

Running head: THYROID CANCER IN LAS VEGAS FIREFIGHTERS

Thyroid Cancer in Las Vegas Firefighters;

Are We the Only Ones?

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**CERTIFICATION STATEMENT**

I hereby certify that this paper constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and that appropriate credit is given where I have used the language, ideas, expressions, or writings of another. I further certify that this work is my own effort and does not represent any position held by the City of Las Vegas or of Las Vegas Fire and Rescue, and was in no way commissioned by either entity.

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Sherri A. Wilcox

### **ABSTRACT**

An ultrasound scan of the throat was recently added to Las Vegas Fire and Rescue's (LVFR's) mandatory annual physical examination. The intent was to help document early artery disease, but the "neck scans" identified an unexpected problem as well; 30-40 individuals exhibited abnormal thyroid glands. Further testing diagnosed nine cases of malignant papillary thyroid cancer, or a rate of 1 in 77, within the department. The purpose of this applied research project was to determine the significance of LVFR's thyroid cancer rate by identifying the specific disease characteristics and comparing it with the documented rates of other similar populations. The descriptive research method was used to define thyroid cancer and its potential risk factors, identify the nature of the thyroid cancer at LVFR, find other populations for which thyroid cancer rates are being charted and compare them with LVFR's rate, and outline the disease's impacts to the department. An anonymous survey was developed to define the frequency and nature of LVFR's cancer rates while protecting the privacy of the participants, and a follow-up interview with the staff physician was used to clarify certain responses to the survey. Though many personnel chose not to respond to the survey, it was discovered that all nine of the afflicted LVFR firefighters have the same type of thyroid cancer and that none of these cases can be positively correlated to any of the commonly known risk factors or exposures. The researcher recommended expanded screening of other local fire department personnel and civilian employees in order to discover the extent of the population which may be affected. A partnership with the University of Nevada, Las Vegas, might then be developed in order to conduct a full-scale scientific study of thyroid cancer incidence in Southern Nevada.

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## INTRODUCTION

Cancer in the United States is not an uncommon thing; according to the Centers for Disease Control and Prevention (CDC), malignant neoplasm (cancer) is the second leading cause of death behind heart disease in this country (2009). Over 500,000 persons died of various forms of cancer in 2006 alone (CDC, 2009). Many people think of these deaths as primarily occurring among the elderly, but the National Institute for Occupational Safety and Health (NIOSH) estimates that approximately 20,000 of these cancer deaths and 40,000 new cases of cancer each year in the United States may be directly attributable to workplace exposures to carcinogens (2009). The occupation of fire fighting is now recognized as one of those activities during which its participants are regularly exposed to known carcinogens. In the Presumptive Health Initiative section of the organization's website, The International Association of Fire Fighters (IAFF) indicates that most of the United States and Canadian provinces currently have some form of presumptive cancer law which publicly acknowledges the links between certain carcinogenic exposures that may occur during firefighting activities and the subsequent development of specific cancers (IAFF, n.d.).

Because these exposures may not always be obvious, and some cancers may take years to develop, the risk at the time of the exposure may not be evident. Proper documentation of the exposures may be intermittent. The effects of exposure to combinations of hazardous materials may be difficult to predict given the infinite number of possible combinations and the relatively small volume of research completed in this area. All of these variables increase the difficulty of identifying which exposures link specifically with which occupational disease and further put off successful efforts at exposure prevention.

The problem that this applied research project will address is that the personnel of Las Vegas Fire and Rescue (LVFR) appear to be experiencing a very high diagnosis rate of thyroid cancer (approximately 1 in 77), but it is difficult to justify further studies into the potential causes of these cancers and the extent of the population who may be affected until LVFR's thyroid cancer incidence and its impacts are first proven to be significant.

The purpose of this applied research project is to determine the significance of LVFR's thyroid cancer rate by identifying the specific disease characteristics and comparing it with the documented rates of other similar populations. This project will also outline the impacts that these cancers are having on both the personnel directly affected and on the Fire Department as a whole, and make recommendations for reducing these impacts, protecting other people who are potentially affected, and promoting further study into the problem.

The descriptive research method will be used to answer the following questions: (a) What causes thyroid cancer (if known), (b) what is the frequency and nature of thyroid cancer being diagnosed in Las Vegas firefighters, (c) what is the documented incidence of thyroid cancer in other populations, (d) how does LVFR's cancer rate compare to that of other populations, and (e) what are the impacts of thyroid cancer on Las Vegas Fire and Rescue?

### **BACKGROUND AND SIGNIFICANCE**

Las Vegas Fire and Rescue is a career fire department with a proud 65-year history of protecting the citizens of and visitors to the ever-expanding Las Vegas valley. The department is accredited through the Commission on Fire Accreditation International (CFAI) and maintains a Public Protection Classification (PPC) of Class 1 from Insurance Services Office, Inc. (ISO). Las Vegas Fire and Rescue currently carries 694 authorized positions which include personnel assigned to emergency medical response, fire suppression, communications and dispatch, hazardous materials responses, fire prevention, and fire investigation.

In keeping with the Fire Service Joint Labor Management Wellness-Fitness Initiative (IAFF, 2008, p. 11), LVFR provides mandatory annual physical examinations for its fire suppression personnel. Support personnel also have the option of an annual physical examination, but it is not mandatory for these employees. For consistency, privacy, and economic efficiency, a permanent departmental staff physician was hired to provide this service and maintain personnel records. Dr. Lawrence Pellegrini develops and conducts LVFR's medical evaluations, makes referrals for advanced diagnoses and treatments, maintains confidential staff records, and provides valuable feedback and educational classes on health and wellness topics to all department personnel.

While developing LVFR's annual medical evaluation format, Dr. Pellegrini recently added ultrasound screening of the carotid arteries in the neck to the firefighters' mandatory annual physical examination. The doctor's purpose was to help to diagnose early artery disease and encourage the firefighters to take action to improve their circulatory health and help to prevent strokes and heart attacks. During these ultrasound screenings, the doctor began to notice thyroid gland abnormalities in several of the personnel. These employees were referred for additional testing, and over the past two years there have been 30 to 40 abnormal thyroids noted and nine cases of thyroid cancer documented within the fire suppression ranks of Las Vegas Fire and Rescue. As of this writing, the department has approximately 1 in 77 fire suppression personnel who have been diagnosed with malignant papillary thyroid cancer. The Surveillance, Epidemiology, and End Results (SEER) Program, a respected source for cancer statistics in the United States, indicates that thyroid cancer has been relatively uncommon nationally; the age-adjusted average incidence of this type of cancer in the general population from 2002–2006 was 9.6 per 100,000 men and women per year (SEER, 2008). This might indicate that LVFR's

cancer rate is abnormally high and that other fire department personnel, fire department retirees, other City employees, or private citizens may be in danger from unknown exposures.

LVFR's thyroid cancer incidence has created several impacts on the department. According to the Report on Cancer in Nevada, 2000–2004 (University of Nevada, Reno, 2008, p. 57), the average daily hospital billed amount for thyroid cancer treatment was second only to the cost of treating breast cancer at \$7,540. This has had a direct financial impact on both the insurance systems and the departmental budget where backfilling was needed to cover for personnel who were on leave for treatment or on light-duty assignments while undergoing chemotherapy. There is also a heavy psychological burden on the fire department personnel and their families. Though LVFR follows standardized procedures for documenting and reporting known hazardous exposures to its personnel, it is currently unknown which substances may have resulted in these cancers, when and where the exposures occurred, and who else may have been involved in the incident.

Another impact to LVFR involves the long-term prognosis for thyroid cancer patients. According to data maintained by the Surveillance, Epidemiology, and End Results Program (SEER), the average national mortality rate of thyroid cancer from 2002-2006 was only 0.5 deaths per 100,000 in population (SEER, 2008). Why worry about the occurrence of new thyroid cancers when it is so rarely fatal? The answer lies in the required follow-up treatment; thyroid cancer patients suffer a recurrence rate of 30% with an 8% death rate on the recurrent disease (Mazzaferrri, 1994, p. 418). Untreated thyroid cancer may also spread to other parts of the body with metastases to lymph nodes, lung, and brain being the most common. This is a particularly distressing fact to the personnel of LVFR as the department has also experienced five firefighters being diagnosed with various brain cancers during the past four years.

Researchers in Japan have reported seven cases of brain metastasis specifically from aggressive

papillary thyroid carcinomas (Ikekubo, 2000). Patients who choose to have a total thyroidectomy in an attempt to avoid the recurrence or spreading of thyroid cancer must be administered thyroid replacement hormones and undergo regular complete cancer screenings for the rest of their lives. This level of follow-up care creates a long-term financial impact on local and State health-care systems and also results in a high stress level for affected personnel, their families, and their co-workers.

Cancers which develop from exposures during firefighting activities can kill firefighters, cause life-altering changes, and place an enormous burden on community resources. The United States Fire Administration (USFA) reflects the need to resolve problems such as this within its Operational Objectives (USFA, 2005, p.3); specifically Objective #3, “Reduce the loss of life from fire of firefighters.” This applied research project will address this objective as well as Objective #5, “To respond in a timely manner to emerging issues”, by defining LVFR’s thyroid cancer problem and offering recommendations to move toward its resolution. This project is also being conducted in accordance with course requirements of the USFA’s Executive Fire Officer Program as delivered by the National Fire Academy. This topic directly relates to the Executive Development Course Goals (USFA, 2006, p. SM 0-3) by defining a previously unknown problem and leading the process necessary to begin the changes that will be required to attempt to break the cancer cycle in the future.

### **LITERATURE REVIEW**

A literature review was conducted to answer two of the previously introduced research questions: (a) What causes thyroid cancer, and (c) what is its documented incidence in other populations? The information gained from this review was used to guide the development of the procedures to be used for this applied research project. Research question (b) What is the frequency and nature of thyroid cancer being diagnosed in Las Vegas fire fighters? is answered

through the designed Procedures section. The final two questions: (d) How does LVFR's cancer rate compare to that of other populations? and (e) What are the impacts of thyroid cancer on Las Vegas Fire and Rescue, both current and projected? are examined within the Discussion section.

In order to understand thyroid cancer, it is first important to grasp how the healthy gland functions. The thyroid gland is a butterfly-shaped gland that is located at the base of the throat under what is commonly known as the Adam's apple. It is part of the body's endocrine system, and its function is to produce hormones which help to regulate blood pressure, body temperature, heart rate, and body weight by acting upon a person's metabolism. Certain cells (follicular) within the thyroid gland take iodine from the blood to produce the thyroid hormone. Other cells produce calcitonin, a hormone which helps to regulate how the body uses calcium. A specific diagnosis for a certain type of thyroid cancer is based upon which of the types of thyroid cells have been affected (American Cancer Society, 2009a, Thyroid gland section, para. 6).

There are four main types of thyroid cancer: papillary thyroid carcinoma, follicular thyroid carcinoma, medullary thyroid carcinoma, and anaplastic thyroid carcinoma (American Cancer Society, 2009a, Malignant thyroid tumor section, para. 1). Although scientists have found correlations between several different factors, the exact cause of most thyroid cancers is not yet known. Few clear risk factors have been identified, but several factors have been found to be more common to certain thyroid cancers, and they include: familial history, iodine deficiency, gender, age, and exposure to sources of ionizing radiation (MedicineNet, Inc., p. 2).

A family history of thyroid cancer can be a risk indicator for the development of the medullary and anaplastic types of thyroid cancer. Both of these types of carcinomas may exhibit DNA defects in different genes which were inherited from the patient's parents. The American Cancer Society (ACS) reports that some inherited mutations may be detected by testing the DNA

in the subject's blood cells for the specific factors which have been linked to the development of these thyroid cancers (ACS, 2009b, last two sec.).

Areas of the world where peoples' diets are low in iodine have a higher occurrence of follicular thyroid cancers (ACS, 2009c, head. A diet low in iodine). In the United States, where dietary iodine is added to table salt and other foods, iodine deficiencies are extremely rare; the probability of thyroid cancers induced by iodine deficiency is very low.

For unclear reasons, gender and age may also be indicators of a higher risk for developing some thyroid cancers. According to the American Cancer Society, women may be up to three times more likely than men to be diagnosed with a malignant thyroid cancer (ACS, 2009c, head. Gender and age). Furthermore, thyroid cancer is different from many other cancers as two-thirds of the cases are diagnosed in younger patients who are between 20 and 60 years old (ACS, 2009c, head. Gender and age). Anaplastic thyroid cancer, which accounts for less than 2% of all cases, more typically occurs in patients who are over 65 years of age (MedicineNet, Inc., p. 1).

There are several sources of radiation exposure that have been strongly linked to papillary thyroid cancer development. Exposure to radioactive fallout from the atmosphere is one of the most highly correlated carcinogenic radiation exposures known due in part to the high number of previously exposed human subjects available for study. Fallout can result from above-ground atomic weapons testing, such as that conducted by the United States at the Nevada Test Site during 1958–1963. Radioactive fallout can also be produced during accidental or intentional releases by nuclear power plants, such as the 1986 disaster at the Chernobyl Nuclear Power Facility. Another potential source of radioactive fallout is from accidental or intentional releases by nuclear materials production facilities, such as the Hanford Site in south-central Washington State (National Institutes of Health, 2002, p. 5). Fallout contains radioactive iodine,

or I-131, which can become concentrated in the thyroid through the gland's iodine-uptake process (National Cancer Institute, 2002). The link between exposure to ionizing radiation from the above-ground nuclear testing in Nevada and the later development of several types of cancer is well established; on October 5, 1990, Congress passed a law which provides payments to people who can show that they have contracted certain illnesses following their exposure to radiation from the atomic testing. This law is known as the Radiation Exposure Compensation Act (RECA) and has facilitated the processing of awards totaling \$1,417,758,199 as of July 9, 2009 to test site workers, uranium ore workers, and "downwinders" (people in Nevada, Utah, Arizona, and other states who were exposed to fallout in areas downwind of above-ground nuclear testing). Applications are accepted at multiple sites around the country, and 71% of those who apply are approved for compensation (RECA, 2008).

Another well-documented source of carcinogenic radiation exposure is through medical tests and treatments. Physicians used radiation treatments mainly in the 1950's and 1960's to treat enlarged tonsils, acne, and other problems of the head and neck. Though these procedures are no longer practiced, people who were treated with radiation as children have been shown to have an increased risk of developing papillary thyroid cancer as many as 40 years later (ACS, 2009c, head. Radiation). Individuals can also be exposed to carcinogenic levels of ionizing radiation through modern procedures used to treat specific primary cancers. In its publication *New Malignancies Among Cancer Survivors: SEER Cancer Registries, 1973-2000*, the National Cancer Institute (NCI) followed the cases of several hundred thousand cancer patients to determine what the risk of subsequent primary cancer development might be. The goal was to attempt to determine whether there is a correlation between treatments for certain cancers and the subsequent development of new cancers in the same patients. For primary cancers of the mouth, respiratory tract, prostate, kidney, bone, and brain, the researchers reported as much as a

three-fold increase in the risk of subsequently developing thyroid cancer. In *Chapter 14: New Malignancies Following Cancer of the Brain and Central Nervous System*, Peter D. Inskip and Ellen F. Heineman agreed with the findings of other researchers in multiple chapters throughout the full document when they wrote that “radiotherapy appeared to contribute to the excess of new malignancies of the bone, brain, and thyroid gland, whereas chemotherapy probably played a major role in the excess of subsequent leukemia” (Curtis et al., 2006, p. 363). The U.S. Department of Health and Human Services (DHHS) now officially lists X-radiation and gamma-radiation as “known human carcinogens” in its biennial *Report on Carcinogens, 11<sup>th</sup> Edition* (DHHS, 2005a, sec. III, Substance profiles).

Naturally occurring radon gas is another known source of ionizing radiation. It is also listed among those substances “known to be human carcinogens” in the *Report on Carcinogens, 11<sup>th</sup> Edition* (DHHS, 2005a, sec. III, Substance profiles). Radon gas is formed from the natural decomposition of uranium and other substances found in normal soil. It can enter a building through gaps around pipes, cracks or spaces in the foundation, openings in walls, and through drinking water. Newer energy efficient homes that limit air exchange may have the effect of trapping radon gas and allowing it to accumulate in various parts of buildings, especially in basements. According to the Environmental Protection Agency (EPA) exposure to radon gas is the second leading cause of lung cancer in the United States behind cigarette smoking (EPA, 2009, para. 3). Though radon gas is recognized as a common and dangerous form of ionizing radiation, it has not yet been scientifically linked to instances of cancer other than specific disease of the lung.

Beyond these relatively well-known risk factors, there are several studies linking exposure to other types of chemicals to potential thyroid cancer development. A recent study of Swedish workers concluded that exposure to certain substances used in leather-working seems to

be associated with an excessive occurrence of thyroid cancer in women (Lope, 2009, conclusion). The *Report on Carcinogens, 11<sup>th</sup> Edition*, issued by the DHHS also maintains a list of substances that are “reasonably anticipated to be human carcinogens” which have been linked to follicular thyroid cancer (DHHS, 2005b, sec. II-B, Carcinogens listed). The list includes chemicals that have been used in the manufacturing of rubber items, hair dyes, insecticides, and other products. Some chemicals have been discontinued, and some are still common for industrial applications today. These substances are not yet listed as “known human carcinogens” because the only definitive research completed has been conducted on animals. New research continues to examine the effects of both chemical and ionizing radiation exposures on humans.

While lung, breast, and prostate cancer are predominant and well-publicized, cancer of the thyroid gland has been comparatively rare; the National Cancer Institute predicts just 37,200 new cases and 1630 deaths from thyroid cancer for 2009 (NCI, n.d.). The number of new research projects which study the relationship between thyroid cancer and occupational exposures to carcinogens is small when compared to the body of research which has been compiled, by comparison, for occupational lung cancer. SEER reports that the national rate of thyroid cancer diagnosis in 2006 was 11.03 (age-adjusted) per 100,000 of population. This represents a 46% increase from the 7.58 per 100,000 which was reported for the year 2000 (SEER, n.d., Table 26.4). In Nevada, thyroid cancer is the most frequent type of cancer diagnosed for the 15-24 and 25-34 year age groups, comes in third for the 35-44 year olds, and drops to sixth for the 45-54 year group (University of Nevada, Reno, 2008, Table 9, p. 55). Nevada’s thyroid cancer rate is slightly higher than the reported national rate for the period of 2000-2004; all counties total at 10.1 cases per 100,000 in population as opposed to SEER’s rate of 8.5 for the same period (University of Nevada, Reno, 2008, p 419).

From 1975–2005, overall rates of cancer incidence and mortality have been decreasing, driven mainly by decreases in numbers of lung, breast, colorectal, and prostate cancers (Jemal, et al., 2008, p. 1672). In contrast, the incidence of thyroid cancer has increased at a rate of 6.5% per year from 1975-2006 (NCI, 2009). Several researchers (Davies and Welch, 2006; Kent, et al, 2007; and Cooper, 2008) support the most popularly held theory that attributes this rise primarily to the advancement in diagnostic procedures and increased public awareness. These experts point out that there is a large increase in small diameter papillary cancers that are being detected by ultrasound scanning which was not widely available in the past, and attribute the total thyroid cancer rate increase to better detection (Davies, 2006, p. 2167). Enewold, et al. (2009), disagrees, pointing out through an analysis of 39,706 case studies that only half of the increase in papillary thyroid carcinomas involved tumors that were less than one centimeter in size and therefore difficult to detect through manual palpation. In conclusion, the authors state that “Medical surveillance and more sensitive diagnostic procedures cannot completely explain the observed increases in papillary thyroid cancer rates. Thus, other possible explanations should be explored.” (Enewold, et al., 2009, p. 784).

Fire departments are actively questioning the significance of their local cancer rates as well. In an article printed in the Seattle Post-Intelligencer, reporters Kathy Mulady and Casey McNerthney compiled the following information from the local Blue Cross and the Seattle Firefighters Pension Board: of the 975 firefighters who were hired prior to 1977 in Seattle, 347 of them have been diagnosed with some form of cancer (2008). Thyroid cancer was listed among the ‘Other’ types of cancer, with 25 combined cases listed. The New York Post reported that eight of 11,000 New York City firefighters who responded to the World Trade Center collapse and clean-up have since been diagnosed with thyroid cancer and that five more have had

partial or total precautionary thyroidectomies due to abnormal growths or cell activity (Otis and Edelman, 2007).

## **PROCEDURES**

This section outlines how a descriptive research method was developed and implemented to determine the nature and frequency of thyroid cancer incidence within the ranks of Las Vegas Fire and Rescue. Since the privacy of the personnel and the confidentiality of their medical records are of utmost importance, an anonymous survey was chosen as the most appropriate instrument to obtain information. The departmental physician, a supervising fire chief, and the union president were all asked to review and comment on the survey questions prior to the distribution of the survey in order to ensure consistency with the subject matter, compliance with the City of Las Vegas' directives, and the appropriateness of each query. Specific questions about where an employee may have lived, how old he or she was, how much leave time was used for treatment and recovery, or what specific treatments were ongoing were disallowed as it was felt that the answers may lead to unintentional identification of the employee. After collecting the responses to the survey, an interview of the departmental physician was conducted to clarify some of the survey results while maintaining confidentiality of the personnel.

The survey questions were designed around specific information that was obtained during the Literature Review for this applied research project. Since thyroid cancer may not develop for years after an identified carcinogenic exposure, the first two questions in the survey were designed to establish ranges of time that the employee has been (a) living in Southern Nevada, and (b) working for Las Vegas Fire and Rescue. The next two questions were intended to discover whether an employee was aware of any previous diagnoses of thyroid abnormalities. Several questions were then added to identify whether the employee had been diagnosed with

any types of cancer (including thyroid) either during or prior to employment with LVFR, and specifically which carcinomas were diagnosed. These questions were intended to define the incidence rates within the department, identify trends of specific disease, and to reveal whether one or more of the previously described risk factors (e.g. radiotherapy of a previous cancer) were present. A question was included to ascertain whether the employee had previously been treated with radiation for acne, tonsillitis, an enlarged thymus gland, or any other ailment. Based on the potential for hereditary tendencies in some thyroid cancers, a question regarding family history of thyroid cancer was also included.

It was determined that the survey would be distributed to all of LVFR's uniformed personnel; though some employees were not directly involved in fire suppression activities, many were previously firefighters and had moved into other positions within the fire department, and so had possibly been previously exposed to carcinogens. Furthermore, it had not been proven that the exposures causing LVFR's thyroid cancers were strictly related to firefighting activities, and excluding non-suppression personnel from the survey might prevent the discovery of significant data.

The survey was compiled on SurveyMonkey.com and delivered by City e-mail address to all 694 uniformed personnel of Las Vegas Fire and Rescue. A copy of the actual survey instrument is reproduced in Appendix A of this report. The mailing was deployed on Monday, December 1, 2008, and a 35-day window was allowed for responses in order to accommodate all shifts and personnel who were on leave. A total of 257 personnel responded to the survey.

Following collection of all survey responses, an interview was conducted with LVFR's staff physician, Dr. Lawrence Pellegrini. Questions were designed to clarify information gained from the survey without revealing confidential information about specific personnel. Examples

of such questions include: “How many of LVFR’s thyroid cancer patients are old enough (born prior to 1963) to have been exposed to radioactive fallout from the above-ground weapons testing at the Nevada Test Site?” and “Of those who are old enough, how many lived within the documented zones where fallout occurred?” A copy of the interview questions along with the doctor’s responses are reproduced in Appendix C of this report. A compiled analysis of the survey responses and Dr. Pellegrini’s answers to the interview questions are outlined in the Results Section of this applied research project.

## RESULTS

After going through all required departmental and managerial approvals, an invitation to go to SurveyMonkey.com and participate in the project entitled *LVFR Cancer Survey* was e-mailed to the 694 uniformed personnel of Las Vegas Fire and Rescue. The invitation message was sent on Monday, December 1, 2008. After the allotted 35 days, the total number of responses collected was 257. The original research question of “What is the frequency and nature of LVFR’s thyroid cancer?” was clearly answered in that there were nine documented cases of thyroid cancer, and all nine were of the papillary carcinoma type.

A summary of the specific responses to the survey questions can be found in Appendix B; however, copies of the cross-tabulated responses have been withheld to protect the privacy of the participants. Of the 257 survey respondents, 94% have lived in Southern Nevada for six years or more, and 83% have been employed by Las Vegas Fire and Rescue for six years or more. There were 33 respondents who answered “Yes” to the question “At any time in your life, have you ever been diagnosed with any type of cancer?” Of these 33 personnel who had received a positive cancer diagnosis, 29 had received the cancer diagnosis since they had been employed by LVFR. 26 had been employed with Las Vegas Fire and Rescue for 10 years or

more, while two more had been with LVFR for at least six years. Nine of the 33 respondents are those with thyroid cancers that are the main focus of this project, while there was also one response each with prostate, bladder, cervical, and uterine cancers; plus 16 skin cancers. One of the “any cancer” respondents had been treated with radiation as a child, but is not among the thyroid cancer patients. Only one of the “any cancer” respondents indicated any history of familial thyroid cancer, and this employee does not have thyroid cancer.

Nine personnel indicated that they had been diagnosed specifically with thyroid cancer. Of these, 100% indicated the papillary type of thyroid cancer. Seven of the nine have lived in Southern Nevada over 10 years; the other two in the 1-5 year time frame. Six of the nine personnel have been with LVFR for over 10 years, one employee in the 6-10 year span, and two in the 1-5 year timeframe. Eight of the nine thyroid cancer respondents indicated that this diagnosis had occurred since employment with LVFR, while one declined to answer. Eight of the nine also indicated that they had never been treated with radiation therapy for other conditions and had no family history of thyroid cancer, while one declined to answer either of these questions. Though seven of the main group of survey-respondents affirmed that thyroid cancer had affected a member of their immediate family, none of these respondents are among the thyroid cancer patients. Four of the main group also affirmed that they had been treated with radiation therapy (excluding regular diagnostic tests) at some point in their lives, but none of these four are among the thyroid cancer patients.

An interview with LVFR’s staff physician, Dr. Lawrence Pellegrini, was conducted following the survey to gain some clarification on some of the results without interfering with the privacy rights of the affected personnel. The specific questions asked, along with Dr. Pellegrini’s responses, can be reviewed in Appendix C. Through this interview, the doctor noted that none of the thyroid cancer patients are female, but did not feel that this item was statistically

significant as LVFR's gender ratio is approximately one female to each nine males. Dr. Pellegrini also researched the specific ages of the department's known cancer patients and reported that only one was known to be old enough to have been exposed to the radioactive fall-out from the above-ground nuclear weapons testing in Nevada (born in 1963 or earlier), but this employee had not lived in any of the known fall-out zones during childhood. Furthermore, none of the thyroid cancer patients had lived in areas where there were nuclear production facilities or known releases of radioactive contaminants.

### **DISCUSSION**

Though thyroid cancers of various types have been studied for years, there are still no definitive answers as to what specifically causes thyroid cancer. The most extensively studied populations have been those groups known to have been exposed to large doses of ionizing radiation from nuclear weapons deployment and testing and by releases from nuclear production facilities (National Institutes of Health, 2002). Other tests have provided solid foundation evidence that there are certain chemical exposures which can increase the apparent risk of thyroid cancer (Lope, et al, 2009). Even the most widely accepted medical treatments for some other cancers have now been shown to increase the risk of developing thyroid cancer as a subsequent primary disease (Curtis, et al., 2006). For Las Vegas Fire and Rescue, this project highlighted the need for further study into the potential causes of thyroid cancer, both for itself and for other fire departments and citizens as well. As of this writing, LVFR has nine personnel who do not have a familial thyroid cancer history, have not been excessively exposed to any known source of ionizing radiation, were not previously treated with radiation therapies, have not been exposed to any of the other known chemicals which might increase their risk, and yet all present with the same papillary form of thyroid cancer. There is currently no documentation available which would indicate whether this cancer incidence is particular to Las Vegas'

personnel, all firefighters in general, or is an early warning to all citizens of a statewide or national trend. The reason that there is so little documentation available to make a comparison is that there are very few normal, healthy, and asymptomatic populations such as the firefighters of LVFR being regularly screened for thyroid gland abnormalities.

The closest reasonable comparison that this researcher discovered would be in the New York City Fire Department, where all personnel are now routinely scanned for cancers and other diseases based on the hazardous materials exposures which they received during their response to the World Trade Center collapse and subsequent clean-up in 2001 and 2002. Otis and Edelman reported that there had been eight cases of malignant thyroid cancer documented among the 11,000 firefighters of New York City within the five years following the September 11<sup>th</sup> terrorist attack (2007). This would be equivalent to a rate of one thyroid cancer in each 1375 personnel. Las Vegas Fire and Rescue's thyroid cancer rate of 1 in 77 is notably higher.

Thyroid cancer is increasing across the country; the national incidence of thyroid cancer increased 46% from 2000 to 2006 (SEER, n.d., extracted from Table 26.4) and continues to climb at a rate of approximately 6.5% per year (NCI, 2009). Some researchers (Davies and Welch, 2006; Kent, et al, 2007; and Cooper, 2008) believe that the underlying reason for the apparent increases in thyroid cancer incidence can be mainly attributed to improved early detection of the disease with more modern and sensitive diagnostic techniques, as was the case at Las Vegas Fire and Rescue. It seems to this researcher that if earlier diagnosis and better public awareness should normally result in a perceived increase in cancer cases, then widely publicized breast, prostate, and lung cancer rates should also be rising as more cases would be discovered at earlier stages. In actuality, these three cancers have exhibited a steady, long-term decline in rate (Jemal, et al., 2008, p. 1672). Other researchers have pointed out that while some of the new thyroid cancer diagnoses of very small nodules can definitely be credited to improved

diagnostics, the number of large nodules which were detected manually is up 30% as well (Enewold, et al., 2009, p. 784). Therefore, the increases in thyroid cancer rates should not be solely attributed to better diagnostic techniques.

Though the thyroid cancers in LVFR's personnel were discovered early in their development using modern diagnostic techniques, the fact remains that 1 in 77 employees of this fire department have malignant papillary thyroid cancer. This occurrence is exceedingly high when compared with the informally reported rates of the Seattle Fire Department (Mulady, 2008) or the New York City Fire Department (Otis, 2007). LVFR's thyroid cancer incidence also appears to be very high when compared with the State's most recently reported rate of 10.1 per 100,000 in population (University of Nevada, Reno, 2008, p. 419) or the most current nationally published thyroid cancer rate of 11.03 per 100,000 (SEER, n.d., Table 26.4).

Thyroid cancer's impacts on Las Vegas Fire and Rescue continue to mount. According to LVFR's staff doctor, some personnel chose to have complete thyroidectomies and must now take thyroid replacement hormones for the rest of their lives. Others chose partial thyroid removal and various treatments of chemotherapy in hopes of recovering to a near-natural condition. Both groups must be screened for recurrence or metastasis of their thyroid cancer for the rest of their lives. All personnel in the department are still wondering what caused these cancers in the first place and whether it is possible to avoid a repeat exposure in the future. Solutions to these problems must be developed through a scientifically correct research process.

## **RECOMMENDATIONS**

### *Recommendations For Further Research*

Results showed that though there are known risk factors for thyroid cancer, not all cancer "clusters" are routine. LVFR's thyroid cancer patients do not appear to have any of the common risk factors of familial history, iodine deficiency, or exposure to known ionizing radiation

sources. More study is needed to determine other potential causes and identify previously unknown populations who may be affected and need to be notified of their potential exposures.

This researcher would recommend the following actions in the given order:

1. Broaden the populations who are currently being scanned for abnormal thyroid glands to include not only LVFR's personnel, but those of other regional fire departments and civilian City employees as well. Since City of Las Vegas employees already have approval to utilize the medical testing facility LifeSigns, Inc. for their annual physicals, the capability to have throat scans is already in place and paid for as part of a routine annual examination. All employees should be strongly encouraged to do so. LVFR's contract physician, Dr. Lawrence Pellegrini, has offered to conduct basic throat scans free of charge to other personnel, including members of fire departments outside LVFR's jurisdiction, if approved by the city management of Las Vegas.
2. Collect anonymous information on the incidence of abnormal thyroid glands. Data should be collected that identifies basic information including: the abnormalities detected, the occupation and jurisdiction of the personnel involved, and date of referral if further testing is recommended. All testing centers which are participating in this effort must share their data in order to support a future request for a formalized study. The University of Nevada, Las Vegas, may be able to assist in the development of this project and the collection of the data.
3. Contact the Centers for Disease Control (CDC) with the compiled information and request a "Cluster Check". The CDC will respond to a request for further investigation when it is substantially supported with locally collected data that a particular disease rate is outside what would be considered ordinary coincidence.

4. Complete a cooperative grant application with the University of Nevada, Las Vegas, to request funding for a formal study of LVFR's thyroid cancer trend. Depending upon the data collected within the first two steps, the study may be broadened to include whichever populations have been identified by the initial testing.

#### *Recommendations For Other Fire Departments*

Based upon the information collected by this applied research project, all fire departments should consider including a routine ultrasound scan of the throat with their annual physical examinations. Plaque build-up in the arteries of the neck and thyroid gland abnormalities are both apparent through this simple, non-invasive test, and early intervention can save firefighters' lives and improve their quality of life as well.

This researcher would also recommend that an ultrasound scan of the neck become a routine part of a thorough annual physical examination for people of all ages. As thyroid cancer is a disease that tends to affect younger people, individuals should be scanned for nodules well before retirement age and prior to becoming symptomatic. The ultrasound scan is not difficult to justify because it addresses both the health of the circulatory system and the potential for thyroid cancer. As the "neck scan" becomes more regularly conducted throughout the general population, data will become available to compare occupational and age groups more accurately.

#### *Recommendations for Other Researchers*

A number of challenges became apparent from the beginning of this applied research project. Obtaining pertinent medical information without violating the privacy rights of the individuals involved was a significant, but necessary, obstacle. Others attempting to duplicate this project may not have the benefit of a staff physician who can research specific data on the affected employees without revealing their identities. More specific survey questions may be utilized to help narrow down potential risk factors without identifying the participants.

Though it would have been helpful to have more specific background information on each respondent, fire department management and union officers felt that such questions would make the survey less than perfectly anonymous.

This survey was not sent to retirees. It would be a recommendation of this researcher that anyone attempting to duplicate this effort should include retired personnel for more accurate results. It should be noted at this point that there have also been at least five brain cancers diagnosed in LVFR personnel within the last four years, and that these personnel were not intentionally excluded from this survey; three have died and two more were diagnosed during the course of this project and were on leave for treatment during its development. The total departmental cancer numbers would have been more accurate if the retirees and those out for treatment had been included.

Another challenge in the development of this project was the surprisingly low response rate. Only 257 of 694 personnel responded to the survey, even after a Deputy Chief reposted it with a strong plea as to the importance of participating in this effort. That the survey was distributed during the Christmas holiday period may have affected the response rate. Even though there was an extended collection period for survey responses, some staff may have been on vacation leave. This would not account for a large number of non-respondents as LVFR's constant staffing requirement would not allow for many employees to be on leave concurrently. Some personnel may have been hesitant to complete the survey due to suspicions that the information was not truly anonymous and that the results would be used in some punitive way. Some may have been lazy. Others may have just been 'freaked out' because of the additional brain cancers that were diagnosed among the firefighters during the course of this project. It is also possible that some personnel may simply not have understood how to use Survey Monkey. This researcher believes that it is likely that most of the department's cancer patients probably

responded to the survey, and that any casual percentages applied to these reported cancer rates should probably be based upon the entire group of 694 personnel rather than the 257 who responded.

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## APPENDIX A:

## SAMPLE OF LVFR CANCER SURVEY

**LVFR Cancer Survey****1. LVFR Cancer Survey**

This brief survey is a tool to attempt to identify some possible cancer exposures to the employees of Las Vegas Fire and Rescue. The information will be used to protect people who may have experienced the same exposures, and may also help us to prevent some of these exposures in the future. No personal identifying information will be requested. Your participation is very important, so thanks in advance for your help!

**1. How long have you lived in Southern Nevada?**

- Less than one year.
- 1 to 5 years.
- 6 to 10 years.
- Over 10 years.

**2. How long have you been employed by Las Vegas Fire and Rescue?**

- Less than one year.
- 1 to 5 years.
- 6 to 10 years.
- Over 10 years.

**3. At any time in your life, have you ever been diagnosed with nodules on your thyroid gland or an otherwise abnormal thyroid?**

- Yes
- No

**4. If you answered "Yes" to the previous question, was this thyroid diagnosis since your employment with Las Vegas Fire and Rescue?**

- Yes
- No

**5. At any time in your life, have you ever been diagnosed with any form of cancer?**

- Yes
- No

APPENDIX A:

SAMPLE OF LVFR CANCER SURVEY (cont.)

**LVFR Cancer Survey**

**6. If you answered "Yes" to the previous question, was this cancer diagnosis since your employment with Las Vegas Fire and Rescue?**

Yes

No

**7. If you answered "Yes" to question 5, which one of the following most closely matches your cancer diagnosis?**

Papillary Thyroid Cancer

Familial Medullary Thyroid Carcinoma

Follicular Thyroid Cancer

Anaplastic Thyroid Cancer

Don't know

Other (please specify) \_\_\_\_\_

**8. At any time in your life, was radiation therapy administered to you to shrink enlarged tonsils or adenoids, treat a skin problem, or reduce an enlarged thymus gland? (Do not include dental or regular diagnostic x-ray treatments)**

Yes

No

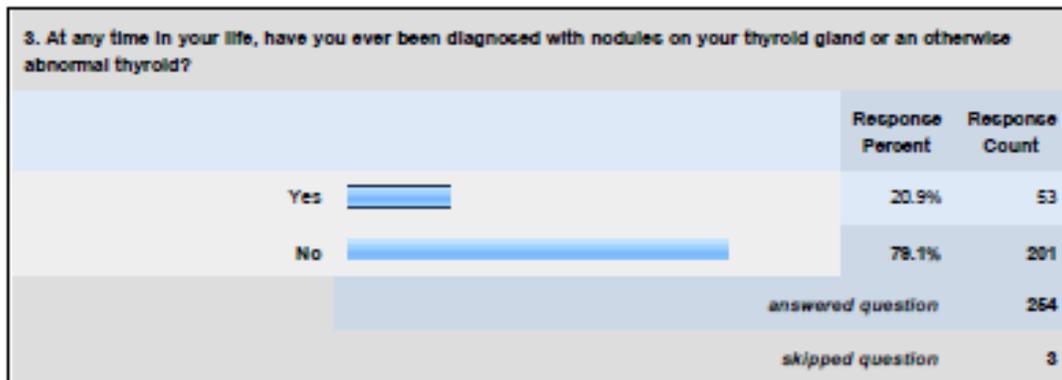
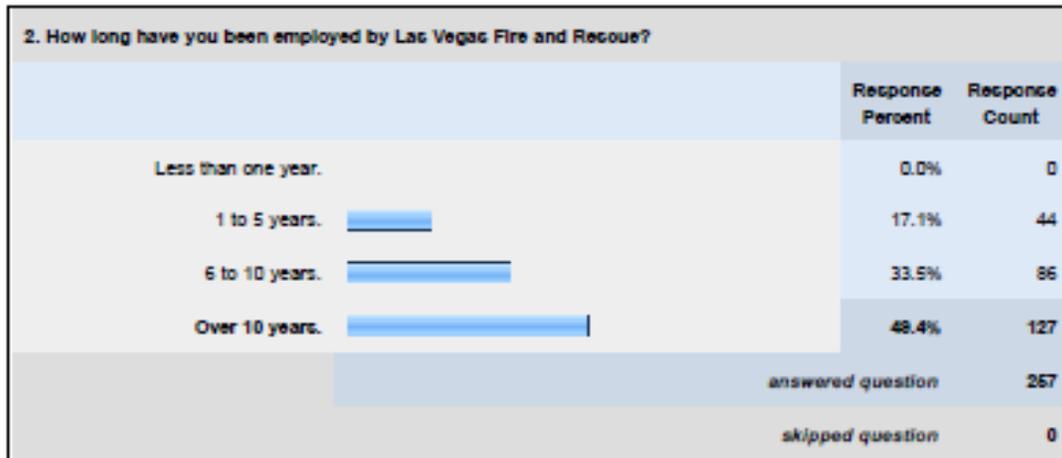
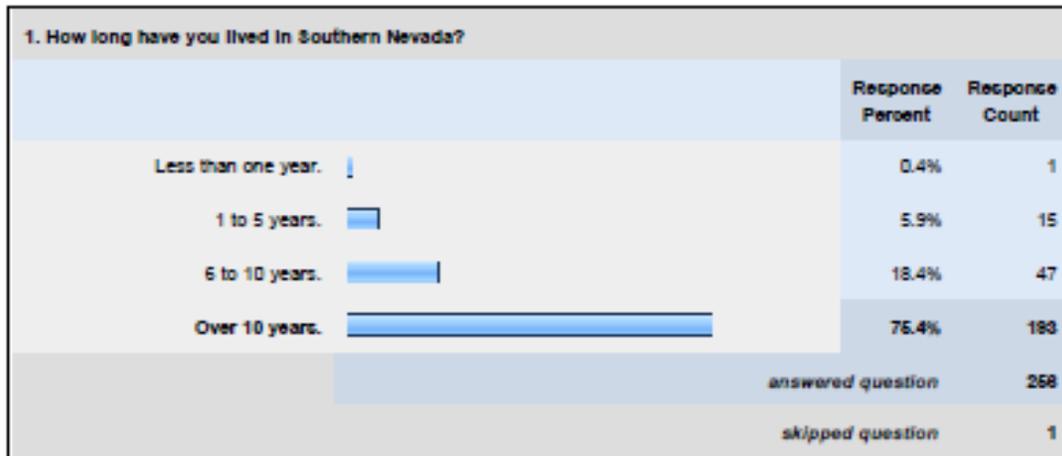
**9. Has anyone in your immediate family ever been diagnosed with any form of thyroid cancer?**

Yes

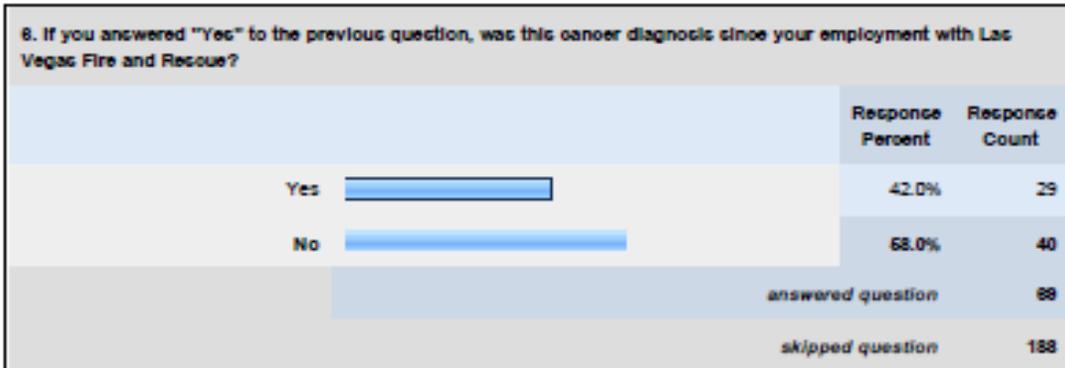
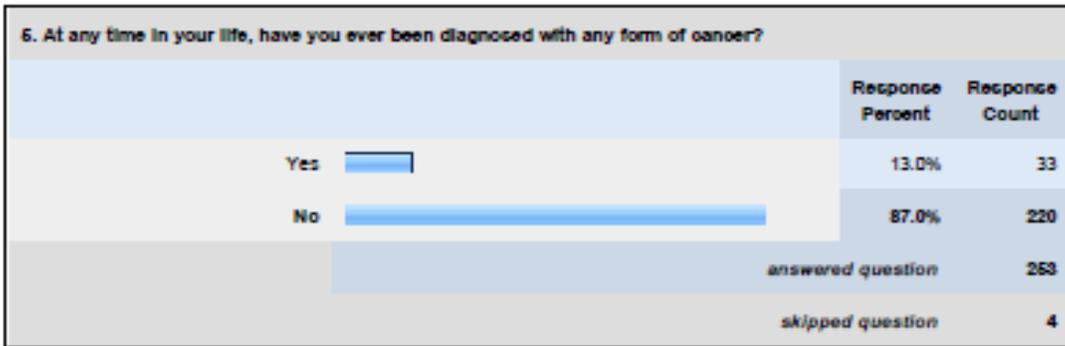
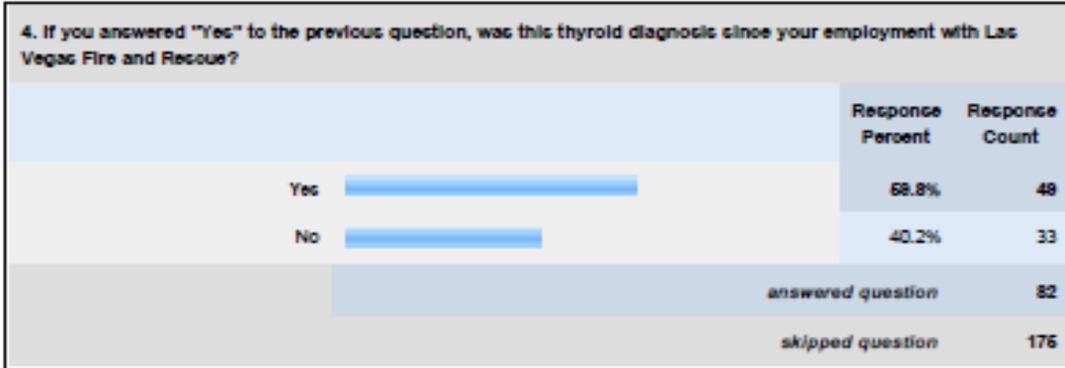
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**APPENDIX B:  
SURVEY SUMMARY RESULTS**

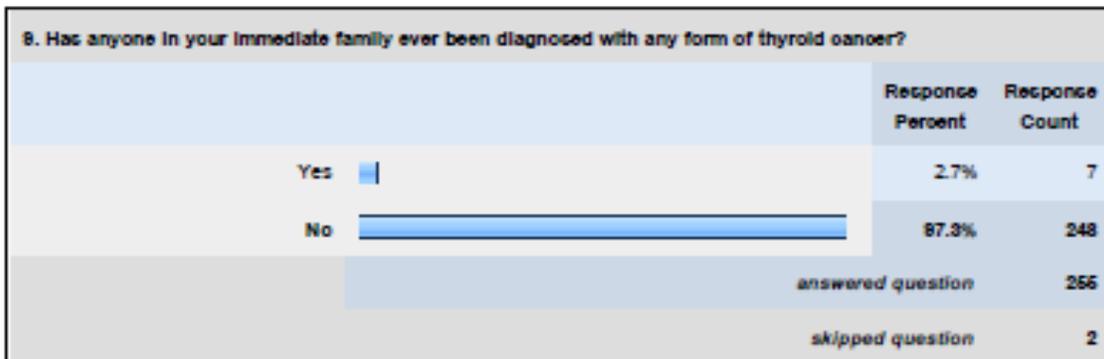
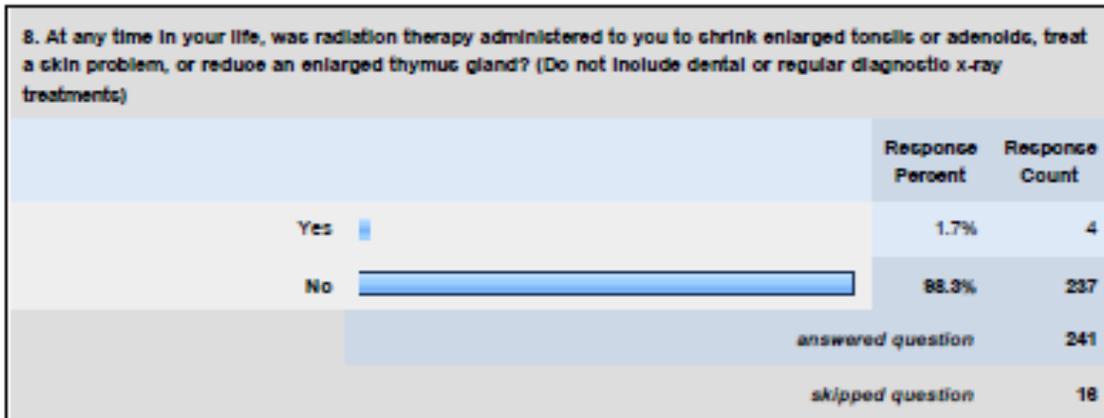
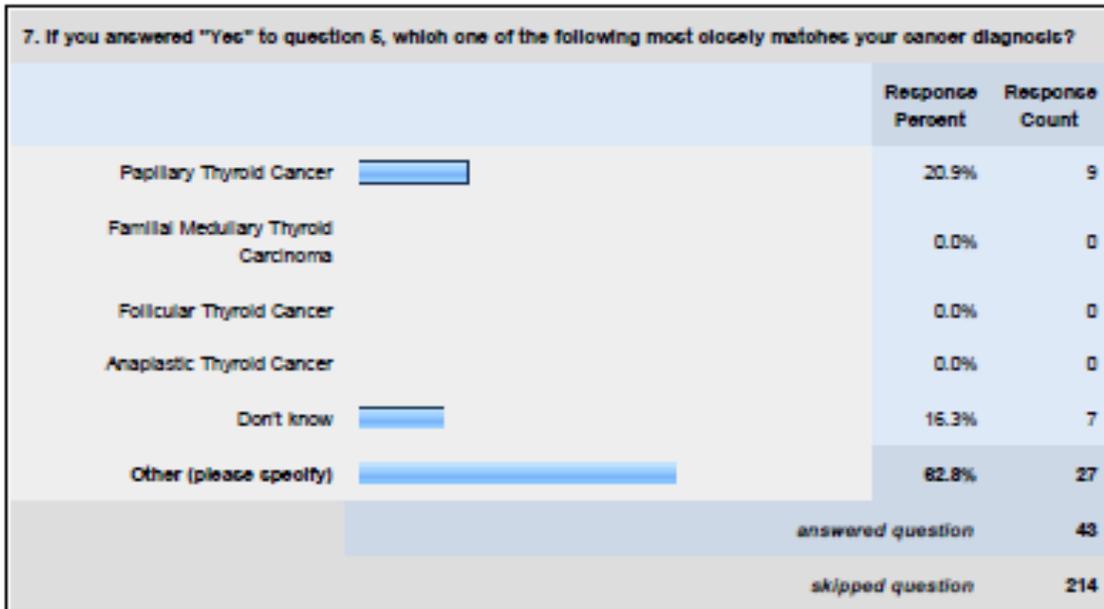
**LVFR Cancer Survey**



**APPENDIX B:  
SURVEY SUMMARY RESULTS (cont.)**



**APPENDIX B:**  
**SURVEY SUMMARY RESULTS (cont.)**



**APPENDIX C:****INTERVIEW WITH STAFF DOCTOR LAWRENCE PELLEGRINI**

1. *Background. What is your training, degrees, and experience?*

I graduated from the Chicago College of Osteopathic Medicine in 1988 and completed a residency program in Emergency Medicine in 1992. I worked in the field of Emergency Medicine in Las Vegas until 2005 when I took the position as the Medical Director with the City of Las Vegas, Fire and Rescue Department.

2. *Tell me about your decision to add ultrasound to your examination.*

I wanted to encourage the firefighters to take a serious look at their fitness and nutrition habits. An ultrasound scan of the carotid arteries in the neck is a great way to take a ‘snapshot’ of what’s going on in there, and also to track changes year to year.

3. *How many actual abnormal thyroids have you found?*

It was 30 to 40. We didn’t start counting right away because small lumps on your thyroid gland are not all that unusual – until we started seeing so many of them.

4. *Were any of the abnormal thyroids or thyroid cancers found in female employees?*

No, but I didn’t find that very unusual since our department is about 90% male.

5. *Did all of the employees who were advised to go for follow-up examinations do it?*

Yes.

6. *Did all employees share the results of the follow up with you?*

Most did, but a few retired before they actually went for follow-up, so they didn’t report back to me. We may have had more cancers than we are currently aware of.

7. *Have you found any more abnormal thyroid glands since the first two run-throughs?*

Yes, several – but to my knowledge no more malignant thyroid cancers.

**APPENDIX C:****INTERVIEW WITH STAFF DOCTOR LAWRENCE PELLEGRINI (cont.)**

8. *How many of the cancer patients were born in 1963 or prior?*

Only one.

9. *Did any of those live within areas of known nuclear testing or production facilities?*

I spoke with the employees involved, and though we have several employees who have worked for the military or out at the Nevada test site, none of our current thyroid cancer patients have indicated working at or living near any type of nuclear facilities.

10. *What additional follow-up has been recommended or done by the department?*

To my knowledge, nothing further.

11. *What potential exposures have been documented as a follow-up to these incidents of thyroid cancer?*

To my knowledge, we have no specific exposures documented which would be known to result in thyroid cancer. That doesn't mean that no exposures have happened – it means that we haven't been able to identify them yet.

12. *Why do you think that only 257 of 694 personnel responded to this survey even after Chief Myers put out the memo encouraging all staff to participate?*

I would be guessing here, but our staff is still getting used to the idea of the mandatory physical exams, and many are suspicious that they'll be disciplined somehow if they don't 'measure up'. The Union has been aggressive in promoting the IAFF's Wellness/Fitness program, but some of the 'old guard' are just going to take awhile to believe that none of this is going to be punitive. It's for their own safety and that of their co-workers and the citizens of the City.