patients. Despite these challenges, the Maryland Cancer Registry has received the gold standard from the National Association of Central Cancer Registries in 2001, 2002, and 2003 for data quality and completeness.

One of the most important types of data collected by the Maryland Cancer Registry which helps link cancers to environmental conditions are data about where people are living when they are diagnosed with cancer. In order to determine if there are unusual groupings of cancers in a geographic region or unexpected increases of cancers over time (both phenomena are suggestive of possible environmental factors) cancer registry data can be converted into cancer rates and mapped. As mapping technologies have become more advanced, especially through the development of special computer software called Geographic Information Systems (GIS), the identification of regions of concern has become easier. A challenge remains, however, in determining why cancer rates are sometimes markedly higher in one particular area or during one particular time period. Although this may likely reflect demographic rather than true environmental risk differences, such differences require explanation. The success in finding the causes of locally elevated cancer rates has been very limited across the country, in part due to the limitations in available investigative tools. Difficulties arise

because some people frequently move and experience a variety of environmental exposures over their lifetimes. The long time period between exposure and the appearance of disease makes linkages to specific exposures difficult. Also, personal factors like smoking and genetics influence individual risk. Recent trends in cancer incidence and mortality in Maryland, however, show that rates of lung cancer, bladder cancer, multiple myeloma, and certain other malignancies are much higher than expected in certain parts of the state. Such trends, which raise concerns regarding environmental and occupational factors, have also been observed in other areas of the country.

When cancer rate calculations and maps document patterns suggestive of environmental influences, a variety of methods and tools can come into play to explore the link between the disease and possible exposures to carcinogens. Investigators may first consult the scientific literature to determine whether there are any reported associations. The International Agency for Research on Cancer (IARC) (http://monographs.iarc.fr/monoeval/grlist.html) and the National Toxicology Program (NTP) (http://ntp-server.niehs.nih.gov/) are two agencies that have developed lists of known human carcinogens and probable human carcinogens based on their evaluation of the strength of available data for each chemical or physical agent. NTP has recently issued its 10th Report on Carcinogens (http://ehp.niehs.nih.gov/roc/) which lists over 45 agents or mixtures as known carcinogens based on their conclusion that there is sufficient evidence from studies in humans to indicate a firm relationship between exposure and human cancer. In addition, over 150 compounds or mixtures are listed as "reasonably anticipated to be human carcinogens." Examples of associations between environmental agents and specific human cancers derived from NTP's 10th Report on Carcinogens are listed in Table 8.1.

If published evidence of an association between the cancer of concern and specific environmental chemical exposures is found, local and state health agencies and community groups in partnership can search for records of the use of these chemicals in the area, including historical practices, or a history of local use of these substances. If records exist, the investigating team may assess the levels of exposure and the risks posed by those exposures. Exposure assessment is a key step, because the presence of a hazard does not necessarily mean that exposures have occurred. One additional approach that can be taken is to link cancer incidence maps with environmental data. The same GIS tools that produce the cancer maps can overlay environmental hazard and exposure data with cancer incidence data to determine whether the patterns converge (suggesting possible links between cancers and exposures to carcinogens in a region) or diverge (suggesting that other factors may be responsible for the cancer occurrences in the region). Although maps may raise the possibility of an environmental association, it is again important to assess the true extent of exposure. However, resources to collect environmental data and conduct these assessments are often limited, and local and state expertise may not be sufficient to deal with the problems. Assistance from public and private universities may be critical in deciding how to investigate suspected environmentally caused cancer outbreaks when and if they merit detailed investigation.

Cancer cluster evaluations

Most requests for cancer cluster investigations from members of the public or even physicians require only cursory study since they are generally not real clusters (i.e. rates are not above expected) but are the product of enhanced local surveillance due to interactions that occur between cancer victims and their families or friends. There is often a sincere belief that something must be causing a perceived cluster, which leads to a demand for environmental testing. Yet most investigations under these circumstances yield little information. The Centers for Disease Control and Prevention (CDC), recognizing that environmental studies of this type seldom yield useful results, has issued guidance to the states that limit excursions in this line of research. The CDC recommends that reported cancer clusters should be approached with caution and the numbers checked before attempts are made to find causes for the occurrences. Even confirmed differences in cancer rates in a given geographic area or time period may still be due to chance. Local health departments do not always have the resources to provide good answers to communities that believe they have unusually high rates of cancer. Data must be made available and analyzed rapidly so that community members understand the true picture early in any investigation. As a general rule, the public more readily accepts the conclusions of experts they view as independent. In particular, the input from experts in academic centers can alleviate concerns and prevent needless expenditures for environmental testing, or conversely, ensure that studies are done when they are appropriate and may lead to helpful findings.

Availability of Databases

As noted earlier, Maryland is fortunate to have a high-quality cancer registry capable of locating and charac-

Table 8.1
Examples of Associations Between Environmental Agents and Cancer

Cancer Site	Agent/Substance/Mixture
Bladder	Tobacco smoke; benzidine and dyes metabolized to benzidine; arsenic; coal tar pitches
Leukemia	Benzene; butadiene; ethylene oxide
Liver and intrahepatic bile duct	Alcoholic beverage consumption; vinyl chloride; thorium dioxide; aflatoxins; arsenic
Lung and bronchus	Tobacco smoke; mustard gas; asbestos, radon; wood dust; coal tar pitches
Lymphoma (non-Hodgkins)	Ultraviolet radiation, broad spectrum; 2,3,7,8-TCDD; 1,3-butadiene
Multiple myeloma	Benzene; vinyl chloride; 2,3,7,8-TCDD

Source: Report on Carcinogens, 10th Edition; U.S. Department of Health and Human Services, Public Health Service, National Toxicology Program, December 2002.

terizing cancer incidence in the state. Access to the Maryland Cancer Registry data is open to qualified investigators and safeguards are in place to protect the privacy of the patients in the database. The registry has been expanding its capability to conduct fine-scale geographic studies, and residential data are now being routinely coded in such a way as to give investigators access to fine-scale geographic information, providing considerable savings in time and effort. This is, then, one of the best starting places for cancer surveillance data.

Data about the occurrence of environmental carcinogens are much less centralized than cancer incidence information and the utility of the data is variable. Datasets about environmental conditions are produced for various purposes by local, state, and national agencies and other institutions. A preliminary look at these datasets reveals that some are detailed and easily obtainable while others have notable gaps and are difficult to obtain. It is not uncommon to find that data collected for one purpose, such as monitoring permits or grading the progress of government programs, lack the type of information necessary to assess cancer risk. In these cases, the data could be used to generate hypotheses that may in turn guide future data collection efforts.

Some of the limitations that exist in currently available databases are summarized below to illustrate the types of efforts that need to be supported to enhance our ability to address environmental and occupational factors in Maryland's cancer incidence. This list is not intended to be comprehensive.

Occupational exposure datasets

Statewide data regarding cancer in occupational groups in the state are limited. The Maryland Cancer Registry collects data about the current occupation of a person diagnosed with cancer, but in some instances the data are not informative (for example, persons may report their occupation as "none" or "retired"), and in other instances the occupation of a deceased person may have been reported inaccurately by the next-of-kin. Documenting occupational histories usually proves difficult and data from the past are needed, given the latency between exposure and the onset of cancer.

Exposure data for chemical carcinogens in the workplace are also difficult to obtain. Employers are required to have lists of all hazardous substances used on the premises and workers usually receive training in how to safely handle these substances. Although the Maryland Department of the Environment (MDE) maintains a

centrally organized repository for these lists that can be used to track changes in these materials over time for a particular facility, this information does not lend itself to calculations of worker exposure levels.

Non-occupational exposures

There are numerous sources of data that address environmental conditions in the state with particular reference to chemical and radiation exposures. The following examples of public data sources are listed because they contain geographic information in grid (exact location) format, which is an ideal data representation for modeling and statistical analysis over regions, allowing investigators to put together the potential hazard maps with population density and with changes in the regions over time. This is not a comprehensive list, but it provides examples of the types of databases that are helpful for investigations of environmental factors in cancer development and includes a discussion of their limitations.

- Land use data are available from the Maryland Department of Planning from 1990 onward. These data consist of aerial surveys (also called remote sensing), which depict the type of cover and activities that exist across the landscape, from housing to orchards, forests, crops, and industrial facilities. This dataset is limited by a lack of data prior to 1990 and needs to be continually updated to reflect changes in land use over time.
- The Environmental Protection Agency's (EPA) Toxics Release Inventory provides data about regulated releases of toxic chemicals into the air, surface water, and soil from 1987 onward. These data are reported by companies as the total pounds of each chemical released per year. While valuable, this data set is limited by the fact that reporting is limited to facilities that meet certain criteria (e.g., the release of certain types of chemical compounds and chemical classes, the type of industry, the number of employees, and the quantity of compounds used). Also, the amounts of released material reported may be estimated rather than measured, and certain chemicals are lumped into larger chemical classes. Exposure modeling is difficult since the amounts released are only reported as yearly totals.
- Some data sources providing information about the quality of drinking water, surface water, and ground water in Maryland are as follows:
  - The United States Geological Society (USGS) and the Maryland Geological Society (MGS) datasets identify and characterize surface waters and aquifers (underground sources of water) in Maryland and show their locations in specific regions. Most, but not all, well water in the state comes from these deep aquifers. Chemical data for a limited number of chemicals such as pesticides are also available. Although helpful, there are challenges to the use of these data because they are organized by drainage basin and other criteria, not by routinely used census or other political boundaries. Also, since chemical concentrations in groundwater can vary due to seasonal use of the chemicals and changes in groundwater flow due to rainfall in the region, the limited chemical sampling may misrepresent actual human exposures.
  - Historical records of public drinking water data exist for nitrates, volatile organic compounds, pesticides, and certain heavy metals. Two systems, the Washington Suburban Sanitary Commission and Baltimore City, supply 80% of Maryland residences with drinking water from municipal water systems and these facilities maintain extensive water quality databases. Additional data from groundwater contamination sites near public water system raw water sources can be obtained from MDE source water assessment plans that are currently being prepared. These plans are scheduled for completion in FY 2003. These data address only the organic and inorganic chemicals mandated by the EPA for routine testing of public water systems.
  - For private wells, it is difficult to obtain water quality data because current regulations only require testing at the time of well construction and the data are not compiled. The geographic information is often limited. Private wells serve the homes of approximately 16% of Maryland residents.
  - The Maryland Department of the Environment maintains discharge monitoring data from permitted industrial and municipal facilities around the state. Data regarding specific toxic and conventional pollutants discharged to surface waters can be retrieved on a facility and watershed basis.
- Maryland's Department of the Environment operates monitors for certain air pollutants. Air monitoring stations are limited in number and generally designed for statewide or regional esti-

mates and compliance with EPA air pollution control targets. Additional monitoring stations are needed to generate air quality data for airborne carcinogens for areas of the state not currently covered by existing stations.

- Maryland's Department of the Environment and the EPA regulate the generation and disposal of hazardous materials. Hazardous waste sites are evaluated for their potential to release toxic chemicals into the surrounding soil, air, underground water, and surface waterways. Information about possible routes of human exposure, compounds present at the site, and dates of operation are available from the EPA CERCLIS database and the Department of the Environment. Specific chemical sampling data for individual sites are difficult to access, however, and nearby land use often changes over time.

Infectious Agents

With knowledge of the nature of carcinogenesis and the importance of cell injury and repair comes a growing understanding of why some infectious agents play an important role in cancer causation. With ongoing cell damage caused by chronic viral infections and repeated repair, the opportunity for DNA "mistakes" grows. The immune status of an individual may also be altered by exposure to biological agents. Research and education on the role of biological agents in cancer causation could lead to better cancer controls through the development of interventions such as vaccines and antibiotics and changes in personal behavior.

Several infectious agents have already been linked to cancer. The Epstein-Barr virus has been implicated in some forms of lymphatic cancer. The human papillomavirus (HPV) has been linked to cervical cancer and more recently to cancer of the head and neck. HPV has also been postulated as a risk factor for prostate cancer. Hepatitis B and C have been linked to primary liver cancer. Stomach cancer is strongly associated with another infectious agent, *Helicobacter pylori,* which is also associated with gastrointestinal problems. HIV, the virus that causes AIDS, has also been linked to Kaposi's sarcoma and cervical cancer.

For each of these agents, strategies to address them should be linked to, and recognized as, part of cancer control efforts. When no strategy has been identified, research should continue with at least equal enthusiasm as has been applied to chemical agents. Possible public health strategies include vaccine delivery to high-risk groups, screening, infection control efforts and, when appropriate, treatment. Databases exist for viral hepatitis as a reportable disease but other cancer-causing infections are not routinely tracked.

Cancer Disparities

The cancer disparities chapter (chapter three of this report) describes several examples of persisting differences in cancer rates between different socioeconomic and ethnic groups and sexes. These differences can be difficult to explain, but it is important to consider the potential role of factors that influence exposure to environmental carcinogens. Proximity to pollution sources, occupations, awareness and attitudes regarding risks, cultural norms, and individual practices regarding diet and other personal behaviors are examples of factors that have the potential to affect environmental exposures. Social injustices prevent some individuals from achieving quality education, housing, and employment, as well as adequate access to health insurance and health care. Circumstances such as these make it difficult for communities and individuals alike to develop preventive health behaviors, utilize cancer screening, and respond to health issues. At the other end of the spectrum, genetic susceptibility to cancer is an emerging area of research that may eventually help identify different levels of risk for individuals and groups within a population.

Environmental Cancer Prevention Programs

Many agencies and institutions within the state conduct activities that promote cancer prevention. These include research, education, and regulatory activities aimed at limiting exposures to known carcinogens. Many existing programs are designed to address lifestyle issues such as diet and exercise. Others promote cancer screening, the reduced use of tobacco products, the proper handling of hazardous materials such as pesticides, safe fish consumption, and stricter regulation of industrial discharges to waterways and air. Although most of these programs are generally considered to be effective, there has been little follow-up to accurately determine their impact. Assessing the effectiveness of these programs designed to prevent direct exposures to carcinogens would make it possible to judge whether they should be continued and/or how they can be improved.

In the early 1990s, in response to public concern, increased attention was given to identifying the exposure of specific populations to known environmental carcinogens, such as radon gas. In addition to sampling to document exposures and risk assessments to characterize the risk, public education programs were developed to inform people of appropriate actions that they could take to limit their exposures to contaminants. Town meetings, fact sheets, and news media were useful tools for communicating with the public. However, identifying and communicating directly with specific "stakeholders" in the community about the development of solutions to specific problems was a key factor in the success of these programs. This approach is an integral part of cancer prevention efforts.

Conclusion

The following goals and objectives are by no means an exhaustive list, but represent areas in which the Environmental Issues and Cancer Committee felt significant progress could be made in cancer control efforts at this time. Recent advancements in our knowledge of the role of environmental factors in cancer causation and promotion provide a foundation for moving ahead in the development of databases and tools needed to better identify linkages between cancer incidence and chronic infections and/or exposures to chemical and physical carcinogens in Maryland. As our understanding of the relative importance of specific environmental factors in cancer incidence grows, we can more effectively develop strategies to reduce exposures to the most important factors through source control and avoidance behaviors. Cancer control goals can best be achieved through the development of collaborative teams that include citizens, researchers from academic institutions, and public health professionals from our county and state governments.

Healthy People 2010 Objectives

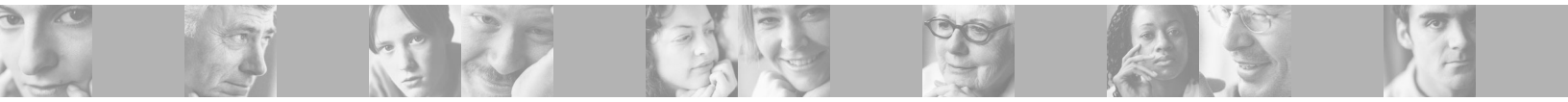
The following are Healthy People 2010 objectives[6] related to environmental health:

Objective:
Reduce exposure of the population to pesticides, heavy metals, and other toxic chemicals, as measured by blood and urine concentrations of the substances or their metabolites.

The U.S. baseline: Developmental

Objective:
Improve the quality, utility, awareness, and use of existing information systems for environmental health.

The U.S. baseline: Developmental



Environmental Issues and Cancer Goals, Objectives, and Strategies

Goal:

Improve prevention of environmentally related cancers through:

- better evaluation of existing cancer prevention programs.
- increased knowledge of environmental and occupational carcinogen exposures among scientists, health agencies, and the public.
- increased efforts to reduce exposures to environmental carcinogens.
- increased surveillance of occupational cancers.
- improved links between academic research institutions and state and local health departments.
- increased efforts to control infections known to increase cancer risk.
- increased efforts, including community involvement, toward programs designed to identify and address factors contributing to cancer disparities.

Targets for Change

By 2008, improve the quality, utility, and use of databases for environmental carcinogens that will enhance exposure assessment.

By 2008, improve the capacity to measure bioindicators, measure the levels of compounds in the environment, and use other means to estimate environmental exposures at the population level.

By 2008, strengthen the practice of dual appointments or establish other formal cooperative relationships between academic institutions and state and local public health agencies.

By 2008, improve the capacity to identify and prevent occupationally related cancer.

Objective 1:
Improve cancer prevention program evaluation.

Strategies:

1. Create a primary prevention committee within the State Council on Cancer Control to ensure that environmental as well as lifestyle issues receive appropriate attention.
2. Support efforts to measure the effectiveness of primary prevention programs and policies, including their impact on toxic exposures and cancer.

Objective 2:
Improve data collection and carcinogen exposure assessment.

Strategies:

1. Explore ways to improve regulatory data collection efforts for cancer hazard assessment and tracking.
2. Support the development of an environmental health tracking system in Maryland.
3. Improve the accessibility and utility of environmental-monitoring data by computerizing databases and geo-coding data.
4. Enhance the capacity of state public health and other laboratories to test for the presence of environmental agents and related biomarkers in urine, blood, and other tissue samples.
5. Explore approaches for the expanded monitoring of commercial and noncommercial pesticide use.
6. Expand the capacity of the state to monitor ambient air toxics.
7. Support the development of a strategy for comprehensive, private well water testing and monitoring.

Objective 3:
Improve information regarding occupational risk factors for cancer.

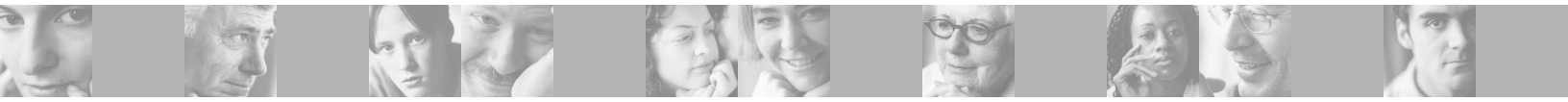
Strategies:

1. Explore opportunities for matching employee databases (from specific industries, trade organizations, etc.) with the state's cancer database in order to better characterize the role of occupation in cancer.
2. Establish an interdisciplinary task force to develop recommendations for occupational cancer investigations in Maryland.

Objective 4:
Enhance collaboration between academic research institutions and state and local public health departments.

Strategies:

1. Develop a formal and adequately funded linkage between academic and government resources to bring their respective teaching, research, and practice agendas in sync with one another. Explore models to make this happen in both the short and long term.
2. Develop a contingency plan for responding to citizen concerns regarding possible cancer clusters that cannot be appropriately handled via routine risk communication and statistical analysis; this plan should include specific contact individuals at local universities.
3. Promote the training of physicians and environmental scientists in occupational and environmental cancer research at Maryland's universities and institutions.
4. Promote the sharing of expertise between the research and practice communities through joint programs such as a "Grand Rounds in Environmental Health" series.



Objective 5:
Improve recognition and screening for cancers associated with infectious agents.

Strategies:

1. Encourage screening for human papilloma viruses (HPV) and support efforts to develop a vaccine for HPV.
2. Promote immunization for the Hepatitis B virus.
3. Support stronger efforts to control blood-borne infections.
4. Consider a recommendation that encourages physicians to test for and treat *Helicobacter pylori* infection in accordance with the American College of Gastroenterology practice guidelines.
5. Promote implementation of guidelines from the National Institutes of Health (NIH) and CDC for the control of Hepatitis C.

Objective 6:
Reduce the differences in cancer rates attributable to socioeconomic status or racial status.

Strategies:

1. Develop a comprehensive public participation plan as a component of the state's cancer control initiative.
2. Create community environmental health characterizations or profiles that may be used to support decision making, priority setting, and the focusing of limited resources in order to best limit exposures and increase accessibility to better preventive health care.
3. Undertake comparative research to better understand and explain different cancer rates between groups.
4. Support community health centers and technical assistance in local communities in order to increase cancer screening and awareness of environmental health issues.
5. Make health care services more culturally acceptable and appropriate.
6. Enhance community planning and zoning processes to reduce health risks by reducing exposures.
7. Continue efforts to document differences in cancer rates among different regions and populations.

Resources

Readers who want more detailed information on the issues presented in this chapter are directed to the websites listed below.

National Toxicology Program Report on Carcinogens

http://ehp.niehs.nih.gov/roc

International Agency for Research on Cancer

http://monographs.iarc.fr/monoeval/grlist.html

American Cancer Society

Environmental & Occupational Cancer Risks
http://www.cancer.org/docroot/PED/ped_1_1.asp?siteArea=WHO

Centers for Disease Control and Prevention

Investigating Clusters of Health Events
http://www.cdc.gov/nccdphp/drh/sata_hlevent.htm

Centers for Disease Control and Prevention

Cancer Cluster Frequently Asked Questions
http://www.cdc.gov/nceh/clusters/faq.htm

Maryland Department of Health & Mental Hygiene

A Message About Cancer Clusters
http://www.cha.state.md.us/oeh/pdf/cancer_clusters.pdf

National Institute of Occupational Safety and Health

Occupational Cancers
http://www.cdc.gov/niosh/occancer.html

National Academy of Sciences

Carcinogens and Anticarcinogens in the Human Diet
http://www.nap.edu/readingroom/books/diet/index.html

U.S. Environmental Protection Agency

National-Scale Air Toxics Assessment for 1996
http://www.epa.gov/ttn/atw/sab/sabrev.html

Current Drinking Water Standards and MCLs
http://www.epa.gov/safewater/mcl.html

Agency for Toxic Substances and Disease Registry (ATSDR)

Homepage and link to ToxFAQs
http://www.atsdr.cdc.gov/

National Library of Medicine

Hazardous substances data bank and other resources in TOXNET
http://toxnet.nlm.nih.gov/

Environmental/chemical databases:

Agricultural pesticide use
http://water.usgs.gov/pubs/

Hydrography data
http://nhd.usgs.gov

Brownfields areas in Maryland
http://www.mde.state.md.us/programs/landprograms/errp_brownfields/index.asp

Air pollution data
http://www.epa.gov/air/data/index.html

Air pollution maps
http://www.epa.gov/air/data/repsst.html?st~MD~Maryland

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