CORONARY CALCIUM SCREENING:
ASSESSING AFFORDABILITY AND ADVANTAGES

Executive Analysis of Community Risk Reduction

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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 are so indicate, and that appropriate credit is given where I have used the language, ideas, expressions, or writings of another.

Signed: ________________________________
ABSTRACT

The problem was the Greensboro Fire Department (GFD) did not arrange for a cost benefit analysis as a potential loss of asymptomatic firefighters related with coronary calcium screening. Determining the advantages, the affordability and potential traditional and non-traditional funding sources was the main research goal. A descriptive research method was selected and used to determine medically recognized health and wellness standards and programs. The literature review incorporated a methodical assessment of various sources and interviews. A survey instrument was included to establish other fire service organization wellness programs and knowledge. Results indicated the median cost of computerized tomography (CT) technology and no insurance coverage exist for the screening. The CT technology was superior for calcium identification, but improved research was required for asymptomatic patients. Government subsidies were not available, but private funds were probable. The prepared recommendations were to offer the screening protecting the human resources through cardiovascular disease prevention.
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INTRODUCTION

The problem is the Greensboro Fire Department (GFD) has not conducted a cost benefit analysis as a potential loss of asymptomatic firefighters associated with coronary calcium screening.

The rationale for the research is to determine affordability and advantages of coronary calcium screening and how the GFD can make available this specific medical screening for qualifying firefighters while simultaneously not introducing additional budgetary cost increases.

A descriptive research method that will be used for this project, utilizing sources on firefighter wellness and health, coronary related fatalities, cardiology, EFOP research project, fire industry standards, wellness organizations and providers, medical care organizations, fire service organizations and other related sources to conduct research. Data collection includes personal interviews, surveys and observations.

The following questions will be answered by this descriptive research:

1. What are the costs of a coronary calcium screening?
2. What are the benefits of a coronary calcium screening?
3. What are the governmental funding sources?
4. What funding is available from private sources?
BACKGROUND AND SIGNIFICANCE

Sudden cardiac death is the leading cause of firefighter fatalities in the United States (U.S.). Data indicates that from 1977 through 1986, sixty firefighters experienced sudden cardiac deaths while on duty. Characteristically for these incidents, medical symptoms occur when the firefighter was on-duty and death occurred before their shift ended. The average number of deaths fell to forty-four per year by the 1990s and to thirty-nine in the 1980s. The decrease of events withstanding, sudden cardiac death still accounted for 40% of the on-duty deaths in the last five years. In 2010, medical records showed that the majority had some type of cardiovascular problem. Additional risk factors were obesity, high cholesterol, smoking and family history. (Fahy, LeBlanc, & Molis, 2011, p. 5)

Since becoming a fully paid department on June 1, 1926, several GFD firefighters have died unexpectedly from heart related causes. The first recorded incident occurred on June 21, 1954, when 35-year old Assistant Chief E. E. McDowell, died from a heart attack while playing softball. Around 1956, the GFD began providing pre-hire medical physicals for new employees, albeit the program was limited.

On June 14, 1987, Captain Raymond Cockman, died from a probable heart attack playing basketball while on duty. Captain Cockman was an ardent athlete and in good physical condition at the time of his death. It was later reported that a cardiovascular birth defect attributed to his death. No data was produced confirming that an annual medical physical program could have saved or prevented Captain Cockman from dying unexpectedly. Nonetheless, his death made an impact on the GFD beginning in 1988, when the GFD initiated an annual medical physical and fitness program following the National Fire Protection Association (NFPA) 1500 guidelines.
By 1997, the GFD had a clearly defined policy on wellness and fitness. Medical physicals and fitness assessments were provided at no charge for new employees and current uniformed personnel. All wellness programs were in compliance with Occupational Safety and Health Administration (OSHA) 1910.120, 1910.134, 1910.156 and NFPA 1582. With these programs and resources in place, the GFD began to see an improvement with firefighter health and wellness. However, the program was perceived as flawed when several firefighters were misdiagnosed with potential heart related conditions after participating in the program. As a result, GFD personnel were medical removed from duty, required to use personal sick leave for needless medical consultations only to be cleared for duty within the week. Concurrently, a few GFD personnel did experience some type of heart related problem or illness after successfully completing the same identical medical physical. These personnel were considered fit for duty, only to be admitted to a medical care facility where they were diagnosed with varying forms of cardiovascular problems. A number of them were medical discharged by the City Medical Director for non-compliance of NFPA 1582. Tragically, on April 10, 2002, Captain Jackie Beard, while instructing recruit firefighters on basic firefighting skills at a training fire, died from sudden heart failure. Captain Jackie Beard had been medically cleared during his annual medical physical in 2001. Like Captain Cockman before him, his death sparked a change in the GFD medical physical and wellness program.

In 2005, two commercial quality gym facilities were built. To complement the new facilities, the GFD formed a 30-member fitness committee and funded the training and certification for seven in-house professional level fitness trainers. GFD personnel recently were allowed to utilize quasi-governmental facilities within their response area to exercise as a company while on duty. Additionally, departmental medical physical results were compiled to
provide a medical profile for review by the City Medical Director, who made program recommendations to the GFD Command Staff.

In 2011, the City Medical Director, using three years of data, reported that the GFD is in good physical shape overall. However, 30% of GFD personnel are obese indicating they are twice as likely to be sick, injured, or permanently disabled on the job. This is in direct relationship to the fact that GFD incurs workers’ compensation costs of approximately $400,000 annually. The final recommendation indicated GFD personnel need to increase their cardiovascular health and reduce their body weight.

For the 2011-2012 physical year, the City Medical Director ended the traditional treadmill/EKG test, claiming this type of coronary test has no medical value in predicting future or potential heart related conditions. This decision was based on the recommendations from the NFPA 1582 Technical Committee for the 2013 standard revision. According to the City Medical Director, a firefighter would be required to achieve twelve metabolic equivalent of task (METS) or rate of energy consumption on a treadmill. The total amount of time to achieve this would depend upon the fitness capability of the firefighter. In conjunction with this, the firefighter’s Framingham Risk Score, predictor of a person’s chance of having a heart attack within the next 10 years, is used. Combined with recommended life style changes, a firefighter would be informed of their predisposition for a heart related problem or condition. In 2011, all sworn personnel underwent this new program. The final report will be presented in late 2012.

With these new examination measures in place, the GFD family experiences another unexpected death on October 16, 2011, when 35-year old Captain Will Caviness collapsed and died while participating in a charity marathon in Chicago, Illinois. The official cause of death
was not directly attributed to a heart attack or disease, but a pre-existing heart condition was believed to be the cause of death.

The implication of this matter indicates a failure exists within the current GFD annual medical physical program for detecting possible cardiovascular illness and disease. It has been expressed that testing for the presence of coronary calcium could enhance the GFD annual physical program providing medical personnel with vital information that could reduce sudden or unexpected coronary failure in firefighters having no apparent symptoms or undetectable cardiovascular problems.

The overreaching wellness program goal is to prevent unexpected firefighter deaths while not compromising GFD’s ability to mitigate emergency responses. To determine affordable enhanced coronary screening that can diminish or halt unexpected coronary related deaths in firefighters would be advantageous for the entire fire service.

As outlined in the Executive Analysis of Community Risk Reduction course, the emergency response is a required component for mitigating community risk. Firefighter health, like any tool, piece of equipment or apparatus is a critical resource for emergency response. Improving and maintaining a firefighter’s physical ability enhances a fire department’s capability to handle emergencies and serves as model of superior personal behavior among the community served. The subject matter shares an appropriate and mutual connection with the United States Fire Administration (USFA) Strategic Framework, to “reduce risk at the local level through prevention and mitigation” by “being responsible and prepared both individually and collectively”. (USFA Publications, 2010)
LITERATURE REVIEW

Penn Medicine Web Team (personal communication, May 14, 2012) contacted the Radiology Business Office at the Hospital of the University of Pennsylvania. The radiology business office representative reported that the CT Coronary Calcium Screening is often not covered by insurance. The cost is $125.00, which is paid upfront by the patient. The patient does need an ordering / referring physician to have the study done.

Cedar-Sinai recommends a coronary calcium scan to be utilized as an early warning measure. Potential patients are informed that the scan is not covered by most insurance plans. To offset this lack of insurance coverage, they make available two price options. Option One (1) includes a calcium scan, a lipid panel, same-day consultation with a cardiac imaging physician and they forward the results to your physician the same day for $250. Option Two (2) includes everything except the consultation with a cardiac imaging physician for $185. (“Coronary Calcium Scan,” 2012)

 Ranked number one in the U.S., the Cleveland Clinic uses CT technology, but most insurance and Medicare consider the CT scan as a screening examination, and is not currently covered. The patient is accountable for all costs at the time of the exam, which is $340.00 and includes all labs, technical, medical and professional interpretation charges. (“Calcium-Score Screening Heart Scan,” 2012)

Offering a coronary CT angiogram (CTA) examination for a cost of $750 and requiring additional patient testing, the Henry Ford Macomb Hospital System states the patient will benefit by detecting not only images of any hard plaque as well as any non-calcified or “soft plaque” in the coronary arteries. This exam utilizes the 64-slice CT, along with a contrast injected via an IV
into the circulatory system that helps physicians detect the soft plaque. ("Cardiac Calcium Screening," 2012)

From their study, (Guirgus-Blake, Lin, & Barton, 2007 “Benefit to Coronary Calcium Screening?” para. 9) found it is somewhat accepted in the medical industry that noninvasive cardiac CT testing may possibly or must be used to group asymptomatic patients at intermediate risk of coronary artery disease (CAD). Cardiac CT is expensive ($400 to $500 per scan) and is unproven to influence the outcomes of patients with no apparent CAD symptoms.

Looking a noninvasive cardiac imaging and presuppose the typical cost of an ultrasound has a cost value of 1, CT is 3.1, two-dimensional imaging with radioactive material is 3.27 and magnetic resonance imaging (MRI) is 5.51, from the consumer or patient viewpoint, the CT is the most cost effective model for patients having less than sixty (60) percentage of CAD symptoms. (Dewey, 2011, p. 29)

Weintraub & Diamond (2008) believe to determine when a person will have a cardiovascular (CVA) event is without a doubt essential for the medical community and for the public good. At present, the US spends more than $400 billion annually on cardiovascular diseases. Conversely, to try to forecast CVA disease due to its frequency or cost should not be the primarily reason. For CVA disease, logical prevention measures can be taken: individuals can stop smoking; exercise, manage their diet, and lose weight.

It is widely agreed by the medical community that CT testing can identify the present of calcium in coronary arteries, and if any quantity is found, arterial disease is likely in patients that would not present normal non-detectable symptoms. (Schoepf, 2005, p. 71)

Echocardiography and MRI are the best noninvasive, non-radiation testing method for cardiology. Availability of testing instruments is good among medical facilities in the US and in
other countries. Advantages are well documented, but they have acknowledged weaknesses in several areas, arterial calcium recognition being most important. (Dewey, 2011, p. 27)

For the patient, there are several benefits of a cardiac CT for calcium scoring. Chiefly, there are no testing instruments, injections, or contrast material that enters the body. In a relatively short amount of time, along with being pain free and no risk of any adverse reactions, the patient can expect to receive a reliable report of the existence of CAD. With the coronary arteries as much as 50% restricted, this test can detect CAD where typical cardiac tests are unreliable with that level of obstruction. When more than half of all heart attacks occur in patients having less than 50% percent narrowing of the arteries, this test is an enormous benefit. (‘Coronary Calcium Scoring,’ 2008)

Patients with known symptoms of CAD, noninvasive imaging testing has demonstrated effectiveness in clinical assessments. For patients with no indicators of CAD, the functionality of these tests is problematical. Persons characterized as having a low, transitional or high risk propensity for CAD, the utilization of imaging test have not indicated improved medical treatment or results. Moreover, the use of this type of screening for low-risk or the populace may be unsafe. (Guirgus-Blake, Lin, & Barton, 2007 “Benefit to Coronary Calcium Screening?” para. 6)

More than a few studies have confirmed the accurateness of coronary CT angiography (CCTA) for revealing obstructive CAD, while other studies showed a good prediction of cardiac events. To prove alternative predictive screenings, like risk scores or calcium scoring, are superior to CCTA was the goal of the research. A comparison was completed between CCTA with calcium scoring and clinical risk scores for the ability to predict cardiac events. The study involved tracking two-thousand and twenty three patients for twenty-eight months with assumed
CAD, who underwent CCTA. CCTA had a noteworthy projecting assessment when compared with calcium scoring. This could affect cardiovascular risk reclassification of a sizeable percentage of patients. (Hadamitzky, et al., 2010)

Established as the foundation of coronary atherosclerosis, coronary heart disease (CHD) is predisposed by an array of risk factors. Industry risk models, like the Framingham risk score, can sensibly forecast CHD risk. Screening for Coronary Artery Calcium (CAC) has significant interest to advance risk prediction for targeted patients, but more studies are indicated to determine the benefit over the conventional risk factors and the cost effectiveness. (Dewey, 2011, p. 76)

Current CT technology can take 70-90 images of the coronary arteries exclusive of any injections, or needles. The procedure is rather quick, ten (10) minutes or less allowing the patient to stay fully dressed. Calcium or plaque detected in your coronary arteries is used to establish your cardiac score. Cardiac scoring is the most recent analytical means to identify calcified plaque in the coronary arteries. The screening results are reviewed by credentialed radiologist and a cardiac score is established for the patient. Understated warning signs of heart disease can be detected with this information allowing the patient’s personal physician to order the most suitable treatment. (“Cardiac Calcium Screening,” 2012)

Cardiac CT is one of the most hopeful noninvasive methods for screening transitional-risk patients. Coronary calcium scores are independent predictors of CAD, but it is unclear if the treatment based on scores will advance medical outcomes. For instance, cholesterol reducing medicines or statins has not clinically shown to effect mortality in patients identified by cardiac CT having measureable coronary calcium. There is also contradictory point of view about whether they reduce the coronary calcium scores. Until continued research is done, the current
data indicates that physicians should not order cardiac CT as a screening test in patients with no symptoms. (Guirgus-Blake, Lin, & Barton, 2007 “Benefit to Coronary Calcium Screening?” para. 6)

Coronary artery calcification (CAC) is a major attribute of arterial disease. The driving force for identification and treatment is influenced by a patient’s lifestyle and physician ordered interventions. Predictions of potential cardiovascular events in various populations can be determined by cardiac CT testing. Once CAC is identified, guidelines to measure the growth and conclude effective interventions for the early stages of atherosclerosis do not exist. However, partial information indicates CAC growth measurements may be a more precise forecaster of prospective cardiac risk than a onetime measurement. Justification by researching the exposure of radiation is needed to measure development and to determine the potential outcomes. Until, then the cardiologists deem it as beneficial as a noninvasive measure of the progression of atherosclerosis. (McEvoy, et al., 2010)

Providing his opinion on coronary screening, Doctor Michael Ghim, (personal communication, June 6, 2012) had reviewed a paper on this topic within a group setting of emergency room doctors. They found it not to be helpful based on the studies available so far. For a cardiologist, it may be useful when looking at people based on risk factors and current symptoms. For low risk chest pain patients in a certain age group and risk factors, a special CT scan can be done to look at the amount of calcium plaques in the coronary vessels. A much thickened lesion means a blockage is significant enough that a patient may be in danger of having a heart attack, or for some unstable angina symptoms requiring an examination from a cardiologist. There are supposedly places where a person can get a screening test if they pay. The problem is it may not be needed or useful. Most people have a few areas of plaque in their
arteries, which is normal. However, a scan may pick it up and it isn't significant in any way. It is similar in that 50% of people with significant MRI's of their backs showing large herniated discs, yet they have no symptoms. If a patient is 20 years old, who doesn’t smoke with any family history of coronary disease, the screening is not needed. A 60 year old diabetic patient, who smokes 3 packs per day and all the men in the family, died of heart attacks by age 61; the screening is not needed. A 40 year old with a father having at least 1 stent procedure at age 60, little exercise and takes fish oil for slightly high cholesterol, the screening may be helpful as a clean CT is good news, and will indicate the person will need to be more aggressive on lowering their risks.

Prospective financial support from both federal and state health organizations is available for CAD prevention, awareness and educational materials, but not allowable for screening procedures. This was confirmed by J. F. Brooks (personal communication, May 23, 2012) who reports that the South Carolina Department of Health has a Heart Disease and Stroke Prevention federal grant, but grant guidance prohibits the funding of screenings of any nature. The grant does not address the need for calcium screening as it relates to cardiac risk. The grant addresses quality improvement surrounding the ABCs of heart disease and stroke with specific emphasis on blood pressure control.

T. Fullmer (personal communication, June 4, 2012) stated that Maine Department of Health does not fund any direct services, including this type of screening and is not aware of any other agencies that provide funding for this type of screening. He offered additional assistance by offering a variety of heart disease and stroke educational materials available at no cost.

The Oregon Public Health Division (OPHD) representative C. Young (personal communication, June 6, 2012), indicated she found this research interesting, but could not
provide additional information to share and confirmed the OPHD does not support or sponsor any CT calcium screening procedures.

The Centers for Disease Control and Prevention (CDC) mission is to promote health and quality of life by preventing and controlling disease, injury, and disability by bestowing up to 85 percent of its budget through grants and contracts. Through contracts, agencies can directly purchase goods and services, while health-related and research organizations that contribute to CDC's mission through health information dissemination, preparedness, prevention, research, and surveillance utilize grants. (“About CDC,” 2009) Non-health organizations, such as fire departments, are not fund eligible, or through a state health organization receiving CDC funding. The Louisiana Office of Public Health Program Manager, M. A. Marino (personal communication, May 24, 2012) acknowledged this fact reporting that the funding they receive for cardiovascular disease from the CDC does not allow funding for screenings.

The U.S. Department of Health and Human Services (HHS) primarily administers Grants.gov, an E-Grants Initiative, which is part of the President's 2002 Fiscal Year Management Agenda to advance government services to the community. This model’s initial stages started with the Federal Financial Assistance Management Improvement Act of 1999, also known as Public Law 106-107. Public Law 106-107 has since sunset and is now known as the Grants Policy Committee (GPC). There are over 1,000 grant programs equaling approximately $500 billion annually. (“About Grants.gov,” 2012) The author researched the Grants.gov website for potential funding. No grants or funding information was identified or found.

The American Heart Association (AHA) funds research broadly related to cardiovascular disease and stroke. AHA does not provide funds for screenings and procedures. (AHA Research Administration, personal communication, May 24, 2012)
Private fund supporting institutions like the Robert Wood Johnson Foundation is dedicated to improving the American Citizens health and health care with the goal of helping society transform itself for the better. (“About RWJF,” 2012) Unfortunately, this kind of research is out of scope for us. (P. Higgins, personal communication, May 29, 2012)

The International Association of Fire Chiefs (IAFC) main goal is to provide leadership to career and volunteer chiefs. The IAFC provides an environment for sharing ideas, expand professionally and discover both the latest goods and services accessible to first responders. (“About IAFC,” 2012) V. Lee (personal communication, May 24, 2012), who is the IAFC Program Manager, stated that the IAFC does not provide health related funding, but if a department wants to include this it can be negotiated with the health insurance provider like any other benefit. Unions can negotiate with the city to have it covered and the city negotiates with the insurance provider. The best way is to audit what services the members are using and not using then negotiate what should be eliminated and added based on actual usage. This helps reduce costs while improving coverage. Volunteer and/or non-union organizations can use the same approach. Just like buying a car, they package their options. You can always special order.

The Everyone Goes Home program has been working with Johns Hopkins in hopes of developing a financially feasible way of conducting Coronary Calcium Screenings. The study is funding calcium screenings for selected participants. The Johns Hopkins report is not due to be completed for 6 to 8 months, which is when the study will end. (V. Stagnaro, personal communications, June 22, 2012)

Based in New York City, the Foundation Center’s main goal is to benefit humanity globally. Utilizing an inclusive grant information system, they offer an assortment of funding resources. The Foundation Directory Online, which allows an individual to locate information
about active foundations and their grants, appears to be a great resource. However, a subscription fee is required to utilize the resource. The Foundation Center attempted to provide all applicable information and was very helpful, but as a reminder stated, that the vast majority of foundation support goes to registered 501(c) (3) nonprofit organizations, as specified by the IRS. (The Foundation Center’s Online Librarian, personal communication, June 5, 2012)

The Fireman’s Fund Insurance Company developed a communal undertaking supporting the fire service beginning in 1863. Annually, the company awards millions of grant dollars for safer communities. R. Clark (personal communication, June 20, 2012), reported the grant dollars may be used for firefighter equipment, training or community education. Within those guidelines, they frequently awarded requests from fire departments for fitness equipment. If a department requested funding for cardiac screening, they would approve that request as well. They are not a traditional foundation, in that their program works differently than most. There are two primary ways to be nominated for a grant. A Fireman’s Fund employee can nominate a local fire department and non-profit fire prevention organizations for grants. Employees are also encouraged to provide volunteer support for non-emergency activities. Secondly, independent insurance agencies and brokers that offer Fireman’s Fund products can direct grants to local fire departments based on the size and growth of their business with Fireman’s Fund. Fireman’s Fund does not accept grant applications directly from fire departments. However, fire departments interested in possible funding should fill out their online survey. Although the survey does not guarantee a grant award, information provided in the survey is shared with agents and employees who are interested in nominating fire departments for grants.
PROCEDURES

A descriptive research method was used by the author for this Applied Research Project (ARP); which included an orderly examination of various resources and sources. Sources included: the NETC Learning Resource Center (LRC), subject matter based web-sites and publications, subject related standards, books and journal articles, including GFD and the City of Greensboro documents and databases.

To determine the costs of a coronary calcium screening, the top 10 ranked cardiac and heart surgery hospitals in the U.S. were identified and contacted by the author. They were the Cleveland Clinic in Cleveland, Ohio, Mayo Clinic in Rochester, Minnesota, John Hopkins Hospital in Baltimore Maryland, Texas Heart Institute at St. Luke’s’ Episcopal Hospital in Houston Texas, Massachusetts General Hospital in Boston, Massachusetts, New York-Presbyterian University Hospital of Columbia and Cornell in New York, New York, Duke University Medical Center in Durham, North Carolina, Brigham and Women’s Hospital in Boston, Massachusetts, Ronald Regan UCLA Medical Center in Los Angeles, California and the Hospital of the University of Pennsylvania in Philadelphia, Pennsylvania.

These medical institutions were identified by ranking criteria established by the U.S. News and World Report Health Section. Rating criterion integrated more six-hundred hospitals possessing advanced cardiovascular knowledge and skills. The evaluation period is from 2007 to 2009 and only hospitals having least one-thousand two-hundred persons staying in the hospital requiring a high level of expertise in this specialty were treated. They were ranked by their score. In addition to the top 10 hospitals, Cedar-Sinai Medical Center in Los Angeles, California and the Henry Ford Macomb Hospital System in Michigan where selected based on their
offering of this specialty type screening. All medical institutions were informed of the purpose and question. Information obtained was consistent with the literature findings.

To decide the benefits of a coronary calcium screening, several books and articles were researched, including the author interviewing Michael Ghim, MD, FACEP. Doctor Ghim was selected because of his experience in emergency medicine at Wake Forest Baptist Health and as the Medical Director of the Guilford County Emergency Medical Services (EMS) in North Carolina.

For the second part of this research, a written analysis method was developed and sent electronically to 30 fire departments (Appendix A). The participating agencies represented fire service organizations across the nation and the State of North Carolina. The survey consisted of 8 questions, all required a response. Of the 30 respondents contacted, 70% provided information. Fundamental prerequisite information was requested that included department description and primary mission. Information was asked related to departmental health and wellness programs, specific cardiovascular screening and/or examination testing methods and funding of current programs.

In addition to the external survey, an internal written appraisal instrument was developed and sent electronically to 148 officers within the GFD. Of the officers contacted, 29% responded to the survey. The survey was made up of 6 questions, all required a response. GFD personnel were to respond to their personal opinion about general CT screening procedures for coronary calcium detection, any personal lifestyle changes they would make, and suggestions for funding this type of screening. To determine governmental funding sources for CT coronary calcium screening, the author selected State Health Departments representing the four regional areas of the U.S. Beginning with the Eastern Region, selected were Florida, Ohio, South
Carolina, Michigan, Indiana, Pennsylvania and Maine. Selected from the Central Region were Wisconsin, Nebraska, Illinois, Oklahoma, Alabama, Louisiana and Texas. From the Mountain Region were Idaho, Colorado, and New Mexico. Lastly from the Pacific Region were California, Oregon and Washington. The following federal governmental agencies: U.S. Department of Health and Human Services (HHS), Centers for Disease Control and Prevention (CDC), National Institutes of Health (NIH), Federal Emergency Management Agency, Assistance to Firefighters Grant (AFG) was contacted. Selection criterion used was based on state health departments and federal agencies predisposition for funding health prevention and research. All were knowledgeable of the intention and subject matter of the research and supported the literature conclusions.

To determine funding sources available from private sources for CT coronary calcium screening, insurance companies and national life safety organizations were identified and selected by the author. A total of fourteen private insurance companies were selected and broken down by unique criteria. The following eight insurance companies were selected based on the region of the U.S. they principally serve and insurance based national company satisfaction survey, they are: AAA, American International Group (AIG), Allstate, Hartford, Metropolitan, Nationwide, Progressive and State Farm. The largest U.S. health insurers collected approximately $650 billion in premiums in 2009 as identified by U.S. News and World Report Health Section and the National Association of Insurance Commissioners. The top ranked insurance companies accounted for nearly two-thirds of the total, the top six selected are: UnitedHealth Group, WellPoint, Inc. Group, Kaiser Foundation Group, Aetna Group, Humana Group and HCSC Group.
The Everyone Goes Home Organization, the Nation Fallen Firefighter Foundation and the National Safety Council were selected based on their life safety initiatives and their ability to concentrate on change in the fire service and general safety concerns.

Definitions

**Computerized Tomography**: radiography in which a three-dimensional image of a body structure is constructed by computer from a series of plane cross-sectional images made along an axis (Dictionary, 2012)

**Ultrasound**: the diagnostic or therapeutic use of ultrasound and especially a noninvasive technique involving the formation of a two-dimensional image used for the examination and measurement of internal body structures and the detection of bodily abnormalities (Dictionary, 2012)

**Magnetic Resonance Imaging**: a noninvasive diagnostic technique that produces computerized images of internal body tissues and is based on nuclear magnetic resonance of atoms within the body induced by the application of radio waves (Dictionary, 2012)

**Echocardiography**: the use of ultrasound to examine the structure and functioning of the heart for abnormalities and disease (Dictionary, 2012)

**Coronary CT Angiography**: the radiographic visualization of the blood vessels after injection of a radiopaque substance

Limitations incorporated the immense and ambiguous information from medical community on the subject of coronary calcium screening utilizing CT. There were additional restrictions as this medical testing / screening procedure, in relation to the specific target group, is comparatively new. Consequently, there was little information found at the National Fire Academy’s (NFA) Learning Resource Center (LRC). The author anticipated supplementary
information from the surveys to support the question related to the benefits of CT screening, anticipating more diversified results. The narrow data collected from the regional and state fire services suggest this type of CT screening is not customary as estimated. The small reaction from the GFD survey indicated a lack of knowledge about CT Screening and Coronary Calcium and the relationship to cardiovascular health. There appears to an increased responsiveness among the GFD ranks to this potential health screening program.
RESULTS

Research Question 1: What are the costs of a coronary calcium screening? The top ranked hospitals, in the United States (U.S.) known for advanced proficiency in cardiology and heart surgery, provide and offer coronary calcium screening from as low as $125 up to $750, with a median cost of $340. Noninvasive computerized tomography (CT) screening for coronary calcium pricing commonly falls within the lower price range, while invasive CT screenings are in the upper price range. Both noninvasive and invasive can detect calcium within the arteries, but there is a direct relationship between the cost and level of detection and medical consultation for the patient. Most institutions, like Hospital of the University of Pennsylvania, require payment beforehand because most insurance plans do not cover the screening. Depending upon the percentage of CAD symptom and considering other type of screening methods, CT is the most cost effective. Overall, there is a noticeable cost and reimbursement variety across hospital and medical institutions within the US.

Research Question 2: What are the benefits of a coronary calcium screening? Cardiovascular disease prevention is among the many goals of the medical industry. Annual costs are exceedingly high for care and treatment of these events. Diagnostic procedures are important and beneficial, including personal prevention measures. From survey respondents, 86% indicated they would request additional medical advice or screening, which is sensible and appropriate considering the seriousness of the condition. Personal actions what disappointing as 50% or less indicated their willingness to engage in self-improvement measures (Appendix B).

The reliability of CT screening used for the identification of calcium in the cardiovascular system exceeds the normal medical industry testing methods (echocardiography and MRI). Depending upon the engineering standard, type of technology, coronary calcium
detection by CT is overall a low risk non-hazardous screening method. Most are noninvasive (no contrast injections), there is minimal radiation exposure for the patient. Of the survey respondents, 50% indicated that radiation exposure would deter them from having the test, while 38% would not be deterred, 11.9% would request more information before having the test (Appendix B). The screening procedure is generally under 10 minutes and results are reviewed in a comparatively short amount of time. The patient’s medical condition and history (low risk or high risk for CAD) versus the medical treatment benefit for having a CT screening performed is difficult for the medical community to determine and agree on. Some studies believe an established calcium score (measurement of plaque in the arteries) using a CT scan will provide the patient and the doctor adequate information in determining the most suitable medical treatment. Cardiologist could find it useful assisting patients their risk based on current medical history and symptoms. Overall, more research data is needed and medical prudence dictates that medical physicians should not order any type of CT screening for asymptomatic patients. Those GFD personnel who responded to the internal survey (Appendix B) over 78% considered coronary calcium screening valuable or very valuable indicating an increased awareness of a healthily lifestyle.

Research Question 3: What are the governmental funding sources? Financial assistance for testing or screening is not available. Funding from governmental sources is limited to governmental and non-governmental agencies charged with health prevention, preparedness awareness, education and research. The primary grantor is the CDC, whose mission is carried out by the grantees. Both the HHS Customer Support and the National Institutes of Health (NIH) Grants Information Staff provided a brief guideline on how to conduct an individual search of the website for a grant related to CT Coronary Calcium Screening, but no qualifying
grant was identified. No federal assistance was determined or available. Government opinion on testing and screening is considered as an individual choice and not for the good of the populace.

Research Question 4: What funding is available from private sources? International and national fire service organizations do not offer any health related funding, but did suggest ways to negotiate funding for the procedure. There was a low response from those fire service organizations, whose mission is firefighter health and safety, except the Everyone Goes Home Organization. They are in development of financial support program for coronary calcium screening with Johns Hopkins. A final report is expected in late 2012 or early 2013. Several philanthropy based organizations and foundations support a variety of humanitarian causes. They possess sufficient funding assets to support their own proprietary goals as well as those organizations in need of financial assistance. Although the author’s research sparked the interest of a majority contacted, no funding was allowable or available. The common thread of denial was two-fold: the fact that it was medical screening procedure and that fire departments are not nonprofit organizations. Most private insurance companies and corporations have programs in place to fund community based injury prevention programs, but could not support this type of program. One insurance company, the Fireman’s Fund Insurance Company gladly supports firefighter health and fitness programs and clearly indicated specific support of coronary calcium screening. Procedurally, a fire department cannot apply directly for funding, but by completing an online survey makes them eligible for their agents/employees to nominate and hopefully receive funding for this screening program.
DISCUSSION

Screening cost for CT screening is broad and directly related to the specific technology of the equipment used and the medical problem-solving outcome selected by the physician. The median cost of this type of screening $340. Payment is usually required upfront by the medical provider, because it is not covered by a majority of insurance companies. These particulars alone make CT screening unaffordable for the overall majority of patients. The current budgetary constraints have caused local governments to eliminate a great deal of the “low hanging budget fruit” which has had an enormous effect on the fire service. The author found it encouraging that 20 out of 21 fire department respondents, 95% require annual physicals which indicate health and wellness programs have not been cut, but found that 29% do not require any heart functionality test. (Appendix A) This indicates that fire departments are being affected by funding to the extent they are not able to provide minimum heart function screening procedures. Advance screening technology, such as CT technology, would be beyond budgetary limits and maybe considered a lavish preventative course of action.

The medical population confirms that utilizing CT screening for the presence of coronary calcium is a superior diagnostic tool for forewarning a patient and thereby determining the correct course of CAD management. The fact that cardiovascular disease and heart attacks are the leading cause of firefighter fatalities in the U.S. should bring about energetic attention within the fire service. As the fire service embraces and formulates nationwide incentives on fire and life safety and prevention programs, it seems unenthusiastic to react or change health and wellness programs that could prevent sudden cardiac failure. From the literature review, it has been determined that the value of preventative measures well exceeds that of cardiovascular care and treatment. Additionally, CT screening is more cost effective and reliable when identifying
calcium levels in the cardiovascular system than traditional echocardiography and MRI technology. The author perceived, probably as most, that coronary calcium screening would be an appropriate diagnostic instrument for all patients, those with symptoms and those without symptoms, by eliminating or confirming the presence of CAD thus providing peace of mind. However, information from the literature review was irresolute. Medical physicians are willing to use CT technology for coronary calcium screening, but require patient medical history before ordering the screening. Taken as a whole, there is a need for continued research using CT screening technology for asymptomatic patients.

From the research, no governmental financial support exists or has been awarded for any type of medical screening for coronary calcium. The governmental grant funding is primarily slated for health prevention, research and development and education. In general, the federal and state governments will not subsidize personal health procedures, regardless of the potential life saving outcomes. To contribute money for medical procedures is in direct conflict with their responsibility to manage budgetary/tax dollars.

At present, both domestic and global fire organizations do not recommend funding for pre-emptive medical procedures. In truth, the author was astonished by the lack of response from the established fire industry organizations whose main objective is firefighter health and safety. To a lesser astonishment, prominent charitable and benevolent foundations do not support medical procedures and for-profit organizations. There was encouraging information from the Everyone Goes Home Organization. They along with Johns Hopkins Medicine are partnering to develop a report to explore the creation of a monetary support program specifically for coronary calcium screening for firefighters. Since the literature review confirmed private insurance companies and corporations do not provide coverage for this particular type of
screening, there was low anticipation of any discovered funding or support from insurance organizations. Unexpectedly, the Fireman’s Fund Insurance Company offer potential financial support for coronary calcium screening for firefighters. Although there was no implication or assurance for funding, it was encouraging to determine private funding is possible.
RECOMMENDATIONS

The outcome of this study confirms the justification of providing coronary calcium screening for GFD firefighters. The tangible cost of CT screening should not deter the GFD from providing this type of screening. To provide the highest level of fire protection and fire prevention, the GFD is not reluctant to embrace industry based fire and life safety incentives as well as protect its resources, such as fire apparatus or equipment. Historically, the GFD practices first-rate stewardship and accepts responsibility of the stakeholder’s view of importance. The GFD’s preventative measures are structured to protect tax payer investments. It should follow then, the GFD should embrace cardiovascular disease prevention for GFD firefighters.

Although the medical community is still unclear and calls for more research on the benefits of coronary calcium screening, the detection of CAC is advantageous for the physician when determining potential cardiovascular events. GFD firefighters, who have certain risk factors along with specific medical history, a CT scan can be ordered by the City Medical Director to determine if calcium plaques exist. The physician can medically evaluate the results and order preventative treatment and care for a firefighter, who could be at high risk of having a heart attack or other cardiovascular problem while on duty. As this type of screening should be available for all GFD firefighters, conversely, it may not be practical for some firefighters, as some levels of coronary calcium is sometimes normal.

The GFD Safety Division should take the lead and incorporate compliance measures to ensure 100% participation with all current wellness and fitness directives, including an awareness program on cardiovascular disease and health. The GFD should continue to protect wellness and fitness funding, including requesting additional municipal funding for coronary calcium CT screening to prevent cardiovascular disease and illness. Until such funding is
readily available, the GFD should explore all potential funding sources and assistance from both governmental and private organizations. The GFD personnel will gain from these recommendations by developing an increased awareness of the importance of coronary calcium detection and improved personal health management. By establishing an aggressive preventative CAD program, the GFD will continue build upon its established principle based method of effective resource management and good stewardship.
REFERENCES


U.S. Fire Administration America’s Fire and Emergency Services Leader Strategic Plan Fiscal

APPENDIX A

The results of the Coronary Calcium Screening External Survey are integrated here; the following shows the responses from that survey:

**Question 1**
Select the type of fire service organization that best describes your department.

<table>
<thead>
<tr>
<th>Type</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Career</td>
<td>17</td>
<td>80.95%</td>
</tr>
<tr>
<td>Volunteer</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Combination</td>
<td>4</td>
<td>19.05%</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
<td>0.00%</td>
</tr>
</tbody>
</table>

**Question 2**
Select your department’s primary mission, select all that apply.

<table>
<thead>
<tr>
<th>Mission</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire</td>
<td>20</td>
<td>95.24%</td>
</tr>
<tr>
<td>Medical (All Levels)</td>
<td>18</td>
<td>85.71%</td>
</tr>
<tr>
<td>Hazardous Material</td>
<td>15</td>
<td>71.43%</td>
</tr>
<tr>
<td>Technical Rescue</td>
<td>14</td>
<td>66.67%</td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
<td>19.05%</td>
</tr>
</tbody>
</table>

**Question 3**
Does your fire department presently make use of a health and wellness program?

<table>
<thead>
<tr>
<th>Response</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>19</td>
<td>90.48%</td>
</tr>
<tr>
<td>No</td>
<td>2</td>
<td>9.52%</td>
</tr>
</tbody>
</table>

**Question 4**
Does your fire department provide an annual physical examination or health screening?

<table>
<thead>
<tr>
<th>Response</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>20</td>
<td>95.24%</td>
</tr>
<tr>
<td>No</td>
<td>1</td>
<td>4.76%</td>
</tr>
</tbody>
</table>

**Question 5**
Does your medical provider require testing of the heart as a part of the annual physical examination?

<table>
<thead>
<tr>
<th>Response</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>15</td>
<td>71.43%</td>
</tr>
<tr>
<td>No</td>
<td>6</td>
<td>28.57%</td>
</tr>
</tbody>
</table>

**Question 6**
If you check yes to question 5, check the heart related testing methods that are utilized as a component of your annual physical examination or health screening.

<table>
<thead>
<tr>
<th>Method</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Echocardiography (ultrasound)</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Test Method</td>
<td>Count</td>
<td>Percentage</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>-------</td>
<td>------------</td>
</tr>
<tr>
<td>Computerized Tomography (CT)</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Magnetic Resonance Imaging (MRI)</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Electrocardiogram</td>
<td>12</td>
<td>57.14%</td>
</tr>
<tr>
<td>Exercise Stress Test (Treadmill)</td>
<td>9</td>
<td>42.86%</td>
</tr>
<tr>
<td>Other</td>
<td>9</td>
<td>42.86%</td>
</tr>
<tr>
<td>No Testing</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Annual treadmill for haz-mat and over forty for firefighters every other year</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Not every year</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Treadmill measuring METS.</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Exercise - Stationary Bike</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

**Question 7**

If you selected any of the heart test methods in Question #6, how does your fire department fund or pay for them?

<table>
<thead>
<tr>
<th>Fund Source</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire Department Budget</td>
<td>19</td>
<td>90.48%</td>
</tr>
<tr>
<td>Health Insurance</td>
<td>2</td>
<td>9.52%</td>
</tr>
<tr>
<td>Grants</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Private Funding</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>City Physician compensated through City budget</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>State Funding for Hazmat</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

**Question 8**

Please list any other comments or information related to this questionnaire that you feel would be beneficial.

- None                                      | 17    | 80.95%     |
- *This type of testing should be done by the fire service.* | 3     | 14.29%     |
- *We are looking at going away from treadmill testing and possibly going to calcium testing in the future.* | 1     | 4.76%      |
APPENDIX B

The results of the Coronary Calcium Screening Internal Survey are integrated here; the following shows the responses from that survey:

**Question 1**

It is generally recognized among some in the medical community that noninvasive testing for the presence of calcium in coronary arteries can prevent sudden cardiac failure in patients having normal non-detectable symptoms. In your opinion, how valuable would a noninvasive testing method for coronary calcium detection for the Greensboro Fire Department.

- **Very Valuable** 22 51.16%
- **Valuable** 12 27.91%
- **Somewhat Valuable** 8 18.60%
- **Not Valuable** 0 0.00%
- **No Opinion** 1 2.33%

**Question 2**

Computerized Tomography (CT) can identify the present of calcium in coronary arteries, but the patient is exposed to a low dose of radiation. In your opinion, does the exposure of radiation outweigh the benefit of finding the early stages of arterial disease?

- **Yes** 22 51.16%
- **No** 16 37.21%
- **Other Comment** 5 11.63%

*how much radiation

I would like to see what the radiation dose is. If it's similar to an x-ray, I wouldn't have a problem with it.

It depends on the individual and their demographic and medical history

Poorly worded question...I would gladly take the radiation exposure since there is a benefit.

Need more information exposure of radiation (ex age, sex, race, weight)

**Question 3**

If you had a coronary calcium screening and it was determined that you had a measurable amount of calcium in your arteries, would you (select all that apply)

- **Request additional medical advice or screening** 37 86.05%
- **Change your nutritional habits** 20 46.51%
- **Participate in a wellness program** 17 39.53%
- **Start an exercise program or increase your current exercise program** 22 51.16%
- **Stop Smoking or Tobacco Use** 3 6.98%
Other
I would do whatever was recommended to reduce the risk of a cardiac event.
As recommended
non smoker
don’t use tobacco

Question 4
In your opinion, do you feel the Greensboro Fire Department should provide coronary calcium screening for firefighters?
Yes 37 86.05%
No 6 13.95%
Other
do not know enough to make a fair cost/benefit analysis
I do not know the benefits and risks for CCS.
Since its an early sign, I don't think it’s necessary for everyone but should be available for certain medically significant groups
I do not know anything about coronary calcium screening so it's hard to answer the question. If it is a medical fact that it is beneficial, then of course I believe it should be completed.

Question 5
Generally, coronary calcium screening is not covered by most insurance providers and required private pay. Please provide suggestions or ideas for funding of this type of screening.
City/Fire Department Budget 12 27.91%
City/Fire Department Budget Incremental Step Plan 2 4.65%
City/Fire Department Wellness Program 2 4.65%
Employee Reimbursement 3 6.98%
Employer/Employee Split Cost 2 4.65%
Foundation 1 2.33%
Fund Raiser 1 2.33%
Grants 6 13.95%
Insurance Company 2 4.65%
N/A 8 18.60%
Partner with Health Provider 2 4.65%
State Fireman's Relief Fund 1 2.33%
Higher taxes 1 2.33%

Question 6
Please list any other comments or information related to this questionnaire that you feel would be beneficial.
A full body scan to check for the development is an aneurism could also be useful. 1 2.33%
Beneficial for the GFD.

* I think this would be very beneficial - the GFD has actual experience with a death involving a sudden cardiac event.

* More awareness of coronary calcium, effects, preventions.

* N/A

* Such testing could result in saving lives, but could also be used negatively to restrict an otherwise healthy person from active duty.

* This is another area where technology is ahead of insurance industry and the Firefighting service.