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## **LUNG CANCERS AMONG NON-SMOKING OCCUPANTS OF STRUCTURES WITH ELEVATED RADON LEVELS**

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### **ABSTRACT**

Air Chek, Inc. is performing survey of over 16,000 households that have tested for radon gas. Rather than attempt to conduct a complete epidemiologic study, the intention is to demonstrate a method of locating lung cancer victims within neighborhoods based on the likelihood that the majority of the structures will have radon measurement levels within a similar range.

A preliminary survey was mailed to computer-selected addresses asking specific health and exposure questions. The initial results indicate there may be some correlation of lung cancer occurrences in residences with elevated radon levels. This paper will provide an overview of the survey method, results and data evaluation.

### **INTRODUCTION**

Most radon-related health studies have been criticized because of their very limited residential measurement data. With this in mind, Air Chek, Inc. decided to initiate a preliminary study of our data base of addresses that have been tested for radon. The objective was to find a better method of locating lung cancer victims who have, for an extended period of time, occupied structures with related levels of radon gas. This study is still in its initial stages; however, it has already generated information worthy of reporting.

### **METHODOLOGY**

The initial survey group was chosen from the Air Chek data base consisting of over one million radon test results. Our first experiment involved mailing a one-page questionnaire to 5000 computer-selected addresses to test the return rate. These were sent to 170 different zip codes having the highest measurements.

First we requested that recipients not respond unless the tested structure was at least 15 years old. Then they were asked to mark, with a circle, the correct answers to a few simple questions. Next they were asked to refold the page in reverse order to reveal a prepaid return address and then drop it in a mail box. The goal was to make responding as simple as possible. Once the requested information was obtained from this group, Air Chek sent follow-up questionnaires to respondents who indicated a lung cancer victim had occupied the tested structure for 15 years or more. The replies to this second mailing are still coming in.

For the next mailing similar surveys were mailed to each group listed below, based on an algorithm which selected zip codes with 20 or more measurements with the majority (approximately 90% of the measurements) falling within the desired range. The algorithm was designed to increase the likelihood that exposures at places outside the home (e.g., in the office or school) might be within the same range. Bear in mind, although not used in this study, in some zip codes areas we have the option of factoring in hundreds of test results made during large-scale school testing programs. Over 250,000 classrooms have been tested using our samplers.

Group 1: 3,436 surveys were mailed to addresses with measurements less than 4 pCi/L, inside of zip codes where most of the measurements were also less than 4 pCi/L.

Group 2: 4,079 surveys were mailed to addresses with measurements ranging from 4 to 10 pCi/L, inside of zip codes where most of the measurements ranged from 4 to 10 pCi/L.

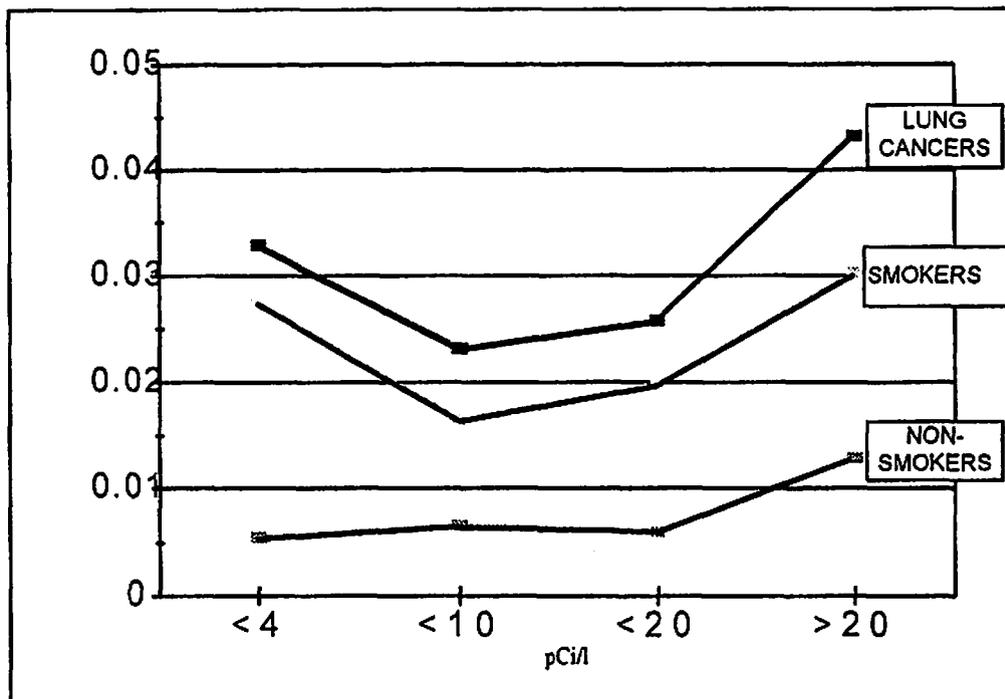
Group 3: 2,012 surveys were mailed to addresses with measurements ranging from 10 to 10 pCi/L, inside of zip codes where most of the measurements ranged from 10 to 20 pCi/L.

Group 4: 6,914 surveys were mailed to addresses that measured over 20 pCi/L. Within this group each zip code had to have a total of 10 or more structures with measurements exceeding 20 pCi/L, but not necessarily having a majority of them over 20 pCi/L. This modification was necessary because there are fewer zip codes that have 90% of their results above 20 pCi/L.

A total of 16,441 survey forms asking health, occupancy, structural and lifestyle questions were mailed to these groups. The first question asked the individual not to respond unless they were acquainted with someone who had occupied the premises for 15 years or more. We asked for the age of structure, whether any occupant had ever smoked, and if yes, for how long? One question asked if any occupant had ever been diagnosed with cancer and if so what type. It also asked the sex of the victim, age when diagnosed, years of occupancy and occupation.

### SURVEY RESULTS

The survey had an overall response rate of 14%. The following chart and table indicates the summation.



ZIP LEVEL	SENT	REPLIED	% RET.	LUNG CA.	% LC	SMK	% SMK	NON	% NON
<4	3436	365	10.6%	12	3.3%	10	2.7%	2	0.55%
<10	7515	906	12%	21	2.3%	15	1.7%	6	0.66%
<20	9527	1163	12.2%	30	2.6%	23	2.0%	7	0.6%
>20	6914	1088	15.7%	47	4.3%	33	3.0%	14	1.3%
TOTALS	16441	2251	14.0%	77		56		21	

## DISCUSSION

All survey respondents had tested their homes for radon. This differentiates them from the general population and could explain the high response rate of 14%. Our requirement of at least 15 years occupancy before responding to the mailing further indicates that people who have tested for radon are much more likely to cooperate in this type of project.

A very interesting item surfaced during this study that deals with the non-smoker lung cancer rate. When comparing the over-20 pCi/L with the under-20 pCi/L non-smoker lung cancer victims we see a clear doubling in the rate.

Another interesting portion of the chart shows no strong correlation between the smoking population and the effect that radon may have on lung cancers within this group. It is the opinion of the authors that it will take ten times this amount of data to filter out the noise caused by the effects of smoking. As an aside, although not a specific topic of this paper, we asked for data on all types of cancer. There was a 50% increase in total cancers (when including all types) if the victim had ever been a smoker.

Of all lung cancer victims who responded to the survey 27% were non-smokers. From the greater than 20 pCi/L group, 30% of the lung cancer victims were non-smokers, whereas 23% of the victims in the less than 20 pCi/L group were non-smokers. The non-smoker lung cancer rate among the less-than-20 group is at least 50% greater than the national average among non-smokers, while the over-20 group rate is at least twice the national average. Unfortunately, not enough information has been gathered to perform an adequate comparison between national averages and this survey's non-smoker lung cancer victims.

The type and location for all lung cancers had not been identified at the time of this writing. A more comprehensive follow-up survey is being considered to possibly determine cancer type and region of the lung effected. Additionally, the age and occupational data of the victims had not been fully tallied at the time of this writing but will be presented with the oral discussion.

## CONCLUSION

Obviously, we do not have sufficient data to make any conclusive statements linking the lung cancers with elevated radon levels. We make no claims as to the radon dose that the lung-cancer victims received. We can only assume, at this time, that there was some potential for radon exposure similar to the measured screening levels.

The preliminary surveys performed by Air Chek, Inc. indicate an unusually high percentage of non-smoker lung cancer victims in the over-20 pCi/L category. Therefore, it appears that the correlation between elevated radon levels and elevated non-smoker lung cancer rates for the areas surveyed certainly deserves further study.

More importantly, the targeting method we have developed is capable of providing block-level address ranges of older structures with highly predictive radon measurement levels. Air Chek has over 17,000 addresses where short term measurements exceed 20 pCi/L and this is supported in a majority of these structures with follow-up measurements. We have also mapped large areas where there are thousands of contiguous sites with no measurements exceeding 2 pCi/L.

The positive results of this preliminary survey indicate that screening levels may be a powerful method for selecting regions for a more intense epidemiological investigation. It is our opinion that a credible organization armed with this information could canvass these neighborhoods locating long term residents who are victims of lung cancer, and the conduct a thorough study of their lifestyles so that better estimates of radon exposure levels could be compiled. This method may then provide sufficient data to better anchor the action level guidelines as they are currently used based on short term measurements.