Protocol for Handling Cancer Cluster Investigations

South Carolina Central Cancer Registry
Department of Health and Environmental Control
August 1, 2000

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Revisions 2/02, 2/03

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INTRODUCTION

History and Development of the Cancer Cluster Investigation Protocol

The investigation of cancer cluster concerns is the responsibility of the South Carolina Central Cancer Registry (SCCCR) within the Department of Health and Environmental Control (DHEC). Initially, cancer cluster investigations were conducted by the Bureau of Preventive Health Services under the Division of Health Hazard Evaluation of DHEC. In 1990, the Division of Cancer Prevention and Control was established within the Center for Health Promotion of DHEC. Four years later, in September, 1994, a Cancer Cluster Investigation and Awareness Program (CCIAP) was established. Responsibility for cancer cluster investigations was transferred to the CCIAP. A cancer cluster advisory team, composed of members of various divisions within DHEC was developed to aid in the transition.

The advisory team agreed that the activities of the CCIAP include responding to individual cancer concerns and increasing public awareness of the various risk factors, symptoms, and prevalence rates of different types of cancer primarily through individual and community education. This education was aimed at target groups such as physicians, school districts, health departments, hospitals, and specific communities. The goal of the program was to increase the public=s knowledge regarding various cancers and provide individuals with a realistic view of their own risk.

CCIAP achieved these goals and activities through several methods. A Cancer Cluster Hotline was created which the public utilized to make inquiries or voice their concerns about cancer. Each caller was asked certain details pertaining to their concern and a brochure was developed entitled ACancer in Your Community@ (Appendix A) which briefly explains the causes of cancer, the nature of a cancer cluster, and the manner in which cancer clusters are investigated in South Carolina. This brochure was mailed to every individual who called the Hotline along with several ACancer Inquiry Report Forms. These forms elicited more detailed information including demographic information, the type of cancer, date of diagnosis, and hospital where diagnosed.

The CCIAP was a very strong, productive program serving communities throughout South Carolina. However, with staffing changes and the loss of graduate assistants to the program, the CCIAP was slowly reduced to an answering machine on which concerned citizens could leave their information and wait for a response.

The SCCCR, under the Office of Public Health Statistics and Information Systems of DHEC, was established in 1993; however, implementation of full operations did not occur until January 1, 1996. The SCCCR was a vital component of the CCIAP, receiving information on all cluster concerns in the event that further statistical analyses were required. The SCCCR is a population-based registry, which collects data on all cancer cases diagnosed on or after January 1, 1996. The availability of data, the growing number of staff, and the previous experience with cancer cluster investigations made the SCCCR a prime choice for the continued investigation of cancer clusters.

While the SCCCR continued to grow, so did its relationships with other areas. The SCCCR has worked closely with the Divsion of Chronic Disease Epidemiology (CDED) in DHEC. In order to ease the burden of cancer cluster calls on the SCCCR, and also to provide a single point of contact concerning cancer clusters, all calls initially reporting a cancer cluster concern were transferred to the CDED. Dr. Tim Aldrich, chief of Chronic Diseae Epidemiology, fielded the calls, gathering pertinent information and assessing whether further action needed to be taken. With the departure of Dr. Aldrich from DHEC, the mechanism for cancer cluster response was again restructured. In March 2000, all cancer cluster operations were shifted to the SCCCR to be handled by the SCCCR staff. A protocol for handling cancer cluster concerns was finished in August 2000. Currently, cancer cluster concerns are immediately directed to the SCCCR and handled accordingly. (See page 9)

Goals and Objectives of Cancer Cluster Investigations

Goals:

1) To respond to individual and community concerns about geographic clusters of cancer cases in a timely and productive manner.

2) To study trends in cancer disease that occur in South Carolina area over time.

Objectives:

1) Collect, analyze, and manage statistics on all new cancer cases in South Carolina; monitor changes in diagnosis, treatment and survival rates and provide reports to appropriate South Carolina constituents through the South Carolina Central Cancer Registry.

2) Maintain an active point of contact for cluster concerns, conduct investigations in coordination with DHEC environmental staff, make communities aware of findings of cluster investigations, and provide information about cancer risks in the environment and preventive measure.

BASIC INFORMATION ABOUT CANCER

What is a Cancer Cluster?

A cancer cluster is the occurrence of a greater than expected number of cases of cancer within a small area **(spatial cluster)** or within a short period of time **(temporal cluster)**. A **true cancer cluster** exists when the number of cases that occur is more than would be expected to occur by chance. This is most often true for rarer cancers, like brain or bladder cancers. Cancer clusters are usually reported when individuals learn that friends, family, neighbors, or co-workers have been diagnosed with cancer. Because cancer is so common, it is important to determine whether these cancers are really the occurrence of more cases than are expected.

Cancer cluster reports may help health professionals in determining specific causes of cancer or identifying risks of cancer in the environment. Nearly all state health departments have a specific mechanism for investigating cancer cluster reports. Responding to a cancer cluster concern requires not only an understanding of cancer epidemiology but also an appreciation for the public=s concern.

Evaluating clusters in communities has not been particularly productive in identifying causal environmental agents. Causal associations have been drawn from cluster studies in the occupational sector where exposures to toxins were higher and exposure periods longer than what would normally occur in communities. Some examples include lung cancer and mesothelioma among asbestos workers, aplastic anemia and leukemia among benzene workers, and angiosarcoma of the liver among vinyl chloride workers. Although most of the human data have arisen from studies in the occupational sector, some causal agents have also been identified through the health surveillance of populations exposed to a certain chemical by means of either water, soil, or air. However, because of the increasing incidence of cancer, the possibility of identifying such a casual agent is rather slim.

Considering the unlikely probability of identifying a causal environmental agent, why do we investigate cancer clusters? The relative lack of positive findings would argue against undertaking these studies at all (Marino). Public health agencies are required to respond for the

following reasons: (1) to educate the public about risk factors that may contribute to the occurrence of cancer (2) to help the public become informed about and focus on the environmental problems in their communities which may underlie their concern about cancer (3) to further substantiate our understanding of the etiologies of cancer.

Categories of Cancer Clusters

Cancer cluster reports may be divided into three broad categories:

1) suspected clusters
2) real clusters
3) meaningful clusters

SUSPECTED CLUSTERS - It is natural to be afraid of cancer. For many years, cancer has been regarded as America=s greatest public health concern. When an individual is diagnosed with cancer, neighbors and family reach out to provide comfort and support. Through this Anetworking@ of persons and families touched by cancer, sometimes people learn of many other cases of cancer in their community. This apparent clustering of cancers is often reported to health authorities or to the media. However, closer inspection usually reveals that these clusters involve several different types of cancer among persons of different ages, genders, and occupations. These cancer cases often have little in common and are not really clusters at all. They appear to be clusters partly because cancer is such a common disease.

REAL CLUSTERS - Cancer is quite common in the United States, striking one of three people at some point throughout their lifetime. When several cancers occur within a limited area in a brief time period, this may represent a real cluster. However, this may not be the result of an increased risk of cancer in a particular community. Cancer rates, similar to rates of other diseases, are subject to simple, periodic variations and chance fluctuations. A perspective is necessary in order to see this type of variation and to identify it as such. This is one of the reasons that cancer registries are so helpful, because they can study cancer trends over a period of years.

MEANINGFUL CLUSTERS - These are the type of cluster reports which are most important to public health. They are the ones that represent a group of people at unusually high risk of cancer. The high risk is due to some factor that the cases have in common or some exposure they have experienced that has increased their risk of developing cancer. A study of these clusters is sometimes necessary for the prevention of further cancers and to help researchers understand more about specific risks for cancer. The cluster report may be valid and the cancer risk for the area and time period involved may be increased. WHY the cancer risk is elevated in this particular population requires extensive research and substantial time and effort.

Investigators of cancer cluster reports over many years have indicated that SUSPECTED clusters comprise nearly 80% of all the cluster reports received. REAL clusters comprise 15% of the reports and less than 5% of all cluster reports are MEANINGFUL. Hypotheses generated from the rare MEANINGFUL clusters sometimes lead to epidemiological studies. When specific risk factors are determined, measures for protecting the public and actions for removing hazards from contact with society may be implemented. Nearly all states have developed a protocol for receiving and evaluating cancer cluster concerns. This manual will address the specific protocol followed in South Carolina as well as the procedures utilized in several other states.

SCCCR Protocol for Handling Cancer Cluster Investigations

Advancements in the collection of statewide cancer data by the SCCCR have made the investigation of cancer clusters a more timely and accurate process. With demographic information on each cancer case, the SCCCR can look to see how many cancer cases occurred within a county or zip code. This actual count of incident cancer cases is very beneficial for cancer cluster investigations because its eliminates the need for the previously used ACancer Inquiry Report Forms," thus making the evaluation of cancer cluster concerns much more efficient.

Cancer clusters are investigated and evaluated using a specified step-wise process. Each step provides opportunities for collecting data and making crucial decisions. The SCCCR follows the protocol established by the Centers for Disease Control (CDC) in responding to possible cancer cluster concerns[1]. The CDC advocates a systematic four-stage approach. The boundaries between the stages are not fixed and many sub-steps exist within each stage. Each reported cluster possibility must be viewed as a unique situation, with considerable local judgment and discretion required.

STAGE 1: The process begins when the SCCCR receives a cancer-related concern through either a personal letter, email, phone call, referral, or internal surveillance. This initial report may simply be a request for information, in which case the desired materials are sent and the process is completed. A second possibility entails a personal concern in which the individual should be referred to their family physician or a specialist. In these situations, the initial contact permits satisfactory closure.

The most common report involves a concern of excessive cancer cases within a particular neighborhood, community, or occupational setting. This type of report requires a precise protocol in order to meet the needs of the concerned citizens or work site employees most efficiently. The SCCCR institutes the following steps in responding to the concerns of excess cancer.

A. Obtain initial information about the caller and the specific concern. Ask detailed

questions to obtain information regarding suspected health events, suspected exposures, number of cases, geographic area of concern, and time period of concern. In some instances, anonymity may be requested. In these situations, one should advise the caller that the inability to follow up might hinder further investigation.

B. Discuss initial impressions with the caller. At this point, many cluster concerns can be resolved simply through educating the caller about cancer. Discuss the following points:

- Different types of cancer speak against a common origin.
- Cancer is a common illness (men have a one in two lifetime risk, women a one in three lifetime risk), with risk increasing with age, and with cases among older persons less likely to be true clusters.
- Length of residency must be substantial to implicate an environmental carcinogen because of long latency periods required for most carcinogens.

C. Assure the caller that he/she will receive a written response (usually the written response confirms what has been communicated by phone).

D. Upon completion of the initial contact, determine whether further evaluation is needed (i.e. single and rare disease entity, plausible exposure or clustering). If further evaluation needed, proceed to Stage 2. If closure permitted, prepare a summary report for the caller.

STAGE 2: This stage aims to determine whether an excess has actually occurred and whether the excess can be linked etiologically to some exposure. This stage of the protocol is shown in detail on the "Flow Diagram for DHEC Internal Response to Community Cancer Concerns" developed by the SCCCR and DHEC (Appendix B).

A. The initial step is to conduct case validation and assessment. The SCCCR developed a SAS program which determines the number of cases/deaths observed and expected within the geographic area and time period of interest. Statistical analyses (i.e. observed/expected ratios and Chi-square tests) are performed by cancer site. Expected numbers are calculated using 2000 census population data and the most recent age-specific incidence or mortality rates for South Carolina. Prior to the use of state rates, age-specific rates from the National Cancer Institute=s Surveillance, Epidemiology, and End Results (SEER) program were used. Therefore,

1. Determine the cases/deaths that have occurred in the area of question by

reviewing cancer registry data and mortality data. Determine the numbers of observed cases/deaths for that area.

2. Calculate observed/expected ratios for each cancer type (Appendix C).

3. Calculate Chi-square statistics for each cancer type (Appendix C).

Results from these statistical tests reveal whether an unusual pattern of cancer exists within the area of concern. If there is no evidence of an unusual pattern, then the results of the study are relayed to the contact person or community either by written report or oral presentation. If the findings are acceptable to the contact or community, then the investigation is closed. However, if the contact or community does not accept the findings, then the SCCCR consults with the appropriate internal/external groups in order to plan further educational meetings within the community.

When evidence of an unusual pattern of cancer exists, then the SCCCR must proceed with activities to determine if a cancer cluster truly exists. The SCCCR begins with a scientific literature review on the specific cancer type. Cancer cases are verified through review of medical records and/or sometimes through interaction with members of the community. Many times the initial caller may make reference to certain industries. In this situation, additional information on environmental risk factors is obtained from the Environmental Quality Control and Health Hazard Evaluation sections of DHEC. Often these activities are interrelated and occur in parallel. The most important activity is to continuously evaluate the communities perceptions and needs throughout the entire cluster investigation process.

If evidence of a cancer cluster exists, then this information is brought before the DHEC Cancer Cluster Advisory Committee. The committee determines how to proceed with Stage 3 of the cancer cluster protocol.

STAGE 3: This stage involves conducting a major feasibility study in order to examine the potential for relating the cluster to a certain exposure. All of the options for geographic and temporal analysis should be considered to determine if the investigation can realistically be accomplished. If the cluster is potentially occupationally related, then the National Institute of Occupational Safety and Health (NIOSH) should be referred the investigation. Non-occupationally related studies may either be contracted out or studied internally within DHEC. The following steps should be considered when instituting a DHEC internal study:

A. Consider the appropriate study design, with attendant costs and expected outcomes of alternatives. Establish the hypothesis to be tested.

B. Determine the nature, extent, and frequency of and the methods used for environmental measurements.

C. Delineate the logistics of data collection and processing.

D. Assess the current social and political ambiance, given consideration to the impact of decisions and outcomes.

E. Assess the resource implications and requirements of both the study and possible alternative findings.

F. If the feasibility study suggests that little will be gained from an etiologic investigation, summarize the results of the process thus far in a written report and submit to the original caller and all concerned parties.

STAGE 4: The purpose of this stage is to perform a thorough investigation to determine if there truly exists a disease-exposure relationship. The primary purpose of the study is to pursue all of the epidemiologic and public health issues that the cluster generated. Thus, this stage consists of a standard epidemiological study, for which all of the preceding effort has been preparatory.

A. Develop the protocol according to the intended design and implementation decided upon in the feasibility study.

B. Keep in mind at all times that every cluster investigation is unique - do not make any assumptions.

C. Implement the study precisely as intended. If alterations to the plan become necessary along the way, ensure that all involved parties are aware of the changes.

D. Determine whether a cluster exists in time or space, or both.

E. Disseminate the outcome of the investigation to all concerned and involved parties.

Because of the diverse and complicated nature of clusters, there is no omnibus test for assessing them. Investigators are advised to perform several related tests and to report the results that are most consistent with validated assumptions.

Telephone Protocol for Handling Cancer Cluster Concerns

LEVEL 1: INFORMATION AND EDUCATION

A. Information about reporter.

1. Name - AIs this information for yourself or are you calling for someone else?@
2. Address
3. Telephone Number
4. Specific problem and suspected causes.
5. Any additional background information - AAre you a diagnosed patient?@; ADoes cancer run in your family?@; A How long have you lived at the same address?@

B. Specific cancer information.

1. Tumor site and histologic type
2. Locality
3. Date of diagnosis
4. Date of death (s) for those in the same community who have died
5. Suspected environmental/occupational, etc. cause
6. Name, address, and phone number of diagnosing and treating physician (s)

C. Education

1. Cancer is not one disease but many
2. Cancer is quite common (approximately one out of three people will develop some form of cancer in their lifetime.)
3. Latency period of 10-30 years necessary
4. Most cancers are linked to lifestyle rather than environmental causes
5. Different carcinogens cause different cancers. Few know carcinogens cause cancer at more than 2 sites-most cause cancer only at a single site
6. Most Atrue@ clusters are due to chance alone, not an environmental cause
7. Absence of clusters in more heavily exposed occupational populations is reassuring
8. Known causes of specific cancer types is reassuring.

LEVEL II: PRELIMINARY INVESTIGATION

A. Criteria

1. Level I completed
2. Reporter still believes a problem exists

ADo you know of other similar cases in your area of concern? Do you know of others with similar exposures? Would your community like a member of the Cancer Cluster Investigation and Awareness Program to come to your neighborhood and deliver an educational presentation regarding different aspects of cancer?@

B. Summarize call

"Let me review what we have discussed thus far to confirm that I have a clear understanding of your cancer concern. This is what I see as your concern.....Here is what I plan to do.....I will be sending you a written response letter along with educational brochures. Please feel free to share any of the information with members of your family and community. In the meantime, I must do some further research into your particular concern. We will review the available information on cancer occurrence in your area. From the results we will prepare a recommendation for further action warranted due to our findings. Can you tell me the best time to reach you if I need further information? If you have any further questions or concerns, please do not hesitate to contact us at 1-800-817-4774. Thank you again for your call.@

C. Organize information

1. Log the date and time of the call
2. Mail the response letter and brochures to the caller.

COMMUNITY EDUCATION AND AWARENESS

What Exactly is Cancer?

Over the past few years, with accumulating environmental problems and changing lifestyles, cancer has become an increasing health problem. Cancer presently ranks second after heart disease as a leading cause of death in the United States, accounting for approximately 25% of the total number of deaths each year. The American Cancer Society estimates that approximately 556,500 Americans will die in 2003 of various types of cancers[2].

PROCESS OF CANCER DEVELOPMENT

Cancers are populations of cells that have acquired the ability to multiply and spread throughout the body without the usual biologic restraints. ACancer@ is a term used to refer to over one hundred diseases rather than one specific disease. There are at least as many different cancers as there are tissues of the body, and each cancer has its own unique features. Still, the basic processes that produce these diverse tumors appear to be quite similar.

Normal Cells - Human life results from the process of individual cell growth and reproduction. The approximately 30 trillion cells of the normal, healthy human body exist interdependently, regulating one another. This process continues repeatedly, almost without error, guided by the DNA in each cell=s genes. Each gene carries specific genetic information, which controls the synthesis of specific proteins and transmits genetic inheritance. New cells, thus, arise only from preexisting cells by cell division. Normal cell structures and functions operate in an orderly manner directed by the genetic code contained in the DNA, with Aregulatory genes@ switching on and off as needed to control normal cell activities. This continuous collaboration among cells ensures that each tissue maintains a size and architecture appropriate to the body=s needs.

Cancer Cells - Cancer cells violate this orderly scheme and Aignore@ the usual

controls on proliferation and follow their own internal agenda for reproduction. They also possess the ability to migrate from the site where they began and invade nearby tissues, forming masses at distant sites in the body. Tumors composed of such malignant cells become increasingly aggressive over time and become deadly when they disrupt the tissues and organs needed for the survival. A cell becomes cancerous, or malignant, when normal gene control over cell reproduction is lost. Several factors may contribute to this loss and change a normal cell into a cancer cell.

A) MUTATIONS: Changes in a cell=s genes, which means an alteration in the DNA, can be caused by the loss of one or more of the regulatory genes in the cell nucleus or damage to a specific gene controlling a specific function.

B) CHEMICAL CARCINOGENS: These are cancer causing agents which interfere with the structure or function of regulatory genes. Exposure to such agents may be by individual choice, as in cigarette smoking, or by general exposure to environmental contaminants such as pesticides. Actions of such substances may result in gene mutation, damage to gene regulation, or activation of a dormant virus.

C) RADIATION: Radiation damage to genes may result from exposure to X-rays, radioactive materials, atomic exhausts or wastes, or sunlight.

D) VIRUSES: Oncogenic, tumor inducing, viruses that interfere with function of regulatory genes have been identified in animals and are the focus of much current research. A virus is little more than a group of several genes, usually fewer than five, whereas cells of complex organisms, such as humans, possess thousands. Disease viruses act as parasites, taking over the cell machinery to reproduce themselves.

E) EPIDEMIOLOGICAL FACTORS: Studies of cancer distribution involve factors such as race, region, age, heredity, occupation, and diet. Racial incidence changes as population groups migrate to new environments with distinct contaminants, diets, and lifestyles. They may then acquire the cancer characteristics of the new population.

F) STRESS FACTORS: Stress is an increasing disease factor in our complex society. Studies of individuals under stress have shown measured reduction of immune response to disease, especially in response to Anatural killer cells@ of the immune system. Such stressful states make an individual more vulnerable to other cancer producing factors

through their influence on the integrity of the immune system, food behaviors, and nutritional status.

Stages of Tumor Development:

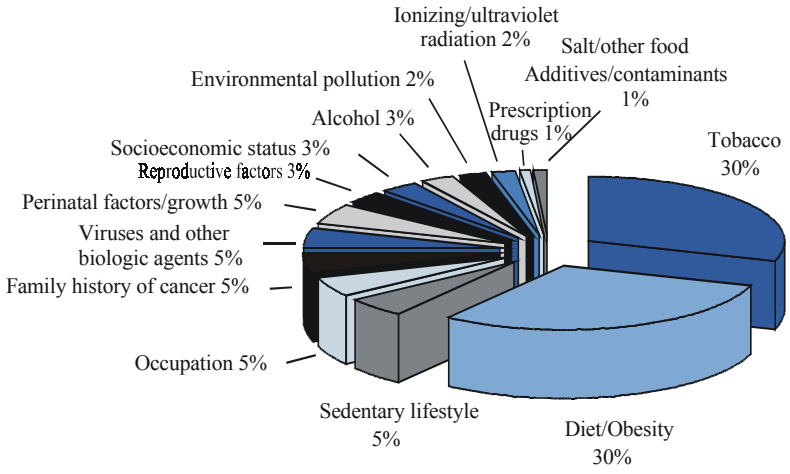
1) *Genetically Altered Cell* - Tumor development begins when some cell within a normal population sustains a genetic mutation that increases its propensity to proliferate when it would normally rest.
2) *Hyperplasia* - The altered cell and its descendants continue to look normal, but they reproduce too much. After years, one in a million of these cells suffers another mutation that further loosens controls on cell growth.
3) *Dysplasia* - In addition to proliferating excessively, the offspring of this cell appear abnormal in shape and in orientation. Once again, after a time, a rare mutation that alters the cell behavior occurs.
4) *In Situ Cancer* - The affected cells become still more abnormal in growth and appearance but have not yet broken through any boundaries between tissues. This tumor may remain contained indefinitely while some may eventually acquire additional mutations.
5) *Invasive Cancer* - If the genetic changes allow the tumor to begin invading underlying tissue and to shed cells into the blood or lymph, the mass is considered to have become malignant. The renegade cells are likely to establish new tumors throughout the body, which may become lethal by disrupting a vital organ.

MAJOR CAUSES OF CANCER

The causal factors that may lead to the development of cancer may act together or in sequence to initiate or promote carcinogenesis. A substantial latency period exists between the time of exposure or mutation and the detection of the cancer. Each type of cancer is unique, differing in respect to its specific cause and the time between exposure to one or more cancer causing agents and the development of cancer. Usually, at least ten

years must pass before signs or symptoms of cancer actually surface. As indicated by the pie chart below, the majority of cancers are preventable as they are caused by voluntary, controllable behaviors, specifically dietary habits and tobacco use.

Figure 1. Causes of Cancer in the United States



Source: Cancer Causes & Control, Harvard Report on Cancer Prevention, 1996

DIETARY HABITS: Many dietary factors can affect cancer risk: types of foods, food preparation methods, portion sizes, food variety, and overall caloric balance. Cancer risk can be reduced by an overall dietary pattern that includes a high proportion of plant foods (fruits, vegetables, grains, and beans), limited amounts of meat and other high fat foods, and a balance of caloric intake and physical activity. The American Cancer Society=s Nutritional Guidelines are covered in detail later.

TOBACCO USE: According to the American Cancer Society, smoking currently accounts for at least 30% of all cancer deaths. Lung cancer mortality rates are about 22 times higher for current male smokers and 12 times higher for current female smokers compared to lifelong never-smokers. In addition to being responsible for 87% of lung cancers, smoking is also associated with cancers of the mouth, nasal cavities, pharynx, larynx, esophagus, stomach, pancreas, liver, uterine cervix, kidney, bladder, and myeloid leukemia[1].

ENVIRONMENTAL FACTORS: Factors such as sunlight, industrial products, and air or water pollution may also contribute to the development of certain cancers. The next section explains in more detail these environmental cancer risks.

Environmental Cancer Risks

Environmental causes of cancer can arise in both community and workplace settings. The degree of cancer hazard posed by these risks depends on the concentration or intensity of the carcinogen and the exposure dose a person received. In situations where high levels of carcinogens are present and where exposures are extensive, significant hazards may exist, but where concentrations are low and exposures limited, hazards are often negligible. However, when low-dose exposures are widespread, they can represent significant public health hazards (for example, second hand tobacco smoke). Strong regulatory control and constant attention to safe occupational practices are required to minimize the workplace potential for exposure to high dose carcinogens.

RISK ASSESSMENT

Risks are assessed to protect people against unsafe exposures and to set appropriate environmental standards. The process of risk assessment has two steps. The first step identifies the chemical or physical nature of a hazard and its cancer producing potential, both in clinical and epidemiologic studies and in laboratory tests using animal or cell systems. Special attention is given to any evidence suggesting that cancer risk increases with increased exposure. The second step measures levels of hazard in the environment (air, water, food, etc.) and the extent to which people are actually exposed. Knowledge of how the body absorbs chemicals or is exposed to radiation is essential for such dose measurements.

Chemicals

Various chemicals, such as benzene, asbestos, vinyl chloride, arsenic, and aflotoxin, show definite evidence of human carcinogenicity[3]. Several others are probable human carcinogens based on evidence from animal experiments. Examples of such substances

include anabolic steroids, formaldehyde, and tetracholoethylene[3]. Often in the past, direct evidence of human carcinogenicity has come from studies of workplace conditions involving sustained, high-dose exposures. Occasionally, risks are greatly increased when particular exposures occur together, such as asbestos exposure and cigarette smoking.

Radiation

Only high frequency radiation, ionizing radiation, and ultraviolet radiation have been proven to cause human cancer. Exposure to sunlight, UV radiation, causes almost all cases of basal and squamous cell skin cancer and is a major cause of skin melanoma.

Evidence that high dose ionizing radiation, such as X-rays, causing cancer comes from studies of atomic bomb survivors, patients receiving radiotherapy, and certain occupational groups (for example, uranium miners). Virtually any part of the body can be affected by ionizing radiation, but especially bone marrow and the thyroid gland. Diagnostic medical and dental X-rays are set at the lowest dose levels possible to minimize risk without losing image quality. Radon exposures in homes can increase lung cancer risk, especially in cigarette smokers.

Unproven Risks

Public concern about environmental cancer risks often focuses on risks for which no carcinogenicity has been proven or on situations where known carcinogen exposures are at such low levels that risks are negligible. The following are examples.

PESTICIDES - Many kinds of pesticides are widely used in producing and marketing our food supply. Although high doses of some of these chemicals cause cancer in experimental animals, the very low concentrations found in some foods are generally well within established safety levels. Environmental pollution by slowly degraded pesticides, such as DDT, can lead to food chain bioaccumulation and to persistent residues in body fat. Such residues have been suggested as a possible risk factor for breast cancer. Studies have shown that concentrations in tissue are low, however, and the evidence has not been conclusive.

Continued research regarding pesticide use is essential for maximum food safety, improved food production through alternative pest control methods, and reduced pollution of the environment. In the meantime, pesticides play a valuable role in sustaining our food

supply. When properly controlled, the minimal risks they pose are greatly overshadowed by the health benefits of a diverse diet rich in foods from plant sources.

NON-IONIZING RADIATION - Electromagnetic radiation at frequencies below ionizing and ultraviolet levels has not been shown to cause cancer. While some epidemiologic studies suggest associations with cancer, others do not, and experimental studies have not yielded reproducible evidence of carcinogenic mechanisms. Low-frequency radiation includes radio waves, microwaves, and radar, as well as power frequency radiation arising from the electric and magnetic fields associated with electric currents.

TOXIC WASTES - Toxic wastes in dump sites can threaten human health through air, water, and soil pollution. Although many toxic chemicals contained in such wastes can be carcinogenic at high doses, most community exposures appear to involve very low or negligible dose levels.

NUCLEAR POWER PLANTS - Ionizing radiation emissions from nuclear facilities are closely controlled and involve negligible levels of exposure for communities near such plants. Although reports about cancer case clusters in such communities have raised public concern, studies show that clusters do not occur more often near nuclear plants than they do by chance elsewhere in the population.

Leading Cancer Sites

Although cancer can develop in almost any tissue or organ in the human body, certain areas seem to be more frequently affected. According to the 2003 Cancer Facts and Figures, the leading cancer sites at present are the breast, prostate, lung, and colon/rectum. Because of the high incidence and prevalence of these four types of cancer, special attention should be paid to the specific causes and risk factors associated with each.

Breast Cancer

Breast cancer rates in the United States are among the highest in the world. Approximately one of every eight women in the United States will develop breast cancer in her lifetime. The American Cancer Society estimates that 211,300 new cases of invasive breast cancer will occur among women in the United States during 2003. Breast cancer incidence rates have continued to increase since 1980, although rates of increase have slowed in recent years. Married women, women in northern states, women living in urban areas versus rural areas, and women of higher socioeconomic status have the highest rates[2].

The earliest sign of breast cancer is an abnormality that shows up on a mammogram before it can be felt by the woman or her health care provider. When breast cancer is not detected early through screening, physical symptoms will develop. These physical manifestations of cancer include breast changes such as a lump, thickening, swelling, dimpling, skin irritation, distortion, retraction, scaliness, pain, tenderness of the nipple, or nipple discharge. Breast pain in very commonly due to benign conditions and is uncommonly the first symptom of breast cancer.

RISK FACTORS: Breast cancer risk increases with age, and risk is higher in women who have a personal or family history of breast cancer or atypical hyperplasia. Also, women experiencing an early menarch/late menopause, who never had children or had their first child after age 30, who consume two or more alcoholic drinks a day, and/or who eat a diet high in fat have an increased risk of breast cancer.

Additional risk factors which may be associated with increased breast cancer risk and that are currently under study include pesticide and other chemical exposures, alcohol consumption, induced abortion, and physical inactivity[2].

Lung Cancer

An estimated 171,900 new cases of lung cancer is estimated for year 2003 by the American Cancer Society. These cases would account for 13% of all cancer diagnoses. Approximately 28% of all cancer deaths occurring each year are lung cancer deaths. Cigarette smoking is by far the most important cause in the development of lung cancer. Those who do not smoke but are exposed to passive smoke from others= cigarettes are also at an increased risk of developing this disease. Persistent cough, sputum streaked with blood, chest pain, and recurring pneumonia or bronchitis are all common signs and symptoms of lung cancer[2].

RISK FACTORS: Cigarette smoking, especially a long history of smoking, increases one=s risk of developing lung cancer. Occupational and environmental factors may also play a role for those who are regularly exposed to certain chemicals. Industrial substances such as arsenic, nickel, chromium compounds, asbestos, radioactive ores, and uranium have been linked to the development of lung cancer. The risk associated with these substances is increased even more when the individual is also a smoker. Air pollution and tuberculosis are additional risk factors associated with lung cancer[2].

Prostate Cancer

An estimated 220,900 new cases of prostate cancer and 28,900 prostate cancer deaths are expected to occur in U.S. men in 2003. Prostate cancer is the second leading cause of cancer death in men. Between 1989 and 1992, prostate cancer incidence rates increased dramatically due to increased use of screening tests. However, incidence rates are now declining. Signs and symptoms of prostate cancer include weak or interrupted urine flow, inability to urinate, the need to urinate frequently (especially at night), blood in the urine, pain or burning upon urination, or continuing pain in the lower back, pelvis, or upper thighs[2].

RISK FACTORS: The incidence of prostate cancer increases with age. More than 70% of all prostate cancers are diagnosed in men over age 65. Genetic and environmental factors seem to play a significant role in the development of prostate cancer. African Americans possess the highest prostate cancer incidence rates in the world, and the disease is common in North America and Northwestern Europe. However, it is rare in the Near East, Africa, and South America. There may be some familial associations but these are unclear as of yet. International studies suggest that dietary fat may also be a factor[2].

Colon and Rectum

An estimated 147,500 cases are expected for 2003, including 105,500 cases of colon cancer and 42,000 cases of rectal cancer. Colorectal cancer is responsible for approximately 10% of all cancer deaths, contributing to an estimated 57,100 deaths in 2000. Incidence rates have declined in recent years due to increased screening and polyp removal. Signs and symptoms of colorectal cancer include rectal bleeding, blood in the stool, or a change in bowel habits[2].

RISK FACTORS: A personal or family history of colorectal cancer or polyps, and inflammatory bowel disease have been associated with increased colorectal cancer risk. This type of cancer occurs more frequently among persons 40 years of age and older. A history of ulcerative colitis (ulcers of the colon) increases an individual=s risk of developing colon cancer. Other possible risk factors include physical inactivity, high-fat and/or low-fiber diet, as well as inadequate intake of fruits and vegetables. More specifically, obesity increases the risk of colon cancer. Recent studies have suggested that estrogen replacement therapy and nonsteroidal antiinflammatory drugs, such as aspirin, may reduce colorectal cancer risk[2].

Cancer Prevention

There are several steps we can take toward preventing the development of various cancers. Since researchers now believe that the majority of cancers are related to lifestyle and the environment, individuals can help reduce their personal risk by taking control of certain variables in their daily lives. Dietary and smoking behaviors are of utmost concern and should be the primary targets of successful prevention.

DIET

The following guidelines can help reduce cancer risk through proper nutrition.

A. Reduce total fat intake to less than 30% of total calories per day.
   - reduce saturated fat to less than 10%
   - limit intake of red meats
   - choose low-fat/skim dairy products
   - bake, broil, or boil food instead of frying

B. Eat at least 5 servings of fruits and vegetables per day.
   - especially emphasize cruciferous vegetables, such as broccoli, cauliflower, and cabbage
   - emphasize fruits and vegetables high in vitamins A and C, such as carrots, peaches, apricots, grapefruits, oranges, and strawberries.

C. Increase fiber intake to 20-35 grams per day.
   - foods from plant sources, such as whole grain breads, cereals, rice, fruits, vegetables, and potatoes.

D. Limit alcohol intake.
   - reduce consumption to 2 drinks per day for men and 1 per day for women: this is equivalent to 12 oz. of beer, 3 oz. of wine, or 11/2 oz. liquor.
   - alcohol consumption AND smoking together greatly increases one=s risk of cancers of the mouth, larynx, throat, and esophagus.

E. Limit consumption of salt-cured and smoked foods.

- reduce intake of bacon, smoked, and pickled meats

LIFESTYLE

The following lifestyle behaviors should be followed in addition to adhering to a healthy diet.

A. STOP cigarette smoking.

- THIS IS THE MOST IMPORTANT LIFESTYLE CHANGE ONE CAN MAKE!!!!!

Smoking is the biggest cancer risk factor today accounting for at least 30% of all cancer deaths. There are many different methods available to aid in quitting smoking, including the nicotine patch, nicotine gum, and various 12 step programs and support groups. The American Cancer Society has a list of all the existing strategies - call today!

B. Respect the sun=s rays.

- Whenever outside, individuals should protect themselves with sunscreen. This can be accomplished in a variety of ways. Wearing a sunscreen with at least 15 SPF is essential, as well as wearing long sleeves and a hat, especially during the midday hours of 10am to 3pm. DO NOT use indoor sun lamps or go to tanning beds. If there is a change in a mole or a sore that does not heal, one should see a physician immediately.

C. Maintain a healthy weight.

- Obesity is linked to various cancers. Exercise and lower calorie intake can help avoid gaining weight. Each individual should check first with a physician before beginning any new exercise regimen or special diet.

In addition to following these dietary and lifestyle guidelines, individuals should receive regular cancer related checkups. This exam should include health counseling and depending on a person=s age might include examinations for cancers of the thyroid, oral cavity, skin, lymph nodes, testes, and ovaries as well as for some non-malignant diseases. Special tests for certain cancer sites are recommended as outlined below.

Breast Cancer Checkup Guidelines

* breast self exam monthly
* breast clinical physical examination for women aged 20-40 every 3 years; over 40, every year
* mammography for women aged 40 and over, every year

Colorectal Cancer Checkup Guidelines

Beginning at age 50, both men and women should follow one of the exam schedules below:

* yearly fecal occult blood test (FOBT)
* flexible sigmoidoscopy (FSIG) every five years
* annual FOBT and FSIG every five years (combined testing preferred)
* double contrast barium enema every five years
* colonoscopy every 10 years

Individuals should begin colorectal cancer screening earlier and/or undergo screening more often if they have any of the following colorectal risk factors:

1) personal history of colorectal cancer or adenomatous polyps
2) a strong family history of colorectal cancer or polyps (cancer or polyps in a first degree relative younger than 60 or in two first degree relatives of any age)
3) personal history of chronic inflammatory bowel disease
4) families with hereditary colorectal cancer syndromes (familial adenomatous polyposis and hereditary non-polyposis colon cancer)

Cervical Cancer Checkup Guidelines

* Pap test and pelvic exam for women who are or have been sexually active or have reached age 18, every year. After 3 or more consecutive satisfactory normal annual exams, the Pap test may be performed less frequently at the discretion of the physician.

Endometrial Cancer Checkup Guidelines

* Endometrial biopsy for women at menopause and for women at high risk (history of infertility, obesity, failure to ovulate, abnormal uterine bleeding, or unopposed estrogen (estrogen alone) or tamoxifen therapy). Frequency of endometrial tissue sample is at the discretion of the physician.

Oral Cancer Checkup Guidelines

* Oral exam for men and women yearly.

Prostate Cancer Checkup Guidelines

* Both Prostate-Specific Antigen (PSA) and Digital Rectal Examination (DRE) should be offered annually, beginning at age 50, to men who have at least a 10-year life expectancy, and to younger men who are at high risk. Information should be provided to patients regarding potential risks and benefits of intervention.
* Men who choose to undergo screening should begin at age 50. However, men in high risk groups, such as those with a strong familial predisposition (ex. 2 or more affected first degree relatives) or African Americans should begin at 45.
* Screening for prostate cancer in asymptomatic men can detect tumors at a more favorable stage (anatomic extent of disease). There has been a reduction in mortality from prostate cancer, but it has not been established that this is a direct result of screening.
* An abnormal Prostate-Specific Antigen (PSA) test result has been defined as a value of above 4.0 ng/ml. Some elevations in PSA may be due to benign conditions of the prostate.
* The Digital Rectal Examination (DRE) of the prostate should be performed by health care workers skilled in recognizing subtle prostate abnormalities, including those of symmetry and consistency, as well as the more classic findings of marked induration or nodules. DRE is less effective in detecting

prostate carcinoma compared with PSA.

Skin Cancer Checkup Guidelines

* Skin exam for men and women over 20, every 3 years; for men and women over 40, every year.

In addition to these recommendations, the following 1996 guidelines on diet and nutrition developed by the American Cancer Society should be adhered to in order to decrease one=s risk of developing various cancers.

POINTS OF CONTACT

CANCER CLUSTER HOTLINE: 1-800-817-4774

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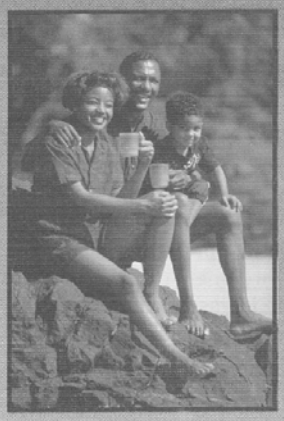
Appendix A.

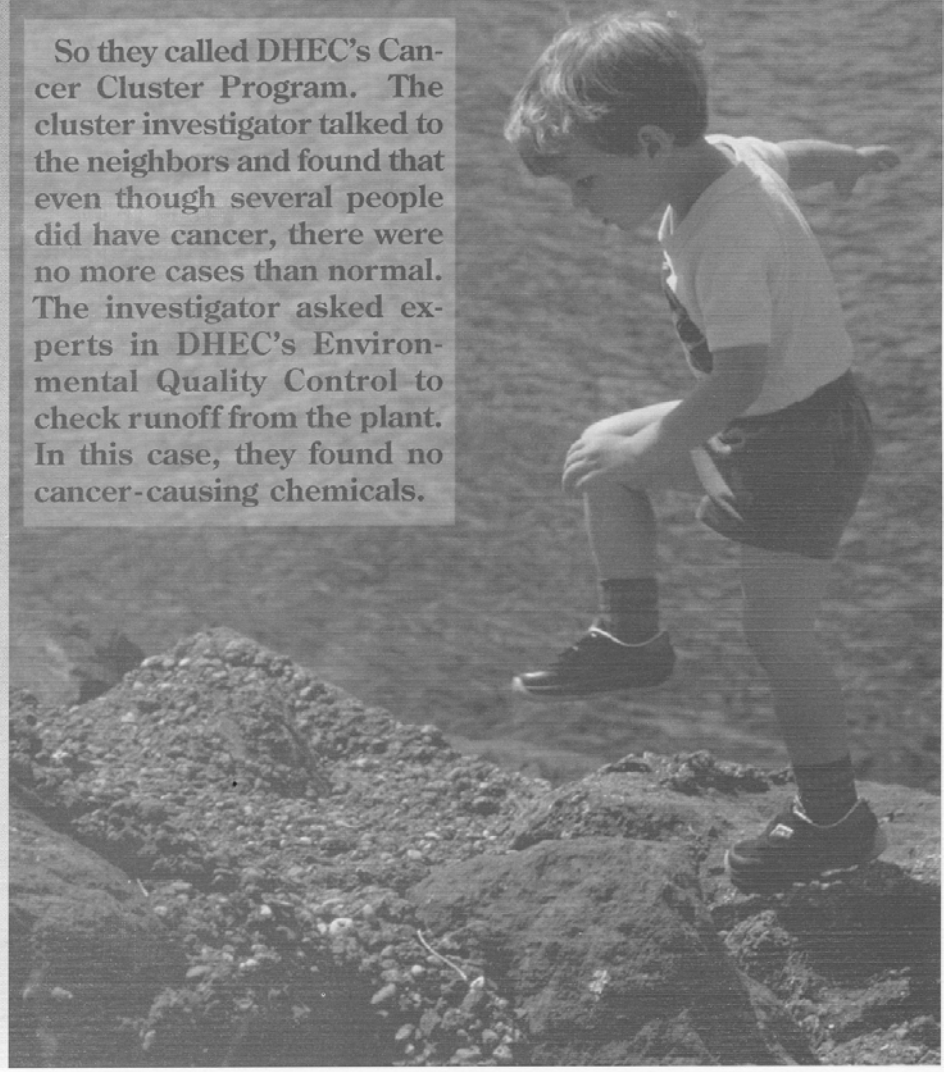
Cancer in Your Community

Why are there so many cases of cancer in my neighborhood?

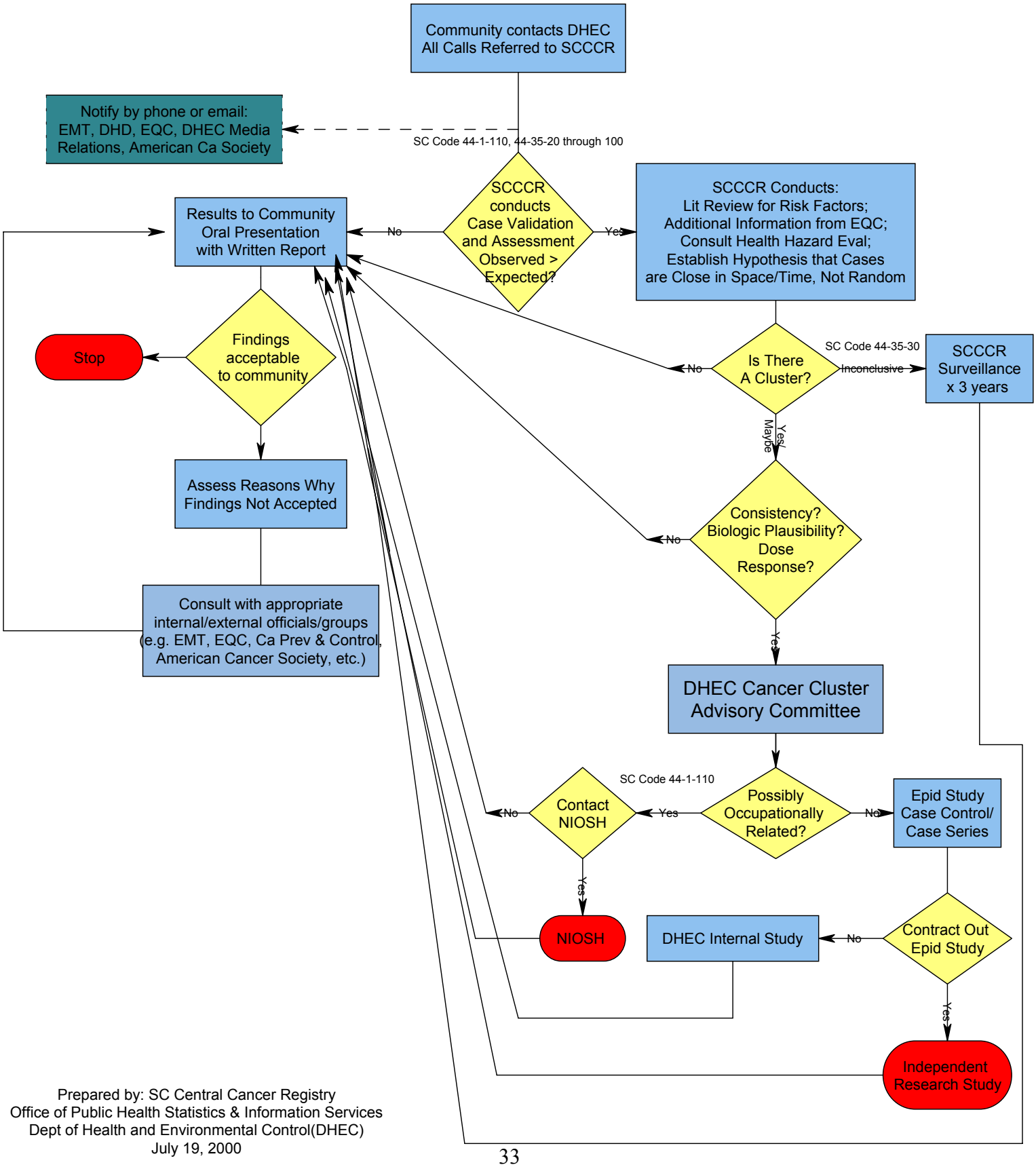


Many people in South Carolina have asked this question. For example, people in the upstate were worried about the number of cancers among their neighbors. They suspected that chemicals from a nearby plant were to blame.

So they called DHEC's Cancer Cluster Program. The cluster investigator talked to the neighbors and found that even though several people did have cancer, there were no more cases than normal. The investigator asked experts in DHEC's Environmental Quality Control to check runoff from the plant. In this case, they found no cancer-causing chemicals.



Appendix B
Flow Diagram for DHEC Internal Response to Community Cancer Concerns



Prepared by: SC Central Cancer Registry
Office of Public Health Statistics & Information Services
Dept of Health and Environmental Control(DHEC)
July 19, 2000

Appendix C.

Table 1. Analysis of New Cancer Cases in Zip Code 29169, 1996-2000

Site	Observed No. of Cases	Expected No. of Cases	Observed/Expected	Chi-SquareTest*
Lung/Bronchus	**137**	**98.6**	**1.39**	**14.94**
Breast (Female)	105	93.2	1.13	1.50
Colon/Rectum	91	82.0	1.11	1.00
Prostate	65	93.1	0.70	8.48
Non-Hodgkin's Lymphoma	24	21.0	1.14	0.43
Kidney/Renal Pelvis	22	15.0	1.47	3.31
Melanoma	20	18.8	1.06	0.07
Pancreas	20	16.6	1.21	0.71
Bladder	18	28.0	0.64	3.59
Uterus	14	15.7	0.89	0.19
Oral/Pharynx	13	16.7	0.78	0.81
Leukemia	11	13.2	0.84	0.35
Stomach	9	11.7	0.77	0.62
Larynx	8	6.9	1.16	0.17
Ovary	7	10.8	0.65	1.32
Brain/CNS	7	7.4	0.95	0.02
Thyroid	7	5.3	1.32	0.53
Esophagus	5	8.1	0.62	1.19
Cervix	5	7.6	0.66	0.87
Multiple Myeloma	4	7.8	0.51	1.86
All Sites	648	634.7	1.02	0.28

Excludes in situ cases of cancer to allow for comparison.
Cancer sites with less than 5 cases of cancer expected are not analyzed due to the unreliability of statistical tests based on small numbers.
*The Chi-Square statistical test allows us to determine if the difference between what is observed and what is expected is significant. If the value is greater than 3.84, then we are 95% confident that the observed number of cases is significantly different from the expected number of cases.
Prepared by: SC Central Cancer Registry, Office of Public Health Statistics and Information Services, Department of Health and Environmental Control, 2600 Bull St., Columbia, SC 29201
February 7, 2003 lcs