State of California
AIR RESOURCES BOARD

RESEARCH PROPOSAL

Resolution 09-27

April 23, 2009

Agenda Item No.: 09-4-2

WHEREAS, the Air Resources Board has been directed to carry out an effective research program in conjunction with its efforts to combat air pollution, pursuant to Health and Safety Code sections 39700 through 39705;

WHEREAS, a research proposal, number 2666-264, entitled "Personal, Indoor and Outdoor Particulate Air Pollution and Heart Rate Variability in Elderly Subjects with Coronary Artery Disease," has been submitted by the University of California, Irvine;

WHEREAS, the Research Division staff has reviewed and recommended this proposal for approval;

WHEREAS, the South Coast Air Quality Management District has agreed to cosponsor this proposal for a total amount of $85,000;

WHEREAS, the Air Resources Board will fund this proposal for a total amount of $150,000; and

WHEREAS, the Research Screening Committee has reviewed and recommends for funding:

> Proposal Number 2666-264 entitled "Personal, Indoor and Outdoor Particulate Air Pollution and Heart Rate Variability in Elderly Subjects with Coronary Artery Disease," submitted by the University of California, Irvine, for a total amount not to exceed $235,000.

NOW, THEREFORE BE IT RESOLVED that the Air Resources Board, pursuant to the authority granted by Health and Safety Code section 39703, hereby accepts the recommendation of the Research Screening Committee and approves the following:

> Proposal Number 2666-264 entitled "Personal, Indoor and Outdoor Particulate Air Pollution and Heart Rate Variability in Elderly Subjects with Coronary Artery Disease," submitted by the University of California, Irvine, for a total amount not to exceed $235,000.

BE IT FURTHER RESOLVED that the Executive Officer is hereby authorized to initiate administrative procedures and execute all necessary documents and contracts for the research effort proposed herein, and as described in Attachment A, in an amount not to exceed $235,000.

I hereby certify that the above is a true and correct copy of Resolution 09-27, as adopted by the Air Resources Board.

Monica Vejar

Monica Vejar, Clerk of the Board

ATTACHMENT A

"Personal, Indoor and Outdoor Particulate Air Pollution and Heart Rate Variability in Elderly Subjects with Coronary Artery Disease"

Background

Findings in cohort and time series studies suggest that PM2.5 air pollution is associated with increases in cardiovascular hospitalization and mortality. Individuals at greatest risk include elderly individuals with pre-existing cardiovascular disease or other diseases that place them at high risk for myocardial infarction or stroke. The National Institute of Environmental Health Sciences (NIEHS) has sponsored a major health assessment study to determine how the elderly are harmed by exposures to PM at four sites in the Los Angeles area. These areas were selected to assess the health effects near to and far from traffic. The Air Resources Board (ARB) and the South Coast Air Quality Management District (SCAQMD) co-funded an extension of this study to conduct extensive monitoring of personal, indoor, and outdoor pollutant levels to refine the relationships between exposure to PM2.5 and cardiovascular health outcomes. The proposed study would build upon that study to more fully investigate how one factor of cardiovascular impact, heart rate variability (HRV), is impacted by exposure to fine and ultrafine PM. Decreases in HRV are known to be associated with the likelihood of future adverse cardiac health outcomes and even death. It is thought that people with cardiovascular disease are less able to cope with various stresses, in part, because their hearts are unable to respond to such stresses compared to people with more normal hearts. Examination of HRV data could provide more information regarding the nature of risks that the elderly experience and how mortality may be driven by environmental exposures to ultrafine PM. This study would be funded by ARB and SCAQMD if approved by both Boards.

Objective

The primary objective of the proposed study is to examine the relationships that may exist between HRV and exposures to personal, indoor, and outdoor particulate air pollution. A secondary objective is to examine whether subject-specific genetic factors modify responses to particulate air pollution.

Methods

This proposal extends analyses of a previously funded study. No new data collection is included. Two lines of research are included in this proposal: the study of PM on HRV, and exploratory assessments of the role of genetic factors in modifying HRV changes that might be associated with exposure to various air pollutants. Data are available for 55 of the original 60 subjects (five were eliminated from this extension because they wore pacemakers, which maintain heart function in people with heart rate instability). All were elderly residents of retirement homes and all had physician-diagnosed cardiovascular disease.

The HRV-related work to be performed in this study will include processing the extensive amounts of continuous recordings of the electrical activity of the heart that were collected over the ten days that each participant was monitored. The initial steps will be performed by computer software. Once the software processes the data it will be reviewed by skilled technicians and a cardiologist to ascertain the validity of the data summaries and to identify any events of interest. The data will be summarized to include 24-hour observations, daytime, and nighttime observations.

Daily activity data will be matched to observation files to assure that activity assumptions are accurate. Various pollutant exposure metrics will be matched to the HRV findings on time bases for as short as hourly time periods up to 24 hours. Statistical analyses will be performed to determine whether any of the HRV events are associated with pollutant exposure estimates. Regression methods will be the primary analytical approach and will include assessments of factors such as gender, medication use, and weather. Seasonality will also be included in models because each site/subject was visited during two seasons. Lag periods will be incorporated into the protocols to allow for delays in the onset of effects. Pollutants are likely to be correlated among themselves, since many come from similar sources, in this case mostly from traffic or more regional sources. Care will be taken to control for such correlations factors. The number of observation hours to be included in this appraisal is large and the investigator should be able to detect fairly small changes in factors related to HRV. Exploratory studies will be performed to determine whether genetic factors play a role in the expression of HRV outcomes. It is postulated that some people may be more sensitive than others based on such factors.

Expected Results
The results from the study to date have shown that PM, especially from traffic sources, affects many circulating factors in the blood and the electrical activity of the hearts of elderly people. These findings support the likelihood that the proposed extension will provide a further refinement of mechanistic explanations regarding the reason that elderly people are at risk from PM exposures. Specifically, fractions of fine or ultrafine PM that have already been shown to impact markers of inflammation and injury, as well as changes in the electrical activity of the heart, may be shown to elicit changes in HRV, a factor that is strongly associated with actual risk of adverse health outcomes. Further, the investigators may find that specific genetic factors in the participants make them more likely to exhibit these changes.

Significance to the Board
This study may show that current regulatory emphasis on PM2.5 mass is not adequate to protect people who are especially at risk for the adverse health impacts of particulate matter. It may also provide further evidence to explain the mechanisms by which particulate matter contributes to adverse health effects in this sensitive group with cardiovascular disease.

Contractor:
University of California, Irvine

Contract Period:
36 months

Principal Investigator (PI):
Ralph Delfino, MD, Ph.D.

Contract Amount:
$235,000

Cofunding:
The South Coast Air Quality Management District is contributing $85,000 to the cost of this study.

Basis for Indirect Cost Rate:
The State and the UC system have agreed to a ten percent indirect cost rate.

Past Experience with this Principal Investigator:
Dr. Delfino has participated in numerous studies of air pollution in California and leads several nationally recognized research centers. He has just completed initial work related to the proposed study which found that particles emitted by traffic appear to pose a potential to adversely impact the health of elderly residents of retirement homes.

Prior Research Division Funding to the University of California, Irvine:

Year	2008	2007	2006
Funding	$369,523	$1,290,054	$356,495

BUDGET SUMMARY

University of California, Irvine

Personal, Indoor and Outdoor Particulate Air Pollution and Heart Rate Variability in Elderly Subjects with Coronary Artery Disease

DIRECT COSTS AND BENEFITS			
1.	Labor and Employee Fringe Benefits	$ 209,314	
2.	Subcontractors	$ 0	
3.	Equipment	$ 0	
4.	Travel and Subsistence	$ 1,150	
5.	Electronic Data Processing	$ 0	
6.	Reproduction/Publication	$ 200	
7.	Mail and Phone	$ 1,472	
8.	Supplies	$ 200	
9.	Analyses	$ 0	
10.	Miscellaneous	$ 1,300	
	Total Direct Costs		$213,636
INDIRECT COSTS			
1.	Overhead	$ 21,364	
2.	General and Administrative Expenses	$ 0	
3.	Other Indirect Costs	$ 0	
4.	Fee or Profit	$ 0	
	Total Indirect Costs		$21,364
TOTAL PROJECT COSTS			**$235,000**