be able to end their exposure and exit the chamber at any time if they choose to end their participation in the study. Total exposure times will be 2 hours. The exposure atmosphere will be at approximately 40 ± 10% RH and approximately 22 ± 2 °C. Clean air will be passed through an air purification system to ensure no presence of pollutant gases (O_3, NO, NO_2, SO_2, CO) in the air. Ozone and DE concentrations will be monitored continuously. The DE will be generated from a diesel engine used to power an air compressor that is located outside the Human Studies Facility, and subsequently introduced into the exposure chamber after different dilutions with clean HEPA and charcoal filtered and humidified air to give a chamber concentration of approximately 300 $\mu g/m^3$. The monitoring analyzer registers a concentration in real time. Exposures will be terminated at values $\geq$ 400 $\mu g/m^3$ during runs in which the exposure targets 300 $\mu g/m^3$ DE. This safety limit will prevent an inhalational exposure greater than 1,080 µg, which assumes that the subject, only resting for 1 hr, exercising for 1 hr, will inhale 2.7 m^3 during the 120 min exposure. It is expected that 75 to 95% of the diesel exhaust PM from this type of engine will be approximately 0.05-0.2 µm. Preliminary testing has shown the mean particle size to be approximately 0.15 ± 0.05 µm. Levels of carbon monoxide (CO), and oxides of nitrogen (NOx; mainly NO, and some NO_2), will be kept under 10 ppm CO, 15 ppm NO, and 3.5 ppm NO_2 or the exposure will be terminated. [The OSHA 8 hr time-weighted average for these substances are: CO=50 ppm; NO=25 ppm; NO_2=5 ppm; Diesel fuel used for the study will be purchased as a commercial ultra low sulfur fuel. This certified fuel represents diesel fuel composition that is typically available at gas stations for most regions of the country except for California. Subjects will enter the exposure chamber. Particle mass will be measured in real time and validated further by weighing filters after the 2 hr exposure is finished. Particle size distribution will be determined at regular intervals. Filter samples will also be analyzed for chemical composition of particles. Minute ventilation will be measured during the exercise periods of exposure.

Lung Function Test:

Primary endpoints for evaluating health effects are changes in lung functions, mainly FEV_1, FVC and FEV_1/FVC before, immediately after, and approximately every hour for up to 4 hrs post exposure.

Measurements and Collections:

Blood pressure, telemetry, and oxygen saturation will be monitored during the exposure period. Other primary endpoints for evaluating health effects, in addition to lung function, are heart rate variability (HRV) and markers of inflammation including total and differential cell counts as well as pro-inflammatory cytokines and immune system mediators and clotting factors from collected blood. Secondary endpoints from additional blood, breath, and urine samples will serve as indicators of the exposure based on the levels of metals (eg, Zn) and organics (eg, PAHs) and other components that may be derived from DE deposition. From the collected blood samples, additional parameters and indices may be obtained as analysis tools become available. Genetic analysis may also be performed on collected blood samples for susceptibility factors. A questionnaire measuring perceived stress by the subject at the beginning of an exposure regimen will be performed. Some of the supplemental spirometric measurements and secondary endpoints may not be obtained if they are deemed unnecessary.

In order to participate in this study, subjects will be asked to:

- Avoid smoke and fumes for 24 hours before all visits.
- Avoid drinking alcohol 24 hours before all visits.
- Avoid strenuous exercise for 24 hours prior to and after all visits.
- Avoid the use of ozone-based home air purifiers during study participation.
- On the exposure days, eat a light breakfast.
- Refrain from all over the counter anti-inflammatory agents including those for allergies for a period of 48 hrs prior to exposure.

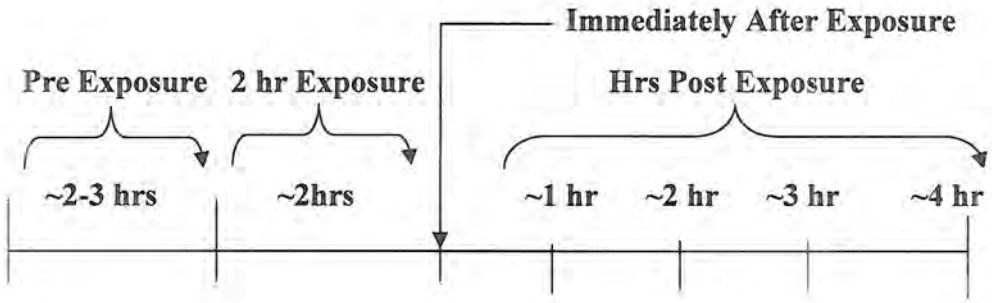
Figure 1

Experimental design:

	Day 1 2 hr exposure	Day 2 2hr exposure	Day 3
Exposure Regime 1	DE + O3	O3	follow up (no exposure)
Exposure Regime 2	O3	O3	follow up (no exposure)
Exposure Regime 3	DE	O3	follow up (no exposure)
Exposure Regime 4	Clean Air	O3	follow up (no exposure)

Figure 2
Endpoints:

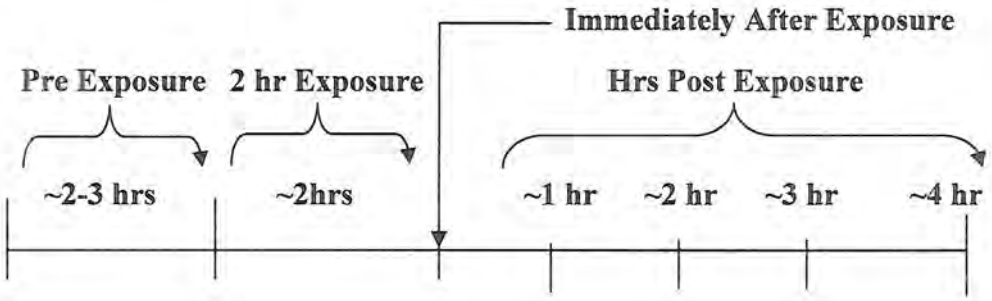
Day 1



Measurements & Collections	*	*				
Lung Function	*	*	*	*	*	*

****

Day 2



Measurements & Collections	*	*

Lung Function * * * * * *

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Day 3

Measurements & Collections *

Lung Function *

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Protocol: Written consent will be obtained. The subjects will be trained (on D0) in techniques for obtaining lung function measurements. Subjects also will exercise on a bicycle, and appropriate settings (the speed and grade of incline) required to produce a desired value of minute ventilation will be determined. On the first day of exposure, subjects will be assessed for vital signs (blood pressure, pulse, temperature and respiratory rate) at the check-in. Subjects may perform pre-exposure baseline lung functions in clean air, have resting heart rate variability (HRV) assessed, and urine, blood, and exhaled breath collected for later analyses of soluble mediators such as clotting factors, inflammatory proteins, and lipids and blood cell types and numbers. These samples may also serve to determine biomarkers of exposure, such as the concentration of PAHs . A questionnaire measuring perceived stress by the subject at the beginning of an exposure regimen will be filled out; this is included as Attachment #1. [Information about grading the questionnaire (Sheldon Cohen Perceived Stress Scale) is described at www.mindgarden.com].The subject then will enter the chamber already set for the appropriate conditions (DE & O3, DE alone, O3 alone, or clean air), and after 15 min begin exercising on a stationary bicycle. Each exposure session will consist of a 4 periods of 15 rest/15 min exercise at a level of approximately 25 liters/min/m^2 body surface area (BSA) in minute ventilation followed. Measurements of lung function may be obtained immediately after, and every hour for up to 4 hr post exposure. Resting HRV may be recorded, and blood, urine, and breath collected immediately post exposure. Following the day 1 exposure, the subject may remain at the Medical Station for follow up measurements of lung function for approximately 2-4 hr. The subjects will go home with a heart rate monitor and blood pressure cuff. On Day 2, the subject will report to the medical station in the morning. The same measurements (resting HRV, lung function; symptoms; venipuncture performed) as Day 1 may be done pre- and post- exposure to O3. Subjects will return on Day 3 for follow up measurements but with no exposures.

Experimental procedures:
Medical history will be collected, including current medications and any recent illness.

Vital signs will be measured to include height, weight, heart rate, respiratory rate, blood pressure, oxygen saturation, and temperature. In addition a pregnancy test will be given to all women before each exposure regime.

Spirometry will be performed on a dry seal digital spirometer including the forced expiratory maneuver, forced vital capacity (FVC), forced expired volume in the first second (FEV_1), and FEV_1/FVC.

Exhaled Breath Collection: The participant will be asked to breathe into a cooled tube for up to 15 minutes. Collected breath condensate may be analyzed for markers of airway inflammation and immune system alterations and exposure markers. Additionally a small Tedlar bag of uncooled, exhaled breath will be collected (up to 5 min) to examine gas phase exposure and inflammation/immune system constituents.

For exercise measurements the subjects breathe for up to 3 min through a pneumotachograph while performing exercise and ventilation parameters including the minute ventilation, tidal volume and breathing frequency will be obtained. Heart rate will be monitored throughout exposure using a telemetry monitor.

Cardiac measurements: Heart Rate Variability monitoring (ambulatory ECG) monitoring: On the day 1 and day 2 of each of the exposure regimes we will mount a Holter monitor to the participants. The skin may be shaved (men only) and prepped. ECG electrodes are attached and connected to the beeper-sized Holter monitor, which participants wear around their waist. After mounting the monitor onto participants, they will be asked to relax for 20 minutes in a reclined position after which a 10-minute resting HRV measurement will be obtained. Participants are released while wearing the Holter monitor and return to the HSF the next morning (day 2 of the study segment) to obtain the Holter monitor information and change the batteries, if necessary. The monitor will be worn for day 2 and removed on day 3. We will analyze time and frequency as well as re-polarization parameters. Participants will be given instructions for the removal of the monitor in case it becomes necessary.

Blood pressure (BP) measurements: BP will be monitored during the study. A BP cuff may be worn to measure BP intermittently. A pressure cuff and a monitor which is about the size of the Holter monitor will be placed and will remain in place until the subjects leave for the day. The subjects will be instructed to keep arm relaxed and still when the pressure cuff is inflated. The subjects may wear the cuff for day 1 and 2 of the study session and have it removed on day 3. Participants will be given instructions for the removal of the monitor in case it becomes necessary.

Venipuncture: Up to approximately 500 ml of blood will be collected for the 8 exposure days over a minimum of 8 weeks. This translates to approximately 50 ml of blood for each exposure day and 25 ml on the follow up day. A portion of the sample will be used for genotyping to examine sensitivity in selected blood types. Blood will be analyzed for, but not limited to, clotting/coagulation and inflammation factors and biomarkers of immune response.
A portion of the peripheral blood sample will be used for genetic testing, to identify potential polymorphisms that may make subjects more susceptible to air pollutants. In addition, samples may be stored for as yet undesignated research. Unwillingness to have samples used for genotyping or stored will NOT exclude a subject from the panel study. Consent for genotyping will be included with the general consent form.

Urine: Participants will collect their urine on days 1, 2, and 3 for each arm of the study. Day 1 will be a 24 hr collection. Urine collection on days 2 and 3 will be limited to subject's stay in the facility. It is estimated that there will be on average seven urine voids collected per person for a 24 hr sampling period [40]. Each urine void will be collected in a separate 1 L polypropylene container (*not pooled*) for this study. In addition, each urine void will be analyzed separately for exposure reconstruction purposes.

For collection of a 24 hr urine sample, each participant will start collecting their individual urine samples on day 1 at the medical station (~8:00 a.m.) and collect through the first morning void the next day (i.e. day 2). The participants will collect each urine void in a separate 1 L polypropylene container and record the time the sample was collected and the time of their last urine void. Then, they will place the container in a provided thermoelectric cooler. The participant will return the cooler containing the 24 hr urine collection samples in the morning at the HSF on day 2, for each arm of the study. On day 2, a

urine sample before and immediately after exposure will be collected. On day 3, one urine sample will be collected. For each person, it is estimated that about 40 samples (~10 urine samples per exposure session X 4 exposure sessions) will be collected from them during the study.

Urine will be examined for markers of exposure (e.g. PAHs) and effect (e.g. IL8 as a marker of inflammation), plus normalization factors (e.g. creatinine).

Likely Personnel assignment	
Subject recruitment and payment	Westat Corporation (Protocol #950518)
Chamber setup and maintenance	TRC Environmental Corporation
Subject surveillance during exposure	Martin Case, BS, Mike Madden, PhD, Tina Stevens, PhD, Howard Kehrl, MD, David Diaz-Sanchez PhD, Medical Station personnel
Lung function testing	Martin Case, BS, Mike Madden PhD, Tina Stevens, PhD Howard Kehrl, MD
Blood sampling	Human Studies Facility Medical Station personnel
Subject screening tests	Human Studies Facility Medical Station personnel
Genomic assay	Michael Schmitt, MS

A.4.6. **Benefits to subjects and/or society.** Describe any potential for direct benefit to individual subjects, as well as the benefit to society based on scientific knowledge to be gained; these should be clearly distinguished. Consider the nature, magnitude, and likelihood of any direct benefit to subjects. If there is no direct benefit to the individual subject, say so here and in the consent form (if there is a consent form). Do not list monetary payment or other compensation as a benefit.

The results of this study will contribute to the overall assessment of air pollution effects in the U.S. and thereby influence health policy. The subjects will not benefit personally from being in this research study other than by undergoing a free limited physical examination and screening.

A.4.7. **Full description of risks and measures to minimize risks.** Include risk of psychosocial harm (e.g., emotional distress, embarrassment, breach of confidentiality), economic harm (e.g., loss of employment or insurability, loss of professional standing or reputation, loss of standing within the community) and legal jeopardy (e.g., disclosure of illegal activity or negligence), as well as known side effects of study medication, if applicable, and risk of pain and physical injury. Describe what will be done to minimize these risks. Describe procedures for follow-up, when necessary, such as when subjects are found to be in need of medical or psychological referral. If there is no direct interaction with subjects, and risk is limited to breach of confidentiality (e.g., for existing data), state this.

This study might involve the following risks and/or discomforts:

1. Blood sampling will be performed by well-trained personnel, and entails only a risk of mild discomfort with the infrequent possibility of lightheadedness, fainting, infection or developing a bruise. Subjects are closely monitored for any signs of faintness, and only allowed to leave the facility after a 15-min waiting period.
2. Breathing tests (spirometry): There pulmonary function tests are standard clinical tests that are commonly performed in hospitals and entail little or no risk to the subjects. However, cough or

dizziness may occur during these tests. If these symptoms occur, they are usually temporary. Subjects will remain seated in a chair until symptoms disappear. There is an extremely small chance that the subject could have a bronchospasm or faint upon performing a forced breath expiratory maneuver for spirometry.

3. Exhaled breath condensate and exhaled breath gas: Minimal risk is associated with these procedures. The subject is seated in a chair during these collections and the technician is always available during this procedure in case the participant becomes light-headed due to hyperventilation.
4. Moderate exercise on a stationary bicycle entails the potential, although minimal, risk of occasional muscle soreness, cramps or general fatigue. These discomforts are temporary and not harmful. Heart rate and rhythm will be monitored continuously. Heart rate will be kept below age related maximum (i.e., 220 bpm – age in years). Exercise will be terminated at any time upon the request of the subject or if the investigator/medical staff observes problems while monitoring the ECG readout.
5. Ozone exposure: Potential risks may include mild airway obstruction, irritation to the nose, eyes, throat and airways, pain on deep inspiration and cough. These symptoms typically disappear 2 to 4 hours after exposure, but may last longer for particularly sensitive people. Ozone may induce an inflammatory reaction that may last for about 24-48 hours after exposure and may increase the chance of catching a cold.
6. ECG and heart rate variability are standard non-invasive techniques commonly used for heart rate and rhythm analysis and entail little or no risk to the subject. There is the possibility that preparation of the skin for electrode placement and removal may cause skin irritation, itching, or soreness in some subjects.
7. Blood pressure and heart rate measurement: Similar to the regular blood pressure measurement, the risk associated with blood pressure monitor is considered minimal.
8. Diesel exhaust (DE) exposure: The amount of DE (target of 300 $\mu g/m^3$) used in this study would be equivalent to concentrations of DE particulate matter that would be encountered at busy intersections in large urban areas and in occupational exposures. Occupational levels for some truck drivers are generally about 100-300 $\mu g/m^3$ and average ~900 $\mu g/m^3$ for some mines where diesel powered machinery are used. A recent study demonstrated diesel exhaust particulate matter concentrations during drive-by incidents averaged about 125 and199 μg/m3 at the height of an adult pedestrian and a child in a stroller, respectively. Using a 2006 diesel engine, (generally recognized as emitting less PM mass than most older models currently on the road), it was demonstrated that an average DEP concentration up to 364 ug/m^3 (over ~9 sec) could be generated at near roadside monitoring stations at head level during drive by simulations with a peak concentration of 860 ug/m^3. [41].

   Controlled, acute DE exposure studies in Sweden, using about 300 $\mu g/m^3$ of DEP, have shown lung inflammatory effects not unlike effects observed with numerous ozone exposure studies performed here at the EPA facility on the UNC campus during the past 20 yr. DE particles contain some probable carcinogenic polycyclic aromatic hydrocarbons and other components, which in high enough concentrations and/or with repeated exposures may induce tumors. Diesel exhaust also contains aldehydes, some of which are possibly carcinogenic in high enough dose and with long enough exposure. However, the exposure time and concentrations to be used in this protocol are minimal relative to the durations required to induce lung cancer. Overall, there are no known long-term health risks in healthy individuals acutely exposed to DE at the PM concentrations given in this study. Short-term health effects include slight alterations in blood clotting, oxygen diffusion capacity and changes in heart rate variability. These symptoms typically disappear within 24 hrs of exposure. During exposure, subjects will

be monitored by direct observation or via closed-circuit television. Subjects will have EKG leads attached during the exposure to monitor cardiac function during exercise. Subjects will be aware that they can terminate their exposure for any reason and still receive compensation for their participation up to that point. The investigators or duty physician will end the exposure if the subject is found to be suffering from any significant adverse effect. No major adverse effects were observed in a completed diesel exhaust study of healthy adults (ages 18-40; entitled "Physiological, Cellular, and Biochemical Effects of Diesel Exhaust in Healthy Young Adults"; Mike Madden, PI; UNC IRB # # 99-0842) where the PM concentration averaged 106 ug/m3. No major adverse health effects were observed in a completed study that exposed subjects (18-35 yr old, healthy volunteers) to concentrated Chapel Hill air particles here at the EPA facility (Physiological and Biochemical Changes Associated with Exposure to Air Pollution Particles; Andrew Ghio, MD, PI; UNC IRB# 95-EPA-310). The maximum PM concentration reached 311 $\mu g/m^3$ during the exposure. The data from this exposure study suggest that normal healthy subjects tolerate inhalation of concentrated ambient PM fairly well, and support the idea that exposures to lower PM concentrations, including DEP, will be fairly safe in terms of cardiopulmonary responses. For safety reasons, pulse oximetry will be performed during the exposures and the subject withdrawn from the chamber if the O_2 saturation value is $\leq$92%. Additionally subjects will have carboxyhemoglobin values determined within 1 hr after an exposure and kept at the Medical Station if levels are >20% (where performance of everyday cognitive tasks may be jeopardized) until levels become <20%; but because the CO levels are expected to be 2-4 ppm [based on preliminary chamber characterizations], levels are expected to be < 5%.

A duty physician is always onsite to respond to an emergency. Fully equipped resuscitation equipment is available for use in the event of a cardiac or pulmonary emergency. Physicians at the University of North Carolina (UNC) Hospitals Emergency Room are also available to assist in treatment of an emergency.

Heart rate and rhythm, and pulse oximetry will be monitored continuously. Subjects will also be monitored for significant respiratory distress or dyspnea, chest pain, significant cardiac arrhythmias, pallor, and ataxia. Subjects will be aware that they can terminate their exposure for any reason and still receive compensation for the entire exposure session. The investigator or duty physician will end the exposure if the subject is found to be suffering from any adverse effect.

9. Effects of combined ozone and diesel exhaust exposure: Because this exposure scenario has not been conducted at our facilities or elsewhere before, we do not yet know whether or not this exposure will include the same risks as diesel exhaust and ozone exposures alone. It is possible that the combination of diesel exhaust and ozone exposures will increase the effects of each pollutant individually, and it is also possible that it will not. We are doing this study in order to find out the answer.
10. Confidentiality: Risk of breach of confidentiality is minimal. All subjects will be assigned a study number which will be used for data recording – not the subject's name. The study number is all that will be entered into computer databases. All paper files that may contain the subject's name or screening number are secure in a locked cabinet in a locked room at the US EPA facility. Any abnormal medical findings (CBC, ECG,

spirometry) will be discussed with the volunteer and the volunteer will be counseled to seek treatment from his/her personal physician. Samples will be stored at the U.S. EPA HSF. A numeric coding system will be used to ensure that subjects cannot be directly identified from the samples alone.

In addition, there may be uncommon or previously unknown risks that might occur. During all testing, subjects will be monitored continuously by the EPA personnel. A duty physician will be available in response to an emergency. A group of physicians employed by EPA and UNC Center for Environmental Medicine, Asthma & Lung Biology have primary responsibility for medical coverage of studies conducted in the EPA Human Exposure Facility. This facility is also equipped with an emergency "crash cart" with standard emergency medications, IV fluids and a defibrillator in the unlikely event of a medical emergency for any challenge or exposure study.

A.4.8. **Data monitoring and analysis.** Tell how the qualitative and/or quantitative data will be analyzed. Explain how the sample size is sufficient to achieve the study aims. This might include a formal power calculation or explanation of why a small sample is sufficient (e.g., qualitative research, pilot studies). Describe the provisions for monitoring the data to ensure the safety of participants. These plans could range from the investigator monitoring subject data for any safety concerns to a sponsor-based DSMB, depending on the study.

The research objective of this study is to determine if healthy volunteers safely exposed to low levels of O3 and DE alone or in combination, will show changes in cardiopulmonary endpoints including modest decrements in lung function. The study will follow a randomized, repeated measures design with each subject exposed to 4 different exposure regimens (see Figures 1 and 2 above). The data analysis will be focused on changes in lung function measurements, primarily FVC and FEV_1, between pre and post 2hr exposure for each exposure, but also blood endpoints include inflammatory factors (eg IL-6), blood clotting factors (eg fibrinogen), and susceptibility factors (eg specific genotypes such as glutathione-S-transferase M1 (GSTM1) null).

In evaluating exposure effects of O3 and DE, alone or in combination, upon lung function, the difference between the pre-exposure and post-exposure FEV1 will be calculated and the pre-post differences for the air and the exposures will be compared utilizing repeated measures ANOVA parametric test. Clinically significant change is determined to be a 10% decrease in FEV1 measured prior to and immediately after the exposure compared to the pre exposure value. For a conservative sample size calculation, we used one sided test for a single sample under the assumption of normal distribution with Type I error of 5% and Type II error of 20%. Therefore, a ρ value of 0.05 or less will be considered significant and the proposed sample size will provide adequate (80%) power for detecting a 10% decrease in ΔFEV1.

Sample size calculation was based on the Forced Expiratory Volume in 1 Second (FEV1) in response to the O3 exposure. Data for the power calculation were obtained from results of FEV_1 [42] for a constant acute exposure to 0.3 ppm O_3 versus clean air (CA). In 22 subjects, the pre exposure FEV_1 was 4.608 ± 0.514 (mean ± SEM) in CA exposure and 4.656 ± 0.592 in O_3. The post exposure FEV_1 was 4.64 ± 0.476 in CA exposure and 3.856± 0.687 in O_3. We used 0.687 as an estimate of standard deviation after the ozone exposure and estimated 10% decrease in pre-exposure FEV1 levels to be 0.46 ml. Based on these data and the test for the mean of a normal distribution with a one-sided alternative the required sample size is 14 subjects. We will recruit 15 subjects for this study to ensure the statistical power that can analyze small differences expected from low concentration exposures.

Although EPA does not have an official Data Safety Monitoring Board, we do have measures in place to insure the safety of our subjects. Adverse events will be reported to Bob Truckner, the EPA/NHEERL human research protection officer of the IRB.

Precautions taken to minimize risk to the subject include:

1. subject monitoring via direct observation or CCTV during exposure
2. Cardiac function will be assessed throughout the exposures. Evidence in 2 individuals of a QTc interval >450 milliseconds (ms) will prompt a pause in the study. The length of the QT period was chosen as the primary endpoint to examine as a marker of cardiac toxicity in part based on this marker's use in Phase 1 Clinical Trials where possible cardiac toxicity was monitored via ECG. In addition, QTc interval increases greater than 60 ms from baseline will also prompt a pause in the study.
3. Pulse oximetry will be performed during the exposures and the subject withdrawn from the chamber if the oxygen saturation value is $\leq 92\%$.
4. Subjects will be aware of their right to terminate their participation in the study without prejudice.
5. Any exposure will be stopped upon evidence of any adverse effects suffered by the subject during the exposure
6. Full resuscitation equipment will be available at all times during exposures and used if needed
7. In the event of an emergency, after initial medical assessment, patients will be transported to the UNC Hospitals Emergency Room for continued treatment
8. A formal pause to the study will be performed by the medical station staff after 4 subjects complete the 4 exposure regimes to assess whether highly adverse effects occurred with respect to lung and cardiac physiology responses. If no highly adverse effects are observed, the study will continue.

A.4.9. **Will you collect or receive any of the following identifiers?** Does not apply to consent forms.

__ No _x_ Yes *If yes, check all that apply*:

a. _x_ Names
b. _x_ Telephone numbers
c. _x_ Any elements of dates (other than year) for dates directly related to an individual, including birth date, admission date, discharge date, date of death. For ages over 89: all elements of dates (including year) indicative of such age, except that such ages and elements may be aggregated into a single category of age 90 and older
d. _x_ Any geographic subdivisions smaller than a State, including street address, city, county, precinct, zip code and their equivalent geocodes, except for the initial three digits of a zip code
e. __ Fax numbers
f. _x_ Electronic mail addresses
g. __ Social security numbers
h. _x_ Medical record numbers
i. __ Health plan beneficiary numbers
j. __ Account numbers
k. __ Certificate/license numbers
l. __ Vehicle identifiers and serial numbers (VIN), including license plate numbers
m. __ Device identifiers and serial numbers (e.g., implanted medical device)
n. __ Web universal resource locators (URLs)
o. __ Internet protocol (IP) address numbers
p. __ Biometric identifiers, including finger and voice prints
q. __ Full face photographic images and any comparable images
r. __ Any other unique identifying number, characteristic or code, other than dummy identifiers that are not derived from actual identifiers and for which the re-identification key is maintained by the health care provider and not disclosed to the researcher

A.4.10. **Identifiers in research data**. Are the identifiers in A.4.9 above linked or maintained with the research data?

__ yes __x no

A.4.11. **Confidentiality of the data**. Describe procedures for maintaining confidentiality of the data you will collect or will receive. Describe how you will protect the data from access by those not authorized. How will data be transmitted among research personnel? Where relevant, discuss the potential for deductive disclosure (i.e., directly identifying subjects from a combination of indirect IDs).

All individuals who have been granted access to the data to perform their research-related duties have received full ethics training. Computer data files are password protected and subjects are coded as an unrelated subject identifying number. The participant's actual identity cannot be ascertained exclusively from these data. The participant's name will not be used in any publications. Access to the records of this study will be provided by the identifying number only and given only to those individuals associated with the study who require access to the data to perform their duties. All such individuals will be bound by this agreement of confidentiality. All records are maintained in a locked room in the medical records office of the USEPA Human Studies Facility.

A.4.12. **Data sharing.** With whom will *identifiable* (contains any of the 18 identifiers listed in question A.4.9 above) data be shared outside the immediate research team? For each, explain confidentiality measures. Include data use agreements, if any.

_x_ No one
__ Coordinating Center:
__ Statisticians:
__ Consultants:
__ Other researchers:
__ Registries:
__ Sponsors:
__ External labs for additional testing:
__ Journals:
__ Publicly available dataset:
__ Other:

A.4.13. **Data security for storage and transmission**. Please check all that apply.

For electronic data stored on a desk top computer:
__x Secure network __x Password access __x Data encryption__x Password protected file(s)
__ Other comparable safeguard (describe):

For portable computing devices/external storage devices (e.g. laptop computer, PDA, CDs, memory sticks):
__x Power-on password __x Automatic log-off __x Data encryption __x Password protected file(s)
__ Other comparable safeguard (describe):

For hardcopy data (including human biological specimens, CDs, tapes, etc.):
__ Data de-identified by research team (stripped of the 18 identifiers listed in question A.4.9 above)
__ Locked suite or office __ x Locked cabinet
__x Data coded by research team with a master list secured and kept separately
__ Other (describe):

A.4.14. **Post-study disposition of identifiable data or human biological materials**. Describe your plans for disposition of data or human biological specimens that are identifiable in any way (directly or via indirect codes) once the study has ended. Describe your plan to destroy identifiers, if you will do so.

The study data will be archived with identifiers by storage in a locked closet in the secured USEPA HSF building. If offsite storage space is ever required for the data, the data will be transferred to offsite storage according to the USEPA's record keeping guideline.

Specimens from subjects who consent for his/her samples to be stored will remain stored in a repository and will be released to investigators for use. Specimens from subjects who opt not to allow for storage will be destroyed at the end of the study.

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Part A.5. The Consent Process and Consent Documentation (including Waivers)

The standard consent process is for all subjects to sign a document containing all the elements of informed consent, as specified in the federal regulations. Some or all of the elements of consent, including signatures, may be altered or waived under certain circumstances.

- If you will obtain consent in any manner, complete **section A.5.1**.
- If you are obtaining consent, but requesting a waiver of the requirement for a signed consent document, complete **section A.5.2**.
- If you are requesting a waiver of any or all of the elements of consent, complete **section A.5.3**.
- If you need to access Protected Health Information (PHI) to identify potential subjects who will then be contacted, you will need a *limited waiver of HIPAA authorization*. This is addressed in section B.2.

You may need to complete more than one section. For example, if you are conducting a phone survey with verbal consent, complete sections A.5.1, A.5.2, and possibly A.5.3.

A.5.1. **Describe the process of obtaining informed consent from subjects.**
Describe who will be obtaining consent (or permission) and from whom. Include discussion, as relevant, any waiting period between the initial consent discussion and obtaining consent, and steps that will be taken to minimize coercion or undue influence. If children will be enrolled as subjects, describe the provisions for obtaining parental permission and assent of the child. If decisionally impaired adults are to be enrolled, describe the provision for obtaining surrogate consent from a legally authorized representative (LAR). If non-English speaking people will be enrolled, explain how consent in the native language will be obtained. Address both written translation of the consent and the availability of oral interpretation. It is expected that the information in the consent document(s) will be communicated to participants or their LAR. *After you have completed this part A.5.1, if you are not requesting a waiver of any type, you are done with Part A.5.; proceed to Part B.*

Prior to participation, all volunteers will be required to read and sign the consent form which asserts that they have read and understood the following: 1.) Subject participation is strictly voluntary; 2.) The

purpose of the study; 3.) The nature and extent of subject participation; 4.) The subject's rights to withdraw at any time; 5.) The subject's right to privacy, 6.) The risks associated with participation; 7.) The method and schedule of compensation; and 8.) The limits of the EPA, University and PI's liability. The PI, co-PIs or study coordinator will briefly describe the study and answer any questions that each subject might have about the study. Subjects will have the opportunity to ask questions at any time during the study by contacting the PI and/or the study coordinators. The subject will be given a copy of the signed consent form for his/her records.

A.5.2. **Justification for a waiver of *written* (i.e., signed) consent**. *The default is for subjects to sign a written document that contains all the elements of informed consent.* Under limited circumstances, the requirement for a signed consent form may be waived by the IRB if either of the following is true. *Choose only one:*

a. The only record linking the subject and the research would be the consent document and the principal risk would be potential harm resulting from a breach of confidentiality (e.g., study topic is sensitive so that public knowledge of participation could be damaging). *Participants should be asked whether they want documentation linking them with the research and the participants' wishes will govern whether they sign the form.* Note: This justification cannot be used in FDA-regulated research. __ yes __ no __ yes __ no

Explain.

b. The research presents no more than minimal risk of harm to subjects and involves no procedures for which written consent is normally required outside of the research context (e.g., phone survey).

Explain.

If you checked "yes" to either (and you are not requesting a waiver in section A.5.3) consent must be obtained orally, by delivering a fact sheet, through an online consent form, or be incorporated into the survey itself. Include a copy of the consent script, fact sheet, online consent form, or incorporated document.

→ If you have justified a waiver of written (signed) consent (A.5.2), you should complete A.5.3 *only* if your consent process will not include all the other elements of consent.

A.5.3. **Justification for a full or partial waiver of consent.** *The default is for subjects to give informed consent.* A waiver might be requested for research involving only existing data or human biological specimens (see also Part C). More rarely, it might be requested when the research design requires withholding some study details at the outset (e.g., behavioral research involving deception). In limited circumstances, parental permission may be waived. This section should also be completed for a waiver of HIPAA authorization if research involves Protected Health Information (PHI) subject to HIPAA regulation, such as patient records.

__ Requesting **waiver of some elements** (specify; see SOP 28 on the IRB web site):
__ Requesting **waiver of consent entirely**

If you check either of the boxes above, answer items a-f.. To justify a full waiver of the requirement for informed consent, you must be able to answer "yes" (or "not applicable" for question c) to items a-f. **Insert brief explanations that support your answers.**

a. Will the research involve no greater than minimal risk to subjects or to their privacy? __ yes __ no

Explain.

b. Is it true that the waiver will *not* adversely affect the rights and welfare of subjects? *(Consider the right of privacy and possible risk of breach of confidentiality in light of the information you wish to gather.)* __ yes __ no
Explain.

c. When applicable to your study, do you have plans to provide subjects with pertinent information after their participation is over? *(e.g., Will you provide details withheld during consent, or tell subjects if you found information with direct clinical relevance? This may be an uncommon scenario.)* __ yes __ not applicable
Explain.

d. Would the research be impracticable without the waiver? *(If you checked "yes," explain how the requirement to obtain consent would make the research impracticable, e.g., are most of the subjects lost to follow-up or deceased?).* __ yes __ no
Explain.

e. Is the risk to privacy reasonable in relation to benefits to be gained or the importance of the knowledge to be gained? __ yes __ no
Explain.

If you are accessing patient records for this research, you must also be able to answer "yes" to item f to justify a waiver of HIPAA authorization from the subjects.

f. Would the research be impracticable if you could not record (or use) Protected Health Information (PHI)? *(If you checked "yes," explain how* not *recording or using PHI would make the research impracticable).* __ yes __ no
Explain.

Part B. Questions for Studies that Involve Direct Interaction with Human Subjects

→ *If this does not apply to your study, do not submit this section.*

B.1. **Methods of recruiting.** Describe how and where subjects will be identified and recruited. Indicate who will do the recruiting, and tell how subjects will be contacted. Describe efforts to ensure equal access to participation among women and minorities. Describe how you will protect the privacy of potential subjects during recruitment. *For prospective subjects whose status (e.g., as patient or client), condition, or contact information is not publicly available (e.g., from a phone book or public web site), the initial contact should be made with legitimate knowledge of the subjects' circumstances. Ideally, the individual with such knowledge should seek prospective subjects' permission to release names to the PI for recruitment. Alternatively, the knowledgeable individual could provide information about the study, including contact information for the investigator, so that interested prospective subjects can contact the investigator.* Provide the IRB with a copy of any document or script that will be used to obtain the patients' permission for release of names or to introduce the study. Check with the IRB for further guidance.

Subjects may be recruited for this study by the Westat Corporation, which has recruited for studies at the U.S. EPA HSF since 1998. The manner in which this will be done is similar to that of past U.S. EPA studies and specific recruitment procedures as per the previously UNC IRB-approved protocol, "Recruitment and Screening of Potential Subjects for EPA Studies" (95-0518; Howard Kehrl, PI). Subjects may be identified from mass emailing for recruits, website [https://www.epastudies.org/ with contact phone numbers listed as 919-966-0604 and toll free 888-279-9353] and newspaper and brochure advertising by Westat Corporation [a recent, advertisement brochure for subject recruitment is included as Attachment #2], and from the Westat database for subjects. These documents (email recruitment wording to current subjects from other studies and potentially new subjects , newspaper advertisement, a study description handout, study reminder notices to subjects, are attached in the appendix section of this application as Attachments 2-7. Every effort will be made to recruit women and members of racial minority groups into this study. Subjects will be asked to call the recruitment office. During the telephone interview, the subjects will receive information regarding the study and their eligibility for the study will be assessed. Subjects who provide responses which indicate that they are likely to meet the criteria will be scheduled for an appointment in the Westat recruitment office in the U.S. Human Studies Facility. At that time the study protocol will be outlined, and a medical history form will be administered.

B.2. **Protected Health Information (PHI).** If you need to access Protected Health Information (PHI) to identify potential subjects who will then be contacted, you will need a *limited waiver of HIPAA authorization.* If this applies to your study, please provide the following information and complete Section C.

a. Will the information collected be limited only to that necessary to contact the subjects to ask if they are interested in participating in the study?

b. How will confidentiality/privacy be protected prior to ascertaining desire to participate?

c. When and how will you destroy the contact information if an individual declines participation?

B.3. **Duration of entire study and duration of an individual subject's participation, including follow-up evaluation if applicable.** Include the number of required contacts and approximate duration of each contact.

This study will take approximately 18 months (actual study time) to complete. The study duration is based on 1-2 exposure days per week and 1 subject on each exposure day. This scheduling, however, is subject to change depending on the availability of study subjects and the number of concurrent studies requiring the same chamber facility.

All subjects will have at least 13 visits to the research facility over approximately 3 months. On the first visit, the subject will go through a consent process and then a training session for approximately 3 hours. During each of three subsequent visits (exposure days), subjects are required to check in by about 8:00 am and will be discharged approximately at 4:00 pm. Therefore, subjects will remain in the research facility for approximately 8 hours on exposure day 1. The following day, subjects are required to check in by 8:00 am and will be discharged approximately at 4:00 pm. Therefore, subjects will remain in the research facility for approximately 8 hours on exposure day 2. The 3rd day the subjects are required to check in by 8:00 am and will be discharged approximately at 11:00 am, for a total of approximately 3 hrs. Subjects will come back for the next 3 regimes following the same schedule for days 1-3 with 13 or more days between each regime. The total amount of time at this facility will be ~79 hr

B.4. **Where will the subjects be studied?** Describe locations where subjects will be studied, both on and off the UNC-CH campus.

All subjects will be studied in the USEPA Human Studies Facility located at 104 Mason Farm Road in Chapel Hill on the UNC Campus.

B.5. **Privacy.** Describe procedures that will ensure privacy of the subjects in this study. Examples include the setting for interviews, phone conversations, or physical examinations; communication methods or mailed materials (e.g., mailings should not indicate disease status or focus of study on the envelope).

All interviews and phone conversations will be conducted from either the Westat Recruiting office or the Medical Station in the U.S. EPA Human Studies Facility. This facility is guarded and only individuals working in the building have access beyond the guard's desk without an escort. Physical exams and other procedures will occur in appropriate clinical areas of the EPA. Occasionally 2 subjects may be seen in the clinical area at one time; however, sensitive information is only discussed in private (medication use, pregnancy test results). The subjects will be scheduled with the TRC (Chamber operators) group using a study number; however TRC only maintains a single separate log with the study number and the subject's number but not personal identifying information. Subjects may be contacted by email to schedule/remind them about study visits or to answer specific questions. Any information sent via US mail or campus mail will simply have a return address, no other study specific information.

B.6. **Inducements for participation.** Describe all inducements to participate, monetary or non-monetary. If monetary, specify the amount and schedule for payments and if/how this will be prorated if the subject withdraws (or is withdrawn) from the study prior to completing it. For compensation in

foreign currency, provide a US$ equivalent. Provide evidence that the amount is not coercive (e.g., describe purchasing power for foreign countries). Be aware that payment over a certain amount may require the collection of the subjects' Social Security Numbers. If a subject is paid more than $200.00 per year, collection of subjects' Social Security Number is required (University policy—see SSN Guidance) using the Social Security Number collection consent addendum found under forms on the IRB website (look for Study Subject Reimbursement Form).

Subjects will receive monetary compensation for their time ($12 per hour) and some procedures in the study (See below). In addition, subjects traveling from areas beyond Chapel Hill will be reimbursed for travel expenses commensurate with the US Government mileage rate in effect at the time. Parking will be provided or costs will be paid. Payments will be made after each segment of the study, unless the subject requests otherwise.

A subject who is unable to complete the study for voluntary reasons or failure to comply with eligibility requirements will receive full compensation for his/her participation up to that point. Subjects who are dismissed by the investigators after enrollment in the study but prior to completion for involuntary reasons will be compensated for his/her participation up to that point and will receive compensation at the hourly rate of $12 per hour for that particular scheduled 3 day study session.

In the event a scheduled study activity must be cancelled by the investigators with less than 72 hours prior notice, the subject will be paid at the standard hourly rate for the time scheduled and canceled, and will be paid 50% of procedure fees up to a total maximum of $100 for canceled procedures. Cancellations could occur due to adverse weather conditions, equipment failure, or other unforeseen events. When feasible, the subject will be rescheduled.

Money received by participants in research studies is normally treated as ordinary income by taxing authorities and payments made to you to the Internal Revenue Service as required by law. The money is not intended to coerce completion or participation, but to emphasize the importance of all the visits, and to signify the importance of your time and commitment to the research study.

Subject Compensation for Procedures during Diesel and Ozone Exposure Study

Training Day (assume 3 hr @$12/hr)	$36
First Exposure:	
Day 1	
Hourly payment (assume 8 hr @$12/hr)	$96
On-time bonus (8 a.m.)	$25
Stress questionnaire	$2.50
Blood Draw (twice)	$30
24 hr Urine Sample	$60
Exhaled breath collection (twice)	$10
24 hr Holter Monitoring	$100
24 hr Blood Pressure Monitoring	$50
Lung function (6x)	$60
Lunch	$5
Day 2	
Hourly payment (assume 8 hr @$12/hr)	$96

On-time bonus (8 a.m.)	$25
Blood Draw (twice)	$30
Urine Sample (3x)	$15
Exhaled breath collection (twice)	$10
24 hr Holter Monitoring	$100
24 hr Blood Pressure Monitoring	$50
Lung function (6x)	$60
Lunch	$5
Day 3	
Hourly payment (assume 3 hr @$12/hr)	$36
Blood Draw	$15
Exhaled breath collection	$5
Urine Sample	$5
Lung function	$10

[Total payment First Exposure]	$900.50
Second Exposure	$900.50
Third Exposure	$900.50
Fourth Exposure	$900.50
Completion Bonus (for completing all 4 exposure sessions)	$100
APPROXIMATE TOTAL (including training day)	$3,738.00

Other Possible Costs:
Extra Blood sticks ($10 each)
Extra hours ($12 per hour)
Travel from out of town (based on mileage)

B.7. **Costs to be borne by subjects.** Include child care, travel, parking, clinic fees, diagnostic and laboratory studies, drugs, devices, all professional fees, etc. If there are no costs to subjects other than their time to participate, indicate this.

There will be no cost to the subject excluding child and dependent care. Parking fees are covered by the study in the form of parking vouchers. All study related diagnostic tests such as pregnancy tests, pulmonary function test and labs are covered by the study. Westat subjects are primarily recruited from the Chapel Hill area. Volunteers who come from outside this area may be reimbursed for mileage at the current government rate.

Attachment #1 The Sheldon Cohen Self-Perceived Stress Questionnaire (from www.mindgarden.com)

Perceived Stress Scale

The questions in this scale ask you about your feelings and thoughts **during the last month**. In each case, you will be asked to indicate by circling *how often* you felt or thought a certain way.

Name _____ Date _____

Age _____ Gender (*Circle*): M F Other _____

0 = Never 1 = Almost Never 2 = Sometimes 3 = Fairly Often 4 = Very Often

1. In the last month, how often have you been upset because of something that happened unexpectedly?	0	1	2	3	4
2. In the last month, how often have you felt that you were unable to control the important things in your life?	0	1	2	3	4
3. In the last month, how often have you felt nervous and "stressed"?	0	1	2	3	4
4. In the last month, how often have you felt confident about your ability to handle your personal problems?	0	1	2	3	4
5. In the last month, how often have you felt that things were going your way?	0	1	2	3	4
6. In the last month, how often have you found that you could not cope with all the things that you had to do?	0	1	2	3	4
7. In the last month, how often have you been able to control irritations in your life?	0	1	2	3	4
8. In the last month, how often have you felt that you were on top of things?	0	1	2	3	4
9. In the last month, how often have you been angered because of things that were outside of your control?	0	1	2	3	4
10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?	0	1	2	3	4

Protocol title: "Cardiopulmonary Responses to Exposure to Ozone and Diesel Exhaust with Moderate Exercise in Healthy Adults"; T. Stevens PI

July 27, 2009 version

OFFICE OF HUMAN RESEARCH ETHICS
Institutional Review Board

JUL 21 2010

APPLICATION FOR IRB APPROVAL OF
HUMAN SUBJECTS RESEARCH
Version9 September 29th

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Part A.1. Contact Information, Agreements, and Signatures

Date: July 20, 2010~~May 12, 2010~~

Title of Study: Cardiopulmonary Responses to Exposure to Ozone and Diesel Exhaust with Moderate Exercise in Healthy Adults

Name and degrees of Principal Investigator: Tina Stevens, Ph.D.
Department: US EPA
Mailing address/CB #: 104 Mason Farm Rd.
Chapel Hill, NC
27599-7315

Phone #: (919) 843-8031 Fax #: (919) 966-6367 Email Address: stevens.tina@epa.gov

Name and degrees of Co-Investigator: Michael Madden, Ph.D, David Diaz-Sanchez, Ph.D., Howard Kehrl, MD

For trainee-led projects: __ undergraduate __ graduate __ postdoc __ resident __ other
Name of faculty advisors: N/A

Department: Mailing address/CB #:

Phone #: Fax #: Email Address:

Department: Mailing address/CB #:

Phone #: Fax #: Email Address:

Center, institute, or department in which research is based if other than department(s) listed above:

Name of Project Manager or Study Coordinator (if any):
Department: Michael Schmitt
Mailing address/CB #: 104 Mason Farm Rd.
Chapel Hill, NC
27599-7315

Phone #: (919) 966-0647 Email Address: schmitt.mike@epa.gov

Principal Investigator: I will personally conduct or supervise this research study. I will ensure that this study is performed in compliance with all applicable laws, regulations and University policies regarding human subjects' research. I will obtain IRB approval before making any changes or additions to the project. I will notify the IRB of any other changes in the information provided in this application. I will provide progress reports to the IRB at least annually, or as requested. I will report promptly to the IRB all unanticipated problems or serious adverse events involving risk to human subjects. I will follow the IRB approved consent process for all subjects. I will ensure that all collaborators, students and employees assisting in this research study are informed about these obligations. All information given in this form is accurate and complete.

_____

Tina Stevens, Signature of Principal Investigator Date

Faculty Advisor if PI is a Student or Trainee Investigator: I accept ultimate responsibility for ensuring that this study complies with all the obligations listed above for the PI.

_____

David Diaz-Sanchez, Signature of Faculty Co-Advisor Date

_____

Michael Madden, Signature of Faculty Co-Advisor Date

Part A.2. Summary Checklist *Are the following involved?*	Yes	No
A.2.1. Existing data, research records, patient records, and/or human biological specimens?	__	__x
A.2.2. Surveys, questionnaires, interviews, or focus groups with subjects?	_x_	__
A.2.3. Videotaping, audiotaping, filming of subjects, or analysis of existing tapes?	__	_x_
A.2.4. Do you have specific plans to enroll subjects from these vulnerable or select populations:		
a. UNC-CH students or UNC-CH employees?	_x_	__
b. Non-English-speaking?	__	_x_
c. Decisionally impaired?	__	_x_
d. Patients?	__	__x
e. Prisoners, others involuntarily detained or incarcerated, or parolees?	__	_x_
f. Pregnant women?	__	_x_
g. Minors (less than 18 years)? ***If yes***, give age range: to years	__	_x_
A.2.5. a. Are sites outside UNC-CH engaged in the research?	__	_x_
b. Is UNC-CH the sponsor or lead coordinating center for a multi-site study?	__	_x_
If yes, include the ***Addendum for Multi-site Studies***.		
If yes, will any of these sites be outside the United States?	__	__
If yes, is there a local ethics review committee agency with jurisdiction? (provide contact information)	__	__
A.2.6. Will this study use a data and safety monitoring board or committee?	__	x__
If yes: UNC-CH NC TraCS DSMB? (must apply separately)	__	__
Lineberger Cancer Center DSMC?	__	__
Other? Specify:	__	__
A.2.7. a. Are you collecting sensitive information such as sexual behavior, HIV status, recreational drug use, illegal behaviors, child/physical abuse, immigration status, etc?	__	__
b. Do you plan to obtain a federal Certificate of Confidentiality for this study?	__	x__
c. Is this research classified (e.g., requires security clearance)?	__	x__
A.2.8. a. Investigational drugs? (provide **IND #**)	__	_x_
b. Approved drugs for "non-FDA-approved" conditions?	__	x__
All studies testing substances in humans must provide a letter of acknowledgement from the UNC Health Care Investigational Drug Service (IDS).		
A.2.9. Placebo(s)?	__	x__
A.2.10. Investigational devices, instruments, machines, software? (provide **IDE #**)	__	_x_
A.2.11. Fetal tissue?	__	__x
A.2.12. Genetic studies on subjects' specimens?	_x_	__
A.2.13. Storage of subjects' specimens for future research? *If yes, see instructions for* ***Consent for Stored Samples***.	_x_	__
A.2.14. Diagnostic or therapeutic ionizing radiation, or radioactive isotopes, which subjects would not receive otherwise? *If yes, approval by the* ***UNC-CH Radiation Safety Committee*** *is required.*	__	x__
A.2.15. Recombinant DNA or gene transfer to human subjects? *If yes, approval by the* ***UNC-CH Institutional Biosafety Committee*** *is required.*	__	_x_
A.2.16. Does this study involve UNC-CH cancer patients? *If yes, submit this application directly to the* ***Oncology Protocol Review Committee***.	__	x__
A.2.17. Will subjects be studied in the Clinical and Translational Research Center (CTRC) or is the CTRC involved in any other way with this study? If yes, obtain the ***CTRC Addendum*** *and submit completed application (IRB application and Addendum) directly to the CTRC. The CTRC includes facilities located on the 3rd floor of the Main Hospital (formerly GCRC) and Ground floor Burnett-Womack (formerly CCCT).*	__	_x_
A.2.18. Will gadolinium be administered as a contrast agent?	..__	..x__
A.2.19. Will subjects' Social Security Number (SSN) be collected for:		
a. processing payments greater than $200 per year, to support IRS reporting (see also B.6)?	x__	__
b. processing payments of any amount through UNC-CH Accounts Payable?	_	x__
c. use as a unique identifier for study tracking purposes for national registry or database?	__	_x_

Part A.3. Conflict of Interest Questions and Certification

The following questions apply to **all investigators and study staff** engaged in the design, conduct, or reporting results of this project **and/or their immediate family members.** For these purposes, "family" includes the individual's spouse and dependent children. "Spouse" includes a person with whom one lives together in the same residence and with whom one shares responsibility for each other's welfare and shares financial obligations.

A.3.1. Currently or during the term of this research study, does any member of the research team or his/her family member have or expect to have:		
(a) A personal financial interest in or personal financial relationship (including gifts of cash or in-kind) with the sponsor of this study?	__ yes	__x no
(b) A personal financial interest in or personal financial relationship (including gifts of cash or in-kind) with an entity that owns or has the right to commercialize a product, process or technology studied in this project?	__ yes	_x_ no
(c) A personal financial interest in or personal financial relationship (including gifts of cash or in-kind) with an entity engaged in the performance of this project as a subcontractor, sub-recipient or vendor?	__ yes	_x_ no
(d) A board membership of any kind or an executive position (paid or unpaid) with the sponsor of this study or with an entity that owns or has the right to commercialize a product, process or technology studied in this project?	__ yes	_x_ no
A.3.2. Has the University or has a University-related foundation received a cash or in-kind gift from the sponsor of this study for the use or benefit of any member of the research team?	__ yes	__x no
A.3.3. Has the University or has a University-related foundation received a cash or in-kind gift for the use or benefit of any member of the research team from an entity that owns or has the right to commercialize a product, process or technology studied in this project?	__ yes	_x_ no

If the answer to ANY of the questions above is *yes*, the affected research team member(s) must complete and submit the form, which is accessible online at http://coi.unc.edu. List name(s) of all research team members for whom any answer to the questions above is *yes*:

_____

Certification by Principal Investigator: By submitting this IRB application, I (the PI) certify that the information provided above is true and accurate regarding my own circumstances, that I have inquired of every UNC-Chapel Hill employee or trainee who will be engaged in the design, conduct or reporting of results of this project as to the questions set out above, and that I have instructed any such person who has answered "yes" to any of these questions to complete and submit for approval a Conflict of Interest Evaluation Form. I understand that as Principal Investigator I am obligated to ensure that any potential conflicts of interest that exist in relation to my study are reported as required by University policy.

_____ _____

Tina Stevens Date

Faculty Advisor if PI is a Student or Trainee Investigator: I accept ultimate responsibility for ensuring that the PI complies with the University's conflict of interest policies and procedures.

_____ _____

Signature of Faculty Advisor Date

Part A.4. Questions Common to All Studies

For all questions, if the study involves only secondary data analysis, focus on your proposed design, methods and procedures, and not those of the original study that produced the data you plan to use.

A.4.1. **Brief Summary**. Provide a *brief* non-technical description of the study, which will be used in IRB documentation as a description of the study. Typical summaries are 50-100 words. *Please reply to each item below, retaining the subheading labels already in place, so that reviewers can readily identify the content.*

Purpose: The purpose of this study is to measure cardiopulmonary responses in healthy young adults before, during, and after exposure to combinations of ozone (O3) and diesel exhaust (DE) for 2 hours with moderate exercise and to primarily investigate whether DE modulates the O3-induced effects on the lung and cardiovascular systems.

Participants: Fifteen (15) healthy young men and women in the age range of 18 – 55 years

Procedures (methods): Each subject will be exposed in environmentally controlled exposure chambers to 4 exposure regimens. Each regimen will require a 2 hr exposure with intermittent, moderate exercise on 2 consecutive days. Day 1 exposure will consist of a combined exposure to DE and O3, O3 only (i.e., no DE), or DE only, or clean air (CA) only. For all 4 regimens, subjects will return the next day (Day 2) to be exposed to O3 alone and again on Day 3 for a follow up visit. Each regimen will be separated by at least 13 days. Techniques measuring lung and cardiac physiology will be performed pre, during, and post exposure. Blood, urine, and breath samples will also be obtained and analyzed for immune and inflammatory markers, clotting factors, susceptibility factors, and exposure markers.

A.4.2. **Purpose and Rationale**. Provide a summary of the background information, state the research question(s), and tell why the study is needed. If a complete rationale and literature review are in an accompanying grant application or other type of proposal, only provide a brief summary here. If there is no proposal, provide a more extensive rationale and literature review, including references.

Numerous epidemiological studies have demonstrated an association between acute and chronic exposure to air pollution and various adverse cardiopulmonary effects including mortality, respiratory tract infections, exacerbation of asthma symptoms, chronic bronchitis, ischemic heart disease, and stroke [1]~~[1]~~ and other health effects. Understanding the components responsible for these effects is difficult because ambient air pollution is a complex mixture of gases and particulate matter (PM). In this complex mixture of ambient air pollution, ozone (O3) and diesel exhaust (DE) are generally major and important components. Controlled exposures of volunteers to either pollutant have resulted in biological effects such as lung physiological changes. However it is not known if co-exposure to both pollutants, similar to polluted ambient air, can induce additive or synergistic effects. Additionally it is also uncertain if exposure to DE, or DE with O3, can alter a subsequent exposure to O3. This study proposes to examine whether co-exposures to O3 and DE, at doses in the upper range of those encountered in urbanized settings, can induce additive or synergistic effects, and whether a previous DE exposure alters a response upon subsequent exposure to O3. The data obtained from this study will contribute to the overall assessment of air pollution effects in the U.S. and thereby may influence future health policy.

One of the best studied gas phase pollutants is ozone (O3). Effects of O3 exposure in a controlled exposure setting have been well documented particularly for decrements of lung function [2-12]~~[2-12]~~ and an influx of neutrophils and other markers of inflammation [13-17]~~[13-17]~~ at concentrations as low as 0.08 ppm in a dose-response manner. Repeated exposure of healthy adolescents to about 0.5 ppm O3 for 2 hrs on 5 consecutive days has shown a decrement in lung function after the first exposure, an even

greater decrement after a second day exposure, but then increasing attenuated lung function decrements for the next 3 exposure days [18-21]~~[18-21]~~. Hence the greatest lung function decrement is after 2 days exposure, with an adaptation occurring after the first two exposures. The adaptation is associated with attenuation of some soluble biochemical mediators collected by lung lavage (eg, PGE2), but not others (eg, IL-8), after 5 consecutive days of exposure [22]~~[22]~~.

A wide variation in lung function and lung cellular response to O3 exposure has been observed among individuals with no clear understanding in the susceptibility factors involved. NSAID usage has been shown to attenuate O3-induced lung function decrements [23]~~[23]~~. Recent reports have linked certain genetic polymorphisms to possible sensitivities to O3. For example, exercising individuals had greater lung function decrements as a group when they possessed a glutathione-S-transferase M1 (GSTM1) null genotype. Field studies over 3 years have shown increased respiratory breathing problems in children living in Mexico City who were GSTM1 null [24, 25]~~[24, 25]~~, but no increased respiratory problems were associated with those children who were GSTP1 null.

PM exposure has been associated primarily with premature mortality [26, 27]~~[26, 27]~~, but also with morbidity such as increased hospitalizations for cardiopulmonary problems including lung infection, asthma symptoms, and heart attacks [28-30]~~[28-30]~~. Controlled ambient PM exposure studies of humans have been used to examine biological responses as surrogates for understanding the health effects and mechanisms involved in the responses. These controlled exposures have utilized inhalation of ambient PM that was concentrated to achieve increased mass concentrations (average 120 ± 14 $\mu g/m^3$ for PM2.5, with a maximum of 207 $\mu g/m^3$) at our EPA facility in Chapel Hill [31]~~[31]~~. The controlled exposure studies have demonstrated no changes in lung physiological measurements. However, a dose-dependent increase in total number of cells, neutrophils, and monocytes was observed in the lavage fluid. Cardiac measurements showed no changes (standard deviation of normal to normal beat intervals (SDNN), percentage of normal to normal beat interval differences > 50 ms (PNN50), the high frequency domain (HF), the low frequency domain (LF), or the ratio of HF/LF) either immediately following PM2.5 exposure and 24 hrs after exposure. Animal studies have suggested that long-term exposure to low concentration of PM altered vasomotor tone, induces vascular inflammation, and potentiates atherosclerosis [32]~~[32]~~.

Diesel exhaust is a component of air pollution in urban settings, and contributes both PM and gaseous phase compounds to the atmosphere. Diesel exhaust fumes contain primarily fine (≤ 2.5 μm) and ultrafine (≤ 0.1 μm) carbonaceous particulates generated by incomplete combustion of fuel. The composition of the DE PM and the gases can vary depending on the type and age of engine, quality of fuel and additives, emission controls, load characteristics, and after treatment. Few controlled human exposures to diesel exhaust have been performed. Healthy human volunteers exposed to 300 $\mu g/m^3$ diesel exhaust for one hour with intermittent exercise resulted in marked systemic and redox-sensitive pulmonary inflammatory responses [33, 34]~~[33, 34]~~, and vascular dysfunction and impaired endogenous fibrinolysis that links diesel exhaust inhalation to the pathogenesis of atherothrombosis and acute myocardial infarction [35, 36]~~[35, 36]~~. Despite a decade of intensive studies, much about the PM health effects problem, especially the cardiovascular effect, is still not well understood.

There are few studies looking at lung responses with combined O3 and DE in a controlled exposure setting. One study using healthy, young adults showed that a sequential exposure to 300 $\mu g/m^3$ DE for 1 hr followed 5 hr later by exposure to 0.2 ppm O3 induced more lung inflammation (eg. neutrophils collected by induced sputum) than DE alone with no O3 exposure [37]~~[37]~~. The same research group, using similar exposure regimen exposure levels and timing, showed that diesel exhaust increased O3-induced lung inflammation (i.e., neutrophils collected by bronchoscopy) relative to O3 exposure alone [38]~~[38]~~. Few studies with controlled O3 exposures have examined changes induced in extrapulmonary responses, including cardiac physiology and blood clotting and inflammatory factors. One study showed an increased diastolic blood pressure in healthy adults exposed to concentrated ambient particular matter

(CAPs; ~147 μg/m^3) and O3 (~0.12 ppm) simultaneously compared to clean air responses [39]~~[39]~~. However, no separate exposure to O3 alone, or CAPs alone, were performed.

The purpose of this study is, first, to examine whether DE can alter lung and cardiovascular responses to O3 exposure when given a day before or during O3 exposure; second, to investigate if co-exposure of DE and O3 on day 1 augments the lung function decrements following a subsequent O3 exposure (day 2); third, to investigate if two consecutive days of O3 affect individual cardiovascular responses such as changes in heart rate variability (HRV) and blood pressure (BP), to ozone in young healthy adults. We will measure spirometric lung function in association with 2-hour exposures to O3. Results will be analyzed for effects of each or combinations of the above on changes in lung function. We hypothesize that an exposure to DE with O3 (day 1) or DE exposure (day 1) given prior to O3 exposure (day2) will not induce a significant decrement in lung function in healthy young adults as a group relative to O3 alone. We further hypothesize that an O3 exposure (on day 2) after the DE and O3 co-exposure (day 1) will cause significant cardiopulmonary responses in healthy young adults. Finally, we hypothesize that two consecutive days of O3 exposure will affect cardiovascular responses.

A.4.3. **Subjects.** *You should describe the subject population even if your study does not involve direct interaction (e.g., existing records).* Specify number, gender, ethnicity, race, and age. Specify whether subjects are healthy volunteers or patients. If patients, specify any relevant disease or condition and indicate how potential subjects will be identified. Researchers are reminded that additional approvals may be needed from relevant "gatekeepers" to access subjects (e.g., school principals, facility directors, hospital or healthcare system administrators).

A group of 15 healthy adults (men and women) between the ages of 18 and 55 years will participate and complete the study. However, because of potential dropouts and early terminations we will recruit as many as needed to have 15 individuals complete all 4 exposure regimens. Enrollment in this study will not be restricted to any specific races and ethnicities. All subjects will be non-smokers for at least a year, with no active cardiac or respiratory disease, or active medical problems of any kind. Pregnant women, those trying to become pregnant, and those breast-feeding, will not be accepted. All potential subjects will undergo screening procedures (previously approved 95-EPA-66 Phase I and II), including a medical history form, physical examination and routine chemical and hematologic screens. All subjects are required to be moderately active so that they could sustain a prolonged period of moderate exercise. All subjects will be recruited without regard to their genetic profiles; however, they will be genotyped and classified for presence or absence of polymorphisms of select genes.

A.4.4. **Inclusion/exclusion criteria.** List required characteristics of potential subjects, and those that preclude enrollment or involvement of subjects or their data. Justify exclusion of any group, especially by criteria based on gender, ethnicity, race, or age. If pregnant women are excluded, or if women who become pregnant are withdrawn, specific justification must be provided.

Inclusion Criteria:

1. Healthy men and women between 18 and 55 years of age
2. Physical conditioning allowing intermittent, moderate exercise for 2 hours
3. Normal lung function:
    a. FVC > 75 % of that predicted for gender, ethnicity, age and height.
    b. FEV_1 > 75 % of that predicted for gender, ethnicity, age and height.
    c. FEV_1/FVC ratio > 75 % of predicted values.
4. Oxygen saturation > 96 %.

Exclusion Criteria:

1. A history of acute and chronic cardiovascular disease, chronic respiratory disease, diabetes, rheumatologic diseases, immunodeficiency state, and acute respiratory illness within 4 weeks.
2. Subjects who are asthmatic or have a history of asthma.
3. Allergic to chemical vapors or gases.
4. Any allergic symptoms during the time of participation in the study
5. Female subjects who are currently pregnant, attempting to become pregnant, or breastfeeding
6. Subjects unwilling or unable to stop taking vitamin C or E or medications which may impact the results of the ozone challenge (such as, systemic steroids and beta blockers) at least 2 weeks prior to the study and for the duration of the study. Medications not specifically mentioned here may be reviewed by the investigators prior to a subject's inclusion in the study.
7. Current and past smokers within 1 year.
8. Uncontrolled hypertension (> 150 systolic, > 90 diastolic).
9. Subjects who do not understand or speak English
10. Subjects unable to perform the moderately active exercise required for the study.
11. Subjects with a history of skin allergies to adhesives used in securing heart rate monitor electrodes.
12. Unspecified diseases or conditions, which in the judgment of the investigator might influence the responses to the exposures, will be a basis for exclusion.
13. Subjects unwilling to stop taking over-the-counter pain medications such as aspirin, Advil, Aleve or other non-steroidal anti-inflammatory medications ("NSAIDS") for 48 hr prior to the exposures and post-exposure visits.
14. Subjects with a marked baseline prolongation of QT/QTc interval (e.g., repeated demonstration of a QTc interval >450 milliseconds (ms))

A.4.5. **Full description of the study design, methods and procedures.** Describe the research study. Discuss the study design; study procedures; sequential description of what subjects will be asked to do; assignment of subjects to various arms of the study if applicable; doses; frequency and route of administration of medication and other medical treatment if applicable; how data are to be collected (questionnaire, interview, focus group or specific procedure such as physical examination, venipuncture, etc.). Include information on who will collect data, who will conduct procedures or measurements. Indicate the number and duration of contacts with each subject; outcome measurements; and follow-up procedures. If the study involves medical treatment, distinguish standard care procedures from those that are research. If the study is a clinical trial involving patients as subjects and use of placebo control is involved, provide justification for the use of placebo controls.

This is a randomized crossover single blind study with 4 arms separated by at least 13 days. In this study we will measure cardiopulmonary responses to O3 (approximately mean concentration of 0.3 ppm over the 2 hr exposure period) and diesel exhaust (DE; ~300 $\mu g/m^3$) combined exposure and singularly, and clean air control in healthy adults undergoing moderate intermittent exercise (minute ventilation = ~ 25 liters/min/m^2 BSA). [See figure 1].

Each subject will be exposed randomly to all 4 exposure regimes separated by at least 13 days. For all regimes, the subject will be exposed to the pollutant or clean air for 2 hrs with moderate exercise during the exposures. Moderate exercise will involve riding a stationary bike in the chamber for 15 min intervals beginning after the first 15 min of exposure and resting for 15 min after each time for a total of 1 hr of moderate exercise per chamber exposure. Ventilation rate measurements will be taken at ~ 6 min into each exercise session to ensure ventilation rates are within the appropriate parameters [target ~25 L/min/ m2 BSA, which in most subjects is ~ 50 L/min.]. For the DE and O3 co-exposure, there is a potential for the O3 to interact with the DE, but the O3 concentration will be maintained at a final mean concentration of about 0.3 ppm.

All exposures will be carried out at the EPA Human Studies Facility on the UNC campus. Subjects will be monitored continuously by the EPA personnel. A duty physician will be available. The subjects will

be able to end their exposure and exit the chamber at any time if they choose to end their participation in the study. Total exposure times will be 2 hours. The exposure atmosphere will be at approximately 40 ± 10% RH and approximately 22 ± 2 °C. Clean air will be passed through an air purification system to ensure no presence of pollutant gases (O_3, NO, NO_2, SO_2, CO) in the air. Ozone and DE concentrations will be monitored continuously. The DE will be generated from a diesel engine used to power an air compressor that is located outside the Human Studies Facility, and subsequently introduced into the exposure chamber after different dilutions with clean HEPA and charcoal filtered and humidified air to give a chamber concentration of approximately 300 $\mu g/m^3$. The monitoring analyzer registers a concentration in real time. Exposures will be terminated at values $\geq$ 400 $\mu g/m^3$ during runs in which the exposure targets 300 $\mu g/m^3$ DE. This safety limit will prevent an inhalational exposure greater than 1,080 µg, which assumes that the subject, only resting for 1 hr, exercising for 1 hr, will inhale 2.7 m^3 during the 120 min exposure. It is expected that 75 to 95% of the diesel exhaust PM from this type of engine will be approximately 0.05-0.2 µm. Preliminary testing has shown the mean particle size to be approximately 0.15 ± 0.05 µm. Levels of carbon monoxide (CO), and oxides of nitrogen (NOx; mainly NO, and some NO_2), will be kept under 10 ppm CO, 15 ppm NO, and 3.5 ppm NO_2 or the exposure will be terminated. [The OSHA 8 hr time-weighted average for these substances are: CO=50 ppm; NO=25 ppm; NO_2=5 ppm; Diesel fuel used for the study will be purchased as a commercial ultra low sulfur fuel. This certified fuel represents diesel fuel composition that is typically available at gas stations for most regions of the country except for California. Subjects will enter the exposure chamber. Particle mass will be measured in real time and validated further by weighing filters after the 2 hr exposure is finished. Particle size distribution will be determined at regular intervals. Filter samples will also be analyzed for chemical composition of particles. Minute ventilation will be measured during the exercise periods of exposure.

Lung Function Test:

Primary endpoints for evaluating health effects are changes in lung functions, mainly FEV_1, FVC and FEV_1/FVC before, immediately after, and approximately every hour for up to 4 hrs post exposure.

Measurements and Collections:

Blood pressure, telemetry, and oxygen saturation will be monitored during the exposure period. Other primary endpoints for evaluating health effects, in addition to lung function, are heart rate variability (HRV) and markers of inflammation including total and differential cell counts as well as pro-inflammatory cytokines and immune system mediators and clotting factors from collected blood. Secondary endpoints from additional blood, breath, and urine samples will serve as indicators of the exposure based on the levels of metals (eg, Zn) and organics (eg, PAHs) and other components that may be derived from DE deposition. From the collected blood samples, additional parameters and indices may be obtained as analysis tools become available. Genetic analysis may also be performed on collected blood samples for susceptibility factors. A questionnaire measuring perceived stress by the subject at the beginning of an exposure regimen will be performed. Some of the supplemental spirometric measurements and secondary endpoints may not be obtained if they are deemed unnecessary.

In order to participate in this study, subjects will be asked to:

- Avoid smoke and fumes for 24 hours before all visits.
- Avoid drinking alcohol 24 hours before all visits.
- Avoid strenuous exercise for 24 hours prior to and after all visits.
- Avoid the use of ozone-based home air purifiers during study participation.
- On the exposure days, eat a light breakfast.
- Refrain from all over the counter anti-inflammatory agents including those for allergies for a period of 48 hrs prior to exposure.

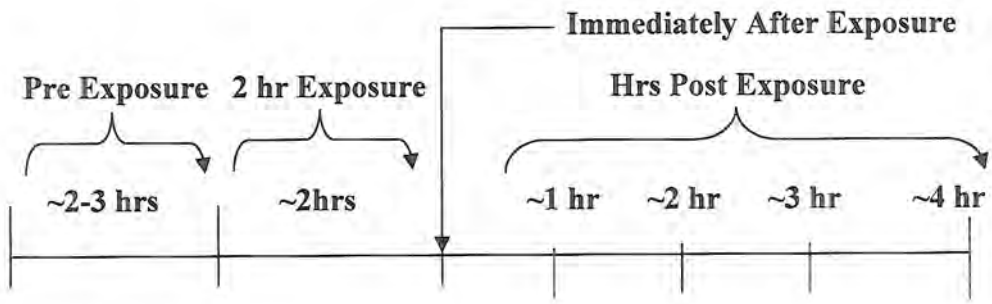
Figure 1

Experimental design:

	Day 1 2 hr exposure	Day 2 2hr exposure	Day 3
Exposure Regime 1	DE + O3	O3	follow up (no exposure)
Exposure Regime 2	O3	O3	follow up (no exposure)
Exposure Regime 3	DE	O3	follow up (no exposure)
Exposure Regime 4	Clean Air	O3	follow up (no exposure)

Figure 2
Endpoints:

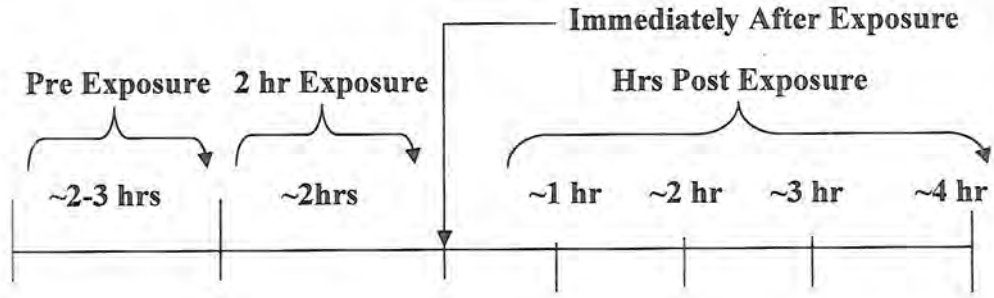
Day 1



Measurements & Collections	*	*				
Lung Function	*	*	*	*	*	*

****

Day 2



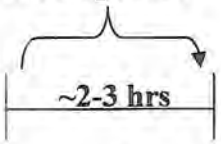
Measurements & Collections	*	*

Lung Function * * * * * *

****

Day 3

Follow up
No Exposure



Measurements & Collections *

Lung Function *

Protocol: Written consent will be obtained. The subjects will be trained (on D0) in techniques for obtaining lung function measurements. Subjects also will exercise on a bicycle, and appropriate settings (the speed and grade of incline) required to produce a desired value of minute ventilation will be determined. On the first day of exposure, subjects will be assessed for vital signs (blood pressure, pulse, temperature and respiratory rate) at the check-in. Subjects may perform pre-exposure baseline lung functions in clean air, have resting heart rate variability (HRV) assessed, and urine, blood, and exhaled breath collected for later analyses of soluble mediators such as clotting factors, inflammatory proteins, and lipids and blood cell types and numbers. These samples may also serve to determine biomarkers of exposure, such as the concentration of PAHs . A questionnaire measuring perceived stress by the subject at the beginning of an exposure regimen will be filled out; this is included as Attachment #1. [Information about grading the questionnaire (Sheldon Cohen Perceived Stress Scale) is described at www.mindgarden.com].The subject then will enter the chamber already set for the appropriate conditions (DE & O3, DE alone, O3 alone, or clean air), and after 15 min begin exercising on a stationary bicycle. Each exposure session will consist of a 4 periods of 15 rest/15 min exercise at a level of approximately 25 liters/min/m^2 body surface area (BSA) in minute ventilation followed. Measurements of lung function may be obtained immediately after, and every hour for up to 4 hr post exposure. Resting HRV may be recorded, and blood, urine, and breath collected immediately post exposure. Following the day 1 exposure, the subject may remain at the Medical Station for follow up measurements of lung function for approximately 2-4 hr. The subjects will go home with a heart rate monitor and blood pressure cuff. On Day 2, the subject will report to the medical station in the morning. The same measurements (resting HRV, lung function; symptoms; venipuncture performed) as Day 1 may be done pre- and post- exposure to O3. Subjects will return on Day 3 for follow up measurements but with no exposures.

Experimental procedures:
Medical history will be collected, including current medications and any recent illness.

Vital signs will be measured to include height, weight, heart rate, respiratory rate, blood pressure, oxygen saturation, and temperature. In addition a pregnancy test will be given to all women before each exposure regime.

Spirometry will be performed on a dry seal digital spirometer including the forced expiratory maneuver, forced vital capacity (FVC), forced expired volume in the first second (FEV_1), and FEV_1/FVC.

Exhaled Breath Collection: The participant will be asked to breathe into a cooled tube for up to 15 minutes. Collected breath condensate may be analyzed for markers of airway inflammation and immune system alterations and exposure markers. Additionally a small Tedlar bag of uncooled, exhaled breath will be collected (up to 5 min) to examine gas phase exposure and inflammation/immune system constituents.

For exercise measurements the subjects breathe for up to 3 min through a pneumotachograph while performing exercise and ventilation parameters including the minute ventilation, tidal volume and breathing frequency will be obtained. Heart rate will be monitored throughout exposure using a telemetry monitor.

Cardiac measurements: Heart Rate Variability monitoring (ambulatory ECG) monitoring: On the day 1 and day 2 of each of the exposure regimes we will mount a Holter monitor to the participants. The skin may be shaved (men only) and prepped. ECG electrodes are attached and connected to the beeper-sized Holter monitor, which participants wear around their waist. After mounting the monitor onto participants, they will be asked to relax for 20 minutes in a reclined position after which a 10-minute resting HRV measurement will be obtained. Participants are released while wearing the Holter monitor and return to the HSF the next morning (day 2 of the study segment) to obtain the Holter monitor information and change the batteries, if necessary. The monitor will be worn for day 2 and removed on day 3. We will analyze time and frequency as well as re-polarization parameters. Participants will be given instructions for the removal of the monitor in case it becomes necessary.

Blood pressure (BP) measurements: BP will be monitored during the study. A BP cuff may be worn to measure BP intermittently. A pressure cuff and a monitor which is about the size of the Holter monitor will be placed and will remain in place until the subjects leave for the day. The subjects will be instructed to keep arm relaxed and still when the pressure cuff is inflated. The subjects may wear the cuff for day 1 and 2 of the study session and have it removed on day 3. Participants will be given instructions for the removal of the monitor in case it becomes necessary.

Venipuncture: Up to approximately 500 ml of blood will be collected for the 8 exposure days over a minimum of 8 weeks. This translates to approximately 50 ml of blood for each exposure day and 25 ml on the follow up day. A portion of the sample will be used for genotyping to examine sensitivity in selected blood types. Blood will be analyzed for, but not limited to, clotting/coagulation and inflammation factors and biomarkers of immune response.
A portion of the peripheral blood sample will be used for genetic testing, to identify potential polymorphisms that may make subjects more susceptible to air pollutants. In addition, samples may be stored for as yet undesignated research. Unwillingness to have samples used for genotyping or stored will NOT exclude a subject from the panel study. Consent for genotyping will be included with the general consent form.

Urine: Participants will collect their urine on days 1, 2, and 3 for each arm of the study. Day 1 will be a 24 hr collection. Urine collection on days 2 and 3 will be limited to subject's stay in the facility. It is estimated that there will be on average seven urine voids collected per person for a 24 hr sampling period [40]. Each urine void will be collected in a separate 1 L polypropylene container (*not pooled*) for this study. In addition, each urine void will be analyzed separately for exposure reconstruction purposes.

For collection of a 24 hr urine sample, each participant will start collecting their individual urine samples on day 1 at the medical station (~8:00 a.m.) and collect through the first morning void the next day (i.e. day 2). The participants will collect each urine void in a separate 1 L polypropylene container and record the time the sample was collected and the time of their last urine void. Then, they will place the container in a provided thermoelectric cooler. The participant will return the cooler containing the 24 hr urine collection samples in the morning at the HSF on day 2, for each arm of the study. On day 2, a

urine sample before and immediately after exposure will be collected. On day 3, one urine sample will be collected. For each person, it is estimated that about 40 samples (~10 urine samples per exposure session X 4 exposure sessions) will be collected from them during the study.

Urine will be examined for markers of exposure (e.g. PAHs) and effect (e.g. IL8 as a marker of inflammation), plus normalization factors (e.g. creatinine).
~~The entire volume of a urine void will be collected on the pre- and post- exposure on Days 1 and 2, and the morning of day 3. Samples may be analyzed for markers of cigarette smoke exposure (eg, cotinine), creatinine for value normalization, exposure markers (eg, PAHs), and mediators of effect related to inflammation and immune system functions (eg, peptidoleukotrienes, other lipids).~~

Likely Personnel assignment	
Subject recruitment and payment	Westat Corporation (Protocol #950518-)
Chamber setup and maintenance	TRC Environmental Corporation
Subject surveillance during exposure	Martin Case, BS, Mike Madden, PhD, Tina Stevens, PhD, Howard Kehrl, MD, David Diaz-Sanchez PhD, Medical Station personnel
Lung function testing	Martin Case, BS, Mike Madden PhD, Tina Stevens, PhD Howard Kehrl, MD
Blood sampling	Human Studies Facility Medical Station personnel
Subject screening tests	Human Studies Facility Medical Station personnel
Genomic assay	Michael Schmitt, MS

A.4.6. **Benefits to subjects and/or society.** Describe any potential for direct benefit to individual subjects, as well as the benefit to society based on scientific knowledge to be gained; these should be clearly distinguished. Consider the nature, magnitude, and likelihood of any direct benefit to subjects. If there is no direct benefit to the individual subject, say so here and in the consent form (if there is a consent form). Do not list monetary payment or other compensation as a benefit.

The results of this study will contribute to the overall assessment of air pollution effects in the U.S. and thereby influence health policy. The subjects will not benefit personally from being in this research study other than by undergoing a free limited physical examination and screening.

A.4.7. **Full description of risks and measures to minimize risks.** Include risk of psychosocial harm (e.g., emotional distress, embarrassment, breach of confidentiality), economic harm (e.g., loss of employment or insurability, loss of professional standing or reputation, loss of standing within the community) and legal jeopardy (e.g., disclosure of illegal activity or negligence), as well as known side effects of study medication, if applicable, and risk of pain and physical injury. Describe what will be done to minimize these risks. Describe procedures for follow-up, when necessary, such as when subjects are found to be in need of medical or psychological referral. If there is no direct interaction with subjects, and risk is limited to breach of confidentiality (e.g., for existing data), state this.

This study might involve the following risks and/or discomforts:

1. Blood sampling will be performed by well-trained personnel, and entails only a risk of mild discomfort with the infrequent possibility of lightheadedness, fainting, infection or developing

a bruise. Subjects are closely monitored for any signs of faintness, and only allowed to leave the facility after a 15-min waiting period.

2. Breathing tests (spirometry): There pulmonary function tests are standard clinical tests that are commonly performed in hospitals and entail little or no risk to the subjects. However, cough or dizziness may occur during these tests. If these symptoms occur, they are usually temporary. Subjects will remain seated in a chair until symptoms disappear. There is an extremely small chance that the subject could have a bronchospasm or faint upon performing a forced breath expiratory maneuver for spirometry.
3. Exhaled breath condensate and exhaled breath gas: Minimal risk is associated with these procedures. The subject is seated in a chair during these collections and the technician is always available during this procedure in case the participant becomes light-headed due to hyperventilation.
4. Moderate exercise on a stationary bicycle entails the potential, although minimal, risk of occasional muscle soreness, cramps or general fatigue. These discomforts are temporary and not harmful. Heart rate and rhythm will be monitored continuously. Heart rate will be kept below age related maximum (i.e., 220 bpm – age in years). Exercise will be terminated at any time upon the request of the subject or if the investigator/medical staff observes problems while monitoring the ECG readout.
5. Ozone exposure: Potential risks may include mild airway obstruction, irritation to the nose, eyes, throat and airways, pain on deep inspiration and cough. These symptoms typically disappear 2 to 4 hours after exposure, but may last longer for particularly sensitive people. Ozone may induce an inflammatory reaction that may last for about 24-48 hours after exposure and may increase the chance of catching a cold.
6. ECG and heart rate variability are standard non-invasive techniques commonly used for heart rate and rhythm analysis and entail little or no risk to the subject. There is the possibility that preparation of the skin for electrode placement and removal may cause skin irritation, itching, or soreness in some subjects.
7. Blood pressure and heart rate measurement: Similar to the regular blood pressure measurement, the risk associated with blood pressure monitor is considered minimal.
8. Diesel exhaust (DE) exposure: The amount of DE (target of 300 $\mu g/m^3$) used in this study would be equivalent to concentrations of DE particulate matter that would be encountered at busy intersections in large urban areas and in occupational exposures. Occupational levels for some truck drivers are generally about 100-300 $\mu g/m^3$ and average ~900 $\mu g/m^3$ for some mines where diesel powered machinery are used. A recent study demonstrated diesel exhaust particulate matter concentrations during drive-by incidents averaged about 125 and199 μg/m3 at the height of an adult pedestrian and a child in a stroller, respectively. Using a 2006 diesel engine, (generally recognized as emitting less PM mass than most older models currently on the road), it was demonstrated that an average DEP concentration up to 364 ug/m^3 (over ~9 sec) could be generated at near roadside monitoring stations at head level during drive by simulations with a peak concentration of 860 ug/m^3. [41]~~[40]~~.
   Controlled, acute DE exposure studies in Sweden, using about 300 $\mu g/m^3$ of DEP, have shown lung inflammatory effects not unlike effects observed with numerous ozone exposure studies performed here at the EPA facility on the UNC campus during the past 20 yr. DE particles contain some probable carcinogenic polycyclic aromatic hydrocarbons and other components, which in high enough concentrations and/or with repeated exposures may induce tumors. Diesel exhaust also contains aldehydes, some of which are possibly carcinogenic in high enough dose and with long enough exposure. However, the exposure time and concentrations to be used in this protocol are minimal relative to the durations required to induce lung cancer. Overall, there are no known

long-term health risks in healthy individuals acutely exposed to DE at the PM concentrations given in this study. Short-term health effects include slight alterations in blood clotting, oxygen diffusion capacity and changes in heart rate variability. These symptoms typically disappear within 24 hrs of exposure. During exposure, subjects will be monitored by direct observation or via closed-circuit television. Subjects will have EKG leads attached during the exposure to monitor cardiac function during exercise. Subjects will be aware that they can terminate their exposure for any reason and still receive compensation for their participation up to that point. The investigators or duty physician will end the exposure if the subject is found to be suffering from any significant adverse effect. No major adverse effects were observed in a completed diesel exhaust study of healthy adults (ages 18-40; entitled "Physiological, Cellular, and Biochemical Effects of Diesel Exhaust in Healthy Young Adults"; Mike Madden, PI; UNC IRB # # 99-0842) where the PM concentration averaged 106 ug/m3. No major adverse health effects were observed in a completed study that exposed subjects (18-35 yr old, healthy volunteers) to concentrated Chapel Hill air particles here at the EPA facility (Physiological and Biochemical Changes Associated with Exposure to Air Pollution Particles; Andrew Ghio, MD, PI; UNC IRB# 95-EPA-310). The maximum PM concentration reached 311 $\mu g/m^3$ during the exposure. The data from this exposure study suggest that normal healthy subjects tolerate inhalation of concentrated ambient PM fairly well, and support the idea that exposures to lower PM concentrations, including DEP, will be fairly safe in terms of cardiopulmonary responses. For safety reasons, pulse oximetry will be performed during the exposures and the subject withdrawn from the chamber if the O_2 saturation value is $\leq 92\%$. Additionally subjects will have carboxyhemoglobin values determined within 1 hr after an exposure and kept at the Medical Station if levels are >20% (where performance of everyday cognitive tasks may be jeopardized) until levels become <20%; but because the CO levels are expected to be 2-4 ppm [based on preliminary chamber characterizations], levels are expected to be < 5%.

A duty physician is always onsite to respond to an emergency. Fully equipped resuscitation equipment is available for use in the event of a cardiac or pulmonary emergency. Physicians at the University of North Carolina (UNC) Hospitals Emergency Room are also available to assist in treatment of an emergency.

Heart rate and rhythm, and pulse oximetry will be monitored continuously. Subjects will also be monitored for significant respiratory distress or dyspnea, chest pain, significant cardiac arrhythmias, pallor, and ataxia. Subjects will be aware that they can terminate their exposure for any reason and still receive compensation for the entire exposure session. The investigator or duty physician will end the exposure if the subject is found to be suffering from any adverse effect.

9. Effects of combined ozone and diesel exhaust exposure: Because this exposure scenario has not been conducted at our facilities or elsewhere before, we do not yet know whether or not this exposure will include the same risks as diesel exhaust and ozone exposures alone. It is possible that the combination of diesel exhaust and ozone exposures will increase the effects of each pollutant individually, and it is also possible that it will not. We are doing this study in order to find out the answer.

10. Confidentiality: Risk of breach of confidentiality is minimal. All subjects will be assigned a study number which will be used for data recording – not the subject's name. The study number is all that will be entered into computer databases. All paper files that may contain the subject's name or screening number are secure in a locked cabinet in a locked room at the US EPA facility. Any abnormal medical findings (CBC, ECG, spirometry) will be discussed with the volunteer and the volunteer will be counseled to seek treatment from his/her personal physician. Samples will be stored at the U.S. EPA HSF. A numeric coding system will be used to ensure that subjects cannot be directly identified from the samples alone.

In addition, there may be uncommon or previously unknown risks that might occur. During all testing, subjects will be monitored continuously by the EPA personnel. A duty physician will be available in response to an emergency. A group of physicians employed by EPA and UNC Center for Environmental Medicine, Asthma & Lung Biology have primary responsibility for medical coverage of studies conducted in the EPA Human Exposure Facility. This facility is also equipped with an emergency "crash cart" with standard emergency medications, IV fluids and a defibrillator in the unlikely event of a medical emergency for any challenge or exposure study.

A.4.8. **Data monitoring and analysis.** Tell how the qualitative and/or quantitative data will be analyzed. Explain how the sample size is sufficient to achieve the study aims. This might include a formal power calculation or explanation of why a small sample is sufficient (e.g., qualitative research, pilot studies). Describe the provisions for monitoring the data to ensure the safety of participants. These plans could range from the investigator monitoring subject data for any safety concerns to a sponsor-based DSMB, depending on the study.

The research objective of this study is to determine if healthy volunteers safely exposed to low levels of O3 and DE alone or in combination, will show changes in cardiopulmonary endpoints including modest decrements in lung function. The study will follow a randomized, repeated measures design with each subject exposed to 4 different exposure regimens (see Figures 1 and 2 above). The data analysis will be focused on changes in lung function measurements, primarily FVC and FEV_1, between pre and post 2hr exposure for each exposure, but also blood endpoints include inflammatory factors (eg IL-6), blood clotting factors (eg fibrinogen), and susceptibility factors (eg specific genotypes such as glutathione-S-transferase M1 (GSTM1) null).

In evaluating exposure effects of O3 and DE, alone or in combination, upon lung function, the difference between the pre-exposure and post-exposure FEV1 will be calculated and the pre-post differences for the air and the exposures will be compared utilizing repeated measures ANOVA parametric test. Clinically significant change is determined to be a 10% decrease in FEV1 measured prior to and immediately after the exposure compared to the pre exposure value. For a conservative sample size calculation, we used one sided test for a single sample under the assumption of normal distribution with Type I error of 5% and Type II error of 20%. Therefore, a ρ value of 0.05 or less will be considered significant and the proposed sample size will provide adequate (80%) power for detecting a 10% decrease in ΔFEV1.

Sample size calculation was based on the Forced Expiratory Volume in 1 Second (FEV1) in response to the O3 exposure. Data for the power calculation were obtained from results of FEV_1 [42]~~[41]~~ for a constant acute exposure to 0.3 ppm O_3 versus clean air (CA). In 22 subjects, the pre exposure FEV_1 was 4.608 ± 0.514 (mean ± SEM) in CA exposure and 4.656 ± 0.592 in O_3. The post exposure FEV_1 was 4.64 ± 0.476 in CA exposure and 3.856 ± 0.687 in O_3. We used 0.687 as an estimate of standard

deviation after the ozone exposure and estimated 10% decrease in pre-exposure FEV1 levels to be 0.46 ml. Based on these data and the test for the mean of a normal distribution with a one-sided alternative the required sample size is 14 subjects. We will recruit 15 subjects for this study to ensure the statistical power that can analyze small differences expected from low concentration exposures.

Although EPA does not have an official Data Safety Monitoring Board, we do have measures in place to insure the safety of our subjects. Adverse events will be reported to Bob Truckner, the EPA/NHEERL human research protection officer of the IRB.

Precautions taken to minimize risk to the subject include:

1. subject monitoring via direct observation or CCTV during exposure
2. Cardiac function will be assessed throughout the exposures. Evidence in 2 individuals of a QTc interval >450 milliseconds (ms) will prompt a pause in the study. The length of the QT period was chosen as the primary endpoint to examine as a marker of cardiac toxicity in part based on this marker's use in Phase 1 Clinical Trials where possible cardiac toxicity was monitored via ECG. In addition, QTc interval increases greater than 60 ms from baseline will also prompt a pause in the study.
3. Pulse oximetry will be performed during the exposures and the subject withdrawn from the chamber if the oxygen saturation value is $\leq 92\%$.
4. Subjects will be aware of their right to terminate their participation in the study without prejudice.
5. Any exposure will be stopped upon evidence of any adverse effects suffered by the subject during the exposure
6. Full resuscitation equipment will be available at all times during exposures and used if needed
7. In the event of an emergency, after initial medical assessment, patients will be transported to the UNC Hospitals Emergency Room for continued treatment
8. A formal pause to the study will be performed by the medical station staff after 4 subjects complete the 4 exposure regimes to assess whether highly adverse effects occurred with respect to lung and cardiac physiology responses. If no highly adverse effects are observed, the study will continue.

A.4.9. **Will you collect or receive any of the following identifiers?** Does not apply to consent forms.

__ No _x_ Yes *If yes, check all that apply*:

a. _x_ Names
b. _x_ Telephone numbers
c. _x_ Any elements of dates (other than year) for dates directly related to an individual, including birth date, admission date, discharge date, date of death. For ages over 89: all elements of dates (including year) indicative of such age, except that such ages and elements may be aggregated into a single category of age 90 and older
d. _x_ Any geographic subdivisions smaller than a State, including street address, city, county, precinct, zip code and their equivalent geocodes, except for the initial three digits of a zip code
e. __ Fax numbers
f. _x_ Electronic mail addresses
g. __ Social security numbers
h. _x_ Medical record numbers
i. __ Health plan beneficiary numbers
j. __ Account numbers
k. __ Certificate/license numbers
l. __ Vehicle identifiers and serial numbers (VIN), including license plate numbers
m. __ Device identifiers and serial numbers (e.g., implanted medical device)
n. __ Web universal resource locators (URLs)
o. __ Internet protocol (IP) address numbers
p. __ Biometric identifiers, including finger and voice prints
q. __ Full face photographic images and any comparable images
r. __ Any other unique identifying number, characteristic or code, other than dummy identifiers that are not derived from actual identifiers and for which the re-identification key is maintained by the health care provider and not disclosed to the researcher

A.4.10. **Identifiers in research data**. Are the identifiers in A.4.9 above linked or maintained with the research data?

__ yes __x no

A.4.11. **Confidentiality of the data**. Describe procedures for maintaining confidentiality of the data you will collect or will receive. Describe how you will protect the data from access by those not authorized. How will data be transmitted among research personnel? Where relevant, discuss the potential for deductive disclosure (i.e., directly identifying subjects from a combination of indirect IDs).

All individuals who have been granted access to the data to perform their research-related duties have received full ethics training. Computer data files are password protected and subjects are coded as an unrelated subject identifying number. The participant's actual identity cannot be ascertained exclusively from these data. The participant's name will not be used in any publications. Access to the records of this study will be provided by the identifying number only and given only to those individuals associated with the study who require access to the data to perform their duties. All such individuals will be bound by this agreement of confidentiality. All records are maintained in a locked room in the medical records office of the USEPA Human Studies Facility.

A.4.12. **Data sharing.** With whom will *identifiable* (contains any of the 18 identifiers listed in question A.4.9 above) data be shared outside the immediate research team? For each, explain confidentiality measures. Include data use agreements, if any.

_x_ No one
__ Coordinating Center:
__ Statisticians:
__ Consultants:
__ Other researchers:
__ Registries:
__ Sponsors:
__ External labs for additional testing:
__ Journals:
__ Publicly available dataset:
__ Other:

A.4.13. **Data security for storage and transmission**. Please check all that apply.

For electronic data stored on a desk top computer:
__x Secure network __x Password access __x Data encryption__x Password protected file(s)
__ Other comparable safeguard (describe):

For portable computing devices/external storage devices (e.g. laptop computer, PDA, CDs, memory sticks):
__x Power-on password __x Automatic log-off __x Data encryption __x Password protected file(s)
__ Other comparable safeguard (describe):

For hardcopy data (including human biological specimens, CDs, tapes, etc.):
__ Data de-identified by research team (stripped of the 18 identifiers listed in question A.4.9 above)
__ Locked suite or office __ x Locked cabinet
__x Data coded by research team with a master list secured and kept separately
__ Other (describe):

A.4.14. **Post-study disposition of identifiable data or human biological materials**. Describe your plans for disposition of data or human biological specimens that are identifiable in any way (directly or via indirect codes) once the study has ended. Describe your plan to destroy identifiers, if you will do so.

The study data will be archived with identifiers by storage in a locked closet in the secured USEPA HSF building. If offsite storage space is ever required for the data, the data will be transferred to offsite storage according to the USEPA's record keeping guideline.

Specimens from subjects who consent for his/her samples to be stored will remain stored in a repository and will be released to investigators for use. Specimens from subjects who opt not to allow for storage will be destroyed at the end of the study.

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Part A.5. The Consent Process and Consent Documentation (including Waivers)

The standard consent process is for all subjects to sign a document containing all the elements of informed consent, as specified in the federal regulations. Some or all of the elements of consent, including signatures, may be altered or waived under certain circumstances.

- If you will obtain consent in any manner, complete **section A.5.1**.
- If you are obtaining consent, but requesting a waiver of the requirement for a signed consent document, complete **section A.5.2**.
- If you are requesting a waiver of any or all of the elements of consent, complete **section A.5.3**.
- If you need to access Protected Health Information (PHI) to identify potential subjects who will then be contacted, you will need a *limited waiver of HIPAA authorization*. This is addressed in section B.2.

You may need to complete more than one section. For example, if you are conducting a phone survey with verbal consent, complete sections A.5.1, A.5.2, and possibly A.5.3.

A.5.1. **Describe the process of obtaining informed consent from subjects.**
Describe who will be obtaining consent (or permission) and from whom. Include discussion, as relevant, any waiting period between the initial consent discussion and obtaining consent, and steps that will be taken to minimize coercion or undue influence. If children will be enrolled as subjects, describe the provisions for obtaining parental permission and assent of the child. If decisionally impaired adults are to be enrolled, describe the provision for obtaining surrogate consent from a legally authorized representative (LAR). If non-English speaking people will be enrolled, explain how consent in the native language will be obtained. Address both written translation of the consent and the availability of oral interpretation. It is expected that the information in the consent document(s) will be communicated to participants or their LAR. *After you have completed this part A.5.1, if you are not requesting a waiver of any type, you are done with Part A.5.; proceed to Part B.*

Prior to participation, all volunteers will be required to read and sign the consent form which asserts that they have read and understood the following: 1.) Subject participation is strictly voluntary; 2.) The

purpose of the study; 3.) The nature and extent of subject participation; 4.) The subject's rights to withdraw at any time; 5.) The subject's right to privacy, 6.) The risks associated with participation; 7.) The method and schedule of compensation; and 8.) The limits of the EPA, University and PI's liability. The PI, co-PIs or study coordinator will briefly describe the study and answer any questions that each subject might have about the study. Subjects will have the opportunity to ask questions at any time during the study by contacting the PI and/or the study coordinators. The subject will be given a copy of the signed consent form for his/her records.

A.5.2. **Justification for a waiver of *written* (i.e., signed) consent**. *The default is for subjects to sign a written document that contains all the elements of informed consent.* Under limited circumstances, the requirement for a signed consent form may be waived by the IRB if either of the following is true. *Choose only one:*

a. The only record linking the subject and the research would be the consent document and the principal risk would be potential harm resulting from a breach of confidentiality (e.g., study topic is sensitive so that public knowledge of participation could be damaging). *Participants should be asked whether they want documentation linking them with the research and the participants' wishes will govern whether they sign the form.* Note: This justification cannot be used in FDA-regulated research. __ yes __ no __ yes __ no

Explain.

b. The research presents no more than minimal risk of harm to subjects and involves no procedures for which written consent is normally required outside of the research context (e.g., phone survey).

Explain.

If you checked "yes" to either (and you are not requesting a waiver in section A.5.3) consent must be obtained orally, by delivering a fact sheet, through an online consent form, or be incorporated into the survey itself. Include a copy of the consent script, fact sheet, online consent form, or incorporated document.

→ If you have justified a waiver of written (signed) consent (A.5.2), you should complete A.5.3 *only* if your consent process will not include all the other elements of consent.

A.5.3. **Justification for a full or partial waiver of consent.** *The default is for subjects to give informed consent.* A waiver might be requested for research involving only existing data or human biological specimens (see also Part C). More rarely, it might be requested when the research design requires withholding some study details at the outset (e.g., behavioral research involving deception). In limited circumstances, parental permission may be waived. This section should also be completed for a waiver of HIPAA authorization if research involves Protected Health Information (PHI) subject to HIPAA regulation, such as patient records.

__ Requesting **waiver of some elements** (specify; see SOP 28 on the IRB web site):
__ Requesting **waiver of consent entirely**

If you check either of the boxes above, answer items a-f.. To justify a full waiver of the requirement for informed consent, you must be able to answer "yes" (or "not applicable" for question c) to items a-f. **Insert brief explanations that support your answers.**

a. Will the research involve no greater than minimal risk to subjects or to their privacy? __ yes __ no

Explain.

b. Is it true that the waiver will *not* adversely affect the rights and welfare of subjects? *(Consider the right of privacy and possible risk of breach of confidentiality in light of the information you wish to gather.)* __ yes __ no
Explain.

c. When applicable to your study, do you have plans to provide subjects with pertinent information after their participation is over? *(e.g., Will you provide details withheld during consent, or tell subjects if you found information with direct clinical relevance? This may be an uncommon scenario.)* __ yes __ not applicable
Explain.

d. Would the research be impracticable without the waiver? *(If you checked "yes," explain how the requirement to obtain consent would make the research impracticable, e.g., are most of the subjects lost to follow-up or deceased?).* __ yes __ no
Explain.

e. Is the risk to privacy reasonable in relation to benefits to be gained or the importance of the knowledge to be gained? __ yes __ no
Explain.

If you are accessing patient records for this research, you must also be able to answer "yes" to item f to justify a waiver of HIPAA authorization from the subjects.

f. Would the research be impracticable if you could not record (or use) Protected Health Information (PHI)? *(If you checked "yes," explain how* not *recording or using PHI would make the research impracticable).* __ yes __ no
Explain.

Part B. Questions for Studies that Involve Direct Interaction with Human Subjects

→ *If this does not apply to your study, do not submit this section.*

B.1. **Methods of recruiting.** Describe how and where subjects will be identified and recruited. Indicate who will do the recruiting, and tell how subjects will be contacted. Describe efforts to ensure equal access to participation among women and minorities. Describe how you will protect the privacy of potential subjects during recruitment. *For prospective subjects whose status (e.g., as patient or client), condition, or contact information is not publicly available (e.g., from a phone book or public web site), the initial contact should be made with legitimate knowledge of the subjects' circumstances. Ideally, the individual with such knowledge should seek prospective subjects' permission to release names to the PI for recruitment. Alternatively, the knowledgeable individual could provide information about the study, including contact information for the investigator, so that interested prospective subjects can contact the investigator.* Provide the IRB with a copy of any document or script that will be used to obtain the patients' permission for release of names or to introduce the study. Check with the IRB for further guidance.

Subjects may be recruited for this study by the Westat Corporation, which has recruited for studies at the U.S. EPA HSF since 1998. The manner in which this will be done is similar to that of past U.S. EPA studies and specific recruitment procedures as per the previously UNC IRB-approved protocol, "Recruitment and Screening of Potential Subjects for EPA Studies" (95-0518; Howard Kehrl, PI). Subjects may be identified from mass emailing for recruits, website [https://www.epastudies.org/ with contact phone numbers listed as 919-966-0604 and toll free 888-279-9353] and newspaper and brochure advertising by Westat Corporation [a recent, advertisement brochure for subject recruitment is included as Attachment #2], and from the Westat database for subjects. These documents (email recruitment wording to current subjects from other studies and potentially new subjects , newspaper advertisement, a study description handout, study reminder notices to subjects, are attached in the appendix section of this application as Attachments 2-7. Every effort will be made to recruit women and members of racial minority groups into this study. Subjects will be asked to call the recruitment office. During the telephone interview, the subjects will receive information regarding the study and their eligibility for the study will be assessed. Subjects who provide responses which indicate that they are likely to meet the criteria will be scheduled for an appointment in the Westat recruitment office in the U.S. Human Studies Facility. At that time the study protocol will be outlined, and a medical history form will be administered.

B.2. **Protected Health Information (PHI).** If you need to access Protected Health Information (PHI) to identify potential subjects who will then be contacted, you will need a *limited waiver of HIPAA authorization*. If this applies to your study, please provide the following information and complete Section C.

a. Will the information collected be limited only to that necessary to contact the subjects to ask if they are interested in participating in the study?

b. How will confidentiality/privacy be protected prior to ascertaining desire to participate?

c. When and how will you destroy the contact information if an individual declines participation?

B.3. **Duration of entire study and duration of an individual subject's participation, including follow-up evaluation if applicable.** Include the number of required contacts and approximate duration of each contact.

This study will take approximately 18 months (actual study time) to complete. The study duration is based on 1-2 exposure days per week and 1 subject on each exposure day. This scheduling, however, is subject to change depending on the availability of study subjects and the number of concurrent studies requiring the same chamber facility.

All subjects will have at least 13 visits to the research facility over approximately 3 months. On the first visit, the subject will go through a consent process and then a training session for approximately 3 hours. During each of three subsequent visits (exposure days), subjects are required to check in by about 8:00 am and will be discharged approximately at 4:00 pm. Therefore, subjects will remain in the research facility for approximately 8 hours on exposure day 1. The following day, subjects are required to check in by 8:00 am and will be discharged approximately at 4:00 pm. Therefore, subjects will remain in the research facility for approximately 8 hours on exposure day 2. The 3rd day the subjects are required to check in by 8:00 am and will be discharged approximately at 11:00 am, for a total of approximately 3 hrs. Subjects will come back for the next 3 regimes following the same schedule for days 1-3 with 13 or more days between each regime. The total amount of time at this facility will be ~79 hr

B.4. **Where will the subjects be studied?** Describe locations where subjects will be studied, both on and off the UNC-CH campus.

All subjects will be studied in the USEPA Human Studies Facility located at 104 Mason Farm Road in Chapel Hill on the UNC Campus.

B.5. **Privacy.** Describe procedures that will ensure privacy of the subjects in this study. Examples include the setting for interviews, phone conversations, or physical examinations; communication methods or mailed materials (e.g., mailings should not indicate disease status or focus of study on the envelope).

All interviews and phone conversations will be conducted from either the Westat Recruiting office or the Medical Station in the U.S. EPA Human Studies Facility. This facility is guarded and only individuals working in the building have access beyond the guard's desk without an escort. Physical exams and other procedures will occur in appropriate clinical areas of the EPA. Occasionally 2 subjects may be seen in the clinical area at one time; however, sensitive information is only discussed in private (medication use, pregnancy test results). The subjects will be scheduled with the TRC (Chamber operators) group using a study number; however TRC only maintains a single separate log with the study number and the subject's number but not personal identifying information. Subjects may be contacted by email to schedule/remind them about study visits or to answer specific questions. Any information sent via US mail or campus mail will simply have a return address, no other study specific information.

B.6. **Inducements for participation.** Describe all inducements to participate, monetary or non-monetary. If monetary, specify the amount and schedule for payments and if/how this will be prorated if the subject withdraws (or is withdrawn) from the study prior to completing it. For compensation in

foreign currency, provide a US$ equivalent. Provide evidence that the amount is not coercive (e.g., describe purchasing power for foreign countries). Be aware that payment over a certain amount may require the collection of the subjects' Social Security Numbers. If a subject is paid more than $200.00 per year, collection of subjects' Social Security Number is required (University policy—see SSN Guidance) using the Social Security Number collection consent addendum found under forms on the IRB website (look for Study Subject Reimbursement Form).

Subjects will receive monetary compensation for their time ($12 per hour) and some procedures in the study (See below). In addition, subjects traveling from areas beyond Chapel Hill will be reimbursed for travel expenses commensurate with the US Government mileage rate in effect at the time. Parking will be provided or costs will be paid. Payments will be made after each segment of the study, unless the subject requests otherwise.

A subject who is unable to complete the study for voluntary reasons or failure to comply with eligibility requirements will receive full compensation for his/her participation up to that point. Subjects who are dismissed by the investigators after enrollment in the study but prior to completion for involuntary reasons will be compensated for his/her participation up to that point and will receive compensation at the hourly rate of $12 per hour for that particular scheduled 3 day study session.

In the event a scheduled study activity must be cancelled by the investigators with less than 72 hours prior notice, the subject will be paid at the standard hourly rate for the time scheduled and canceled, and will be paid 50% of procedure fees up to a total maximum of $100 for canceled procedures. Cancellations could occur due to adverse weather conditions, equipment failure, or other unforeseen events. When feasible, the subject will be rescheduled.

Money received by participants in research studies is normally treated as ordinary income by taxing authorities and payments made to you to the Internal Revenue Service as required by law. The money is not intended to coerce completion or participation, but to emphasize the importance of all the visits, and to signify the importance of your time and commitment to the research study.

Subject Compensation for Procedures during Diesel and Ozone Exposure Study

Training Day (assume 3 hr @$12/hr)	$36
First Exposure:	
Day 1	
Hourly payment (assume 8 hr @$12/hr)	$96
On-time bonus (8 a.m.)	$25
Stress questionnaire	$2.50
Blood Draw (twice)	$30
24 hr Urine Collection~~Urine Sample (3x)~~	$60~~15~~
Exhaled breath collection (twice)	$10
24 hr Holter Monitoring	$100
24 hr Blood Pressure Monitoring	$50
Lung function (6x)	$60
Lunch	$5
Day 2	
Hourly payment (assume 8 hr @$12/hr)	$96

On-time bonus (8 a.m.)	$25
Blood Draw (twice)	$30
Urine Sample (3x)	$15
Exhaled breath collection (twice)	$10
24 hr Holter Monitoring	$100
24 hr Blood Pressure Monitoring	$50
Lung function (6x)	$60
Lunch	$5
Day 3	
Hourly payment (assume 3 hr @$12/hr)	$36
Blood Draw	$15
Exhaled breath collection	$5
Urine Sample	$5
Lung function	$10
[Total payment First Exposure]	$900~~855~~.50
Second Exposure	$900~~855~~.50
Third Exposure	$900~~855~~.50
Fourth Exposure	$900~~855~~.50
Completion Bonus (for completing all 4 exposure sessions)	$100
APPROXIMATE TOTAL (including training day)	$3,738~~558~~.00

Other Possible Costs:
Extra Blood sticks ($10 each)
Extra hours ($12 per hour)
Travel from out of town (based on mileage)

B.7. **Costs to be borne by subjects.** Include child care, travel, parking, clinic fees, diagnostic and laboratory studies, drugs, devices, all professional fees, etc. If there are no costs to subjects other than their time to participate, indicate this.

There will be no cost to the subject excluding child and dependent care. Parking fees are covered by the study in the form of parking vouchers. All study related diagnostic tests such as pregnancy tests, pulmonary function test and labs are covered by the study. Westat subjects are primarily recruited from the Chapel Hill area. Volunteers who come from outside this area may be reimbursed for mileage at the current government rate.

Attachment #1 The Sheldon Cohen Self-Perceived Stress Questionnaire (from www.mindgarden.com)

Perceived Stress Scale

The questions in this scale ask you about your feelings and thoughts **during the last month**. In each case, you will be asked to indicate by circling *how often* you felt or thought a certain way.

Name _____ Date _____

Age _____ Gender (*Circle*): M F Other _____

0 = Never 1 = Almost Never 2 = Sometimes 3 = Fairly Often 4 = Very Often

1. In the last month, how often have you been upset because of something that happened unexpectedly?	0	1	2	3	4
2. In the last month, how often have you felt that you were unable to control the important things in your life?	0	1	2	3	4
3. In the last month, how often have you felt nervous and "stressed"?	0	1	2	3	4
4. In the last month, how often have you felt confident about your ability to handle your personal problems?	0	1	2	3	4
5. In the last month, how often have you felt that things were going your way?	0	1	2	3	4
6. In the last month, how often have you found that you could not cope with all the things that you had to do?	0	1	2	3	4
7. In the last month, how often have you been able to control irritations in your life?	0	1	2	3	4
8. In the last month, how often have you felt that you were on top of things?	0	1	2	3	4
9. In the last month, how often have you been angered because of things that were outside of your control?	0	1	2	3	4
10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?	0	1	2	3	4

Protocol title: "Cardiopulmonary Responses to Exposure to Ozone and Diesel Exhaust with Moderate Exercise in Healthy Adults"; T. Stevens PI

July 27, 2009 version

Attachment# 2 Newspaper Advertisement from Westat Inc, the recruitment contractor for US EPA Studies

The US Environmental Protection Agency is seeking

Adult Volunteers

For Research Study

Now recruiting healthy non-smoking adults ages 18 to 55 for a study about ozone, diesel exhaust & exercise. Study requires screening plus 13 visits over about 10 weeks and pays up to $3,558.

919-966-0604 or **1-888-279-9353**
www.epastudies.org

The Human Studies Facility is located on the UNC-CH campus

Attachment# 3 Web Site Announcement of this specific Study (IRB# 09-1344) at the US EPA Studies Webpage (www.epastudies.org)

DEPOZ Study, IRB Study #09-1344
Web Site Announcement
www.epastudies.org

DEPOZ

What is the purpose of the research study?

The purpose of this research is to find out how the air pollution that causes the haze seen in some polluted cities affects the heart, blood vessels and lungs of healthy adults.

Can I take part in the study?
You may be able to be in the study if you

- Are between 18 and 55 and
- Do not smoke and
- Do not have any heart or lung problems

What will I be asked to do?

- Have a free physical exam
- Have blood drawn
- Take part in several different breathing tests, including spirometry (explanation link provided)
- Have your heart rate (explanation link provided) and blood pressure monitored
- Use an exercise bike during testing
- Come in for a training visit, and then come in 3 days in a row generally every other week for 4 times.
- On the first day of each 3-day study session you will have tests and
  - Breathe clean air, or
  - Breathe air polluted with a carefully controlled amount of diesel exhaust, or
  - Breathe air polluted with carefully controlled amount of ozone, or
  - Breathe a combination of diesel exhaust and ozone,
- On the second day of each 3-day study session you will have tests and breathe air with ozone only
- On the third day of each 3-day study session you will have more tests

The polluted air that you breathe will be a lot like air you might breathe in a city like Los Angeles, New York, or Mexico City on a smoggy day

How long will it take?

- After screening there will be 13 visits, including 1 training visit and 4 sets of 3-day exposure visits, each set separated by at least 13 days
- In total, the study will take about 79 hours over about 10 weeks.

What will I get for volunteering?

- If you complete all visits and procedures, we will pay you $3,738~~558~~.

How can I sign up or get more information?
Call or send an email (link provided). Our office hours are Monday-Friday from 8 am to 5 pm EST. After hours please leave a message on voice mail, and we will return your call promptly.

- (919 966-0604 (local)
- 1-888-279-9353 (toll free)
- **recruitment@epa.gov**

Attachment# 4 Email Advertisement from Westat Inc, the recruitment contractor for US EPA Studies, of this study (IRB# 09-1344) to current participants in EPA studies

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DEPOZ Study E-mail to Current Volunteers

(these are people who are already participating in other EPA studies)

IRB #09-1344

E-mail Subject Line: EPA Research Study about Ozone, Diesel Exhaust and Exercise.

Dear _____,

You have been pre-qualified for a study called "DEPOZ" which will begin [date to be decided]. This research study is for healthy non-smokers between 18 and 55. The purpose of this study is to find out how air pollution – the kind that often causes the haze seen on smoggy days in polluted cities – affects the heart, blood vessels and lungs of healthy young adults. This study involves up to 13 visits after screening over about 10 weeks. It requires a commitment of about 79 hours, including four 2 ½ consecutive day sessions generally every other week. If all visits and procedures are completed this study pays $3,738~~558~~. If you are interested in learning more about the study and/or in scheduling a repeat physical exam (if needed) please call us at 919-966-0604 (or 888-279-9353). Please also visit **www.epastudies.org** for more information.

We look forward to hearing from you!
[Recruiter's name]

Attachment# 5 Email Advertisement from Westat Inc, the recruitment contractor for US EPA Studies, of this study (IRB# 09-1344) to potential participants (ie, not participating currently in EPA studies)

==========

DEPOZ Study E-mail Announcement

(intended for targeted lists, such as that provided by UNC to subscribers)

SUBJECT: INFORMATIONAL: Research Study about Ozone, Diesel Exhaust and Exercise.

This research study is for healthy non-smokers between 18 and 55. The purpose of this study is to find out how air pollution – the kind that often causes the haze seen on smoggy days in polluted cities – affects the heart, blood vessels and lungs of healthy young adults. This study involves up to 13 visits after screening over about 10 weeks. It requires a commitment of about 79 hours, including four 2 ½ consecutive day sessions generally every other week. If all visits and procedures are completed this study pays $3,738~~558~~. Please visit **www.epastudies.org** for more information or call the Westat EPA Recruiting Office at 919-966-0604.

Approved [date], by the Office of Human Research Ethics Biomedical Institutional Review Board. IRB # 09-1344: Cardiopulmonary responses to exposure to ozone and diesel exhaust with moderate exercise in healthy adults.

This email is sponsored by: U.S. Environmental Protection Agency Human Studies Division, located on the UNC-Chapel Hill campus.

Attachment# 6 Recruitment Script describing this specific study (IRB# 09-1344) from Westat Inc, the recruitment contractor for US EPA Studies, to potential participants

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Study Name: DEPOZ
IRB Study # 09-1344

Title
Cardiopulmonary responses to exposure to ozone and diesel exhaust with moderate exercise in healthy adults.

Purpose
The purpose of this research study is to find out how the air pollution that causes the haze seen in some polluted cities (like Los Angeles, New York, and Mexico City) affects the heart, blood vessels and lungs of healthy young adults. This study is for people ages 18 to 55 who are able to exercise.

Procedures and Payment

The study will require two screening visits to the EPA Human Studies Facility (one to complete medical history paperwork, and the other for a physical exam), followed by a 3-hour training session and four 3-day study sessions. Study sessions are generally about two weeks apart, so this study requires 13 visits after screening over about 10 weeks. On the first day of each segment you will be exposed for 2 hours to either clean air, or air polluted with a carefully controlled amount of diesel exhaust or ozone, or both. Then the next day you will come back for another 2-hour exposure just to ozone. Each exposure day will last 8 hours. The third day of each segment will last about 3 hours.

During exposure sessions you will be asked to give blood, urine and breath samples, ride an exercise bike at 15-minute intervals during exposures, and perform several different breathing tests. You will also wear heart and blood pressure monitors during the study sessions and over night. Additionally, you will be asked to collect urine samples over night after the first exposure of each session. The total amount of time is about 79 hours over about 10 weeks. Since each set of exposures is separated generally by 2 weeks, you will spend 2½ days at the clinic every other week, 4 times. Does this seem like something that your schedule can handle?

If you complete the training visit and all four 2½ day sessions, you will be paid $3,738~~558~~.00.

Study Schedule

Screening, 2 visits, as needed: 3 hours
Training visit, *days & times to be decided*: 3 hours
Segment 1, Day 1, 8 AM, *days to be decided*: 8 hours
Segment 1, Day 2, 8 AM, day after Day 1, 8 hours
Segment 1, Day 3, 8 AM, day after Day 2, 3 hours

Study Restrictions
In addition to meeting all study eligibility criteria (*in the IRB application*), volunteers must be willing to adhere to the following restrictions as well:

- No over the counter pain medications such as aspirin, Advil, Aleve, or other non-steroidal anti-inflammatory medications including those used for allergies for 48 hours prior to the exposure and post-exposure visits

- Medications not specifically mentioned here may be reviewed by the investigators prior to your inclusion in the study
- No Vitamins C or E, or supplements containing C or E, for at least 2 weeks prior to and throughout the study.
- Avoid smoke and fumes for 24 hours before all visits
- Avoid drinking alcohol 24 hours before all visits
- Avoid strenuous exercise for 24 hours prior to and after all visits
- Avoid the use of ozone-based home air purifiers during study participation.
- Eat a light breakfast on the exposure day
- Do not consume caffeine for 2 hours prior to the exposure on days 1 & 2 and post-exposure visits

Attachment# 7 Reminder sheet from Westat Inc, the recruitment contractor for US EPA Studies, of this study (IRB# 09-1344) to accepted participants

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TO:

RE: **Your appointment at the EPA Human Studies Facility**

STUDY: **DEPOZ STUDY, IRB # 09-1344**
DATE:

TIME:

PARKING is available on Mason Farm Rd directly in front of the EPA Human Studies building. Please park in Visitor Spaces only. Enter the building, give your name to the Guard, and request a Visitor Permit.

If the EPA lot is full you may also park in [provide current parking availability information]. Use Patient/Visitor spaces only. If you are a UNC Student or are UNC staff or faculty and must use the Dogwood Deck or ACC Lot you MUST print this appointment slip and display it on the dashboard in your car. If you do not display it, you will be ticketed.

May be folded here for display

Study Instructions

Illness
If you are sick or have been sick or injured in the last 4 weeks, please call Recruitment at 966-0604 or 888-279-9353. This includes sore throats, coughs, colds, and cold sores.

Active Allergies or Hay Fever
If you have had seasonal allergy symptoms in the past week, please call Recruitment to reschedule.

Medications
- No over the counter pain medications such as aspirin, Advil, Aleve, or other non-steroidal anti-inflammatory medications, including those taken for allergies, for 48 hours prior to the exposure and post-exposure visits. Tylenol is permitted.

Diet and Exercise
- No Vitamins C or E, or supplements containing C or E, for at least 2 weeks prior to and throughout the study.
- No drinking alcohol 24 hours before all visits
- No strenuous exercise for 24 hours prior to and after all visits
- No caffeine for 2 hours before to the exposure on days 1 & 2 and post-exposure visits.
- Eat a light breakfast on exposure days.

Other
- No smoke and fumes for 24 hours before all visits
- No ozone-based home air purifiers throughout the study
- Wear comfortable clothes and shoes suitable for exercise and bring a change of clothes

- Shower only in the morning before exposures, following the medical staff's instructions for removing and reattaching monitors.

If you are unable to keep your appointment, please call Recruitment. Please be on time!

Thank You! Westat EPA Support Services

THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL

OFFICE OF HUMAN RESEARCH ETHICS
Medical School Building 52
Mason Farm Road
CB #7097
Chapel Hill, NC 27599-7097
(919) 966-3113
Web site: ohre.unc.edu
https://my.research.unc.edu for IRB status
Federalwide Assurance (FWA) #4801

To: Tina Stevens
Epa
CB:7315, MD58A USEPA , 104 Mason Farm Rd , Chapel Hill , NC , 27599

From: Biomedical IRB

Authorized signature on behalf of IRB

Approval Date: 12/10/2010
Expiration Date of Approval: 12/05/2011
RE: Notice of IRB Approval by Full Board Review
Submission Type: Renewal
Study #: 09-1344
Study Title: Cardiopulmonary Responses to Exposure to Ozone and Diesel Exhaust With Moderate Exercise in Healthy Adults
Sponsors: US Environmental Protection Agency - Contracts

This submission has been approved by the above IRB for the period indicated.

Study Description:
Purpose: The purpose of this study is to measure cardiopulmonary responses in healthy young adults before, during, and after exposure to combinations of ozone (03) and diesel exhaust (DE) for 2 hours with moderate exercise and to primarily investigate whether DE modulates the 03-induced effects on the lung and cardiovascular systems. Participants: Fifteen (15 healthy) young men and women in the age of 18-55 years Procedures (methods): Each subject will be exposed in environmentally controlled exposure chambers to 4 exposure regimens. Each regimen will require a 2 hr exposure with intermittent, moderate exercise on 2 consecutive days. Day 1 exposure will consist of a combined exposure to DE and 03, 03 only (i.e., no DE), or DE only, or clean air (CA) only. For all 4 regiments, subjects will return the next day (Day 2) to be exposed to 03 alone and again on Day 3 for a follow up visit. Each regimen will be separated by at least 2 weeks. Techniques measuring lung and cardiac physiology will be performed pre, during, and post exposure. Blood, urine, and breath samples will also be obtained and analyzed for immune and inflammatory markers, possible genotyping, clotting factors, susceptibility factors, and exposure markers.

Submission Description:
With this renewal, an amendment dated 11/16/2010 addresses:

1. updates to study design including monitoring lung function using portable spirometer; safety guideline with this measurement; add saliva collection as endpoint and other administrative and editorial changes.
2. addition of Martha Almond, Carol Robinette, Margaret Herbst, Lynne Newlin-Clapp
3. revise storage consent form subject injury to be consistent with EPA policy
4. updated IRB application

5. updated consents
6. updated recruitment and instructions

Regulatory and other findings:
Based on the information provided, the IRB has determined that HIPAA does not apply to this study.

Investigator's Responsibilities:
Federal regulations require that all research be reviewed at least annually. It is the Principal Investigator's responsibility to submit for renewal and obtain approval before the expiration date. You may not continue any research activity beyond the expiration date without IRB approval. Failure to receive approval for continuation before the expiration date will result in automatic termination of the approval for this study on the expiration date.

When applicable, enclosed are stamped copies of approved consent documents and other recruitment materials. You must copy the stamped consent forms for use with subjects unless you have approval to do otherwise.

You are required to obtain IRB approval for any changes to any aspect of this study before they can be implemented (use the modification form at ohre.unc.edu/forms). Any unanticipated problem involving risks to subjects or others (including adverse events reportable under UNC-Chapel Hill policy) should be reported to the IRB using the web portal at https://irbis.unc.edu/irb.

This study was reviewed in accordance with federal regulations governing human subjects research, including those found at 45 CFR 46 (Common Rule), 45 CFR 164 (HIPAA), 21 CFR 50 & 56 (FDA), and 40 CFR 26 (EPA), where applicable.

CC:
Michael Madden, Environmental Protection Agency
Michael Schmitt
David Diaz-Sanchez
Howard Kehrl, Medicine
Howard Kehrl, (EPA), Non-IRB Review Contact

THIS CONSENT DOCUMENT SHOULD BE USED ONLY
BETWEEN 12-10-10 AND 12-5-11
APPROVED BY
INSTITUTIONAL REVIEW BOARD, UNC-CHAPEL HILL

University of North Carolina-Chapel Hill
Consent to Participate in a Research Study
Adult Subjects
Biomedical Form—

IRB Study # 09-1344 GCRC #: N/A
Consent Form Version Date: November 16, 2010

Title of Study: Cardiopulmonary Responses to Exposure to Ozone and Diesel Exhaust with Moderate Exercise in Healthy Adults
Principal Investigator: Tina Stevens, PhD
UNC-Chapel Hill Department: US Environmental Protection Agency
UNC-Chapel Hill Phone number: (919) 843-8031
Email Address: stevens.tina@epa.gov
Co-Investigators: Michael Madden, PhD; David Diaz-Sanchez, PhD; Howard Kehrl, MD
UNC-Chapel Hill Phone number: (919)966-6257, (919) 966-0676, (919) 966-6208
Email Address: madden.michael@epa.gov; diaz-sanchez.david@.epa.gov; kehrl.howard@epa.gov;
Faculty Advisor: N/A

Funding Source: US Environmental Protection Agency Intramural Federal Research

Study Contact telephone number: (919) 966-6257 (Michael Madden)
Study Contact email: madden.michael@epa.gov

What are some general things you should know about research studies?
You are being asked to take part in a research study. To join the study is voluntary. You may refuse to join, or you may withdraw your consent to be in the study, for any reason at any time.

Research studies are designed to obtain new knowledge that may help other people in the future. You may not receive any direct benefit from being in the research study. There also may be risks to being in research studies.

Your participation is voluntary. Deciding not to be in the study or leaving the study before it is completed will not affect your relationship with the researcher, your health care provider, or the University of North Carolina-Chapel Hill. If you are a patient with an illness, you do not have to be in the research study in order to receive health care.

Details about this study are discussed below. It is important that you understand this information so that you can make an informed choice about being in this research study. You will be given a copy of this consent form. You should ask the researchers named above, or staff members who may assist them, any questions you have about this study at any time.

What is the purpose of this study?

We breathe a complex mixture of air pollution, and ozone and diesel exhaust are generally the major and important components. Controlled exposures of volunteers to either pollutant have resulted in biological effects such as lung physiological changes. However it is not known if co-exposure to both pollutants, similar to inhaling polluted air, can induce effects than either pollutant alone. Additionally it is also uncertain if exposure to diesel exhaust alone, or diesel exhaust mixed with ozone, can alter the body's responses to breathing ozone the following day. This study proposes to examine whether exposure to both ozone and diesel exhaust can cause more of an effect than either pollutant alone. This study will also determine if breathing diesel exhaust can change a response upon exposure to ozone the day after. The purpose of this study is to measure cardiopulmonary responses in healthy young adults before, during, and after exposure to combinations of ozone (O3) and diesel exhaust for 2 hours with moderate exercise and to primarily investigate whether diesel exhaust modulates the O3-induced effects on the lung and cardiovascular systems.

This study will examine whether co-exposures to ozone and diesel exhaust, at doses in the upper range of those encountered in urbanized settings, can induce additive or synergistic effects, and whether a previous DE exposure alters a response upon subsequent exposure to ozone.

The data obtained from this study will contribute to the overall assessment of air pollution effects in the U.S. and thereby may influence future health policy. The ambient permissible concentrations of both ozone and diesel exhaust are currently regulated individually by the US EPA, but the Agency is moving towards regulating pollutant mixtures. Results from this study may increase the understanding of how gaseous and particulate air pollutants (which causes the haze seen in some polluted cities) may adversely affect the functioning of the heart, blood vessels, and lungs. This understanding may be especially important for patients with diseases of the heart and lungs.

Are there any reasons you should not be in this study?

You should not participate in this study if…

- You have a history of chest pain, irregular heart beats, a heart attack or coronary bypass surgery.
- You have a heart pacemaker.
- You have untreated high blood pressure (> 150 systolic, > 90 diastolic).
- You have a history of an EKG finding called QT/QT_C prolongation [a marked baseline prolongation of QT/QTc interval (e.g., repeated demonstration of a QTc interval > 450 milliseconds)]
- You have a history of lung disease and/or active allergy including: hay fever, dust allergies, rhinitis, asthma, chronic bronchitis, chronic obstructive pulmonary disease, tuberculosis, coughing up blood, recurrent pneumonia, chronic or allergic rhinitis or acute or chronic sinusitis.
- You cannot perform moderate exercise
- You cannot remain in a small exposure chamber for about 2 hours
- You are currently taking β-blockers (such as atenolol, metoprolol, propanolol, and acebutolol).
- You have a history of bleeding or coagulation disorders or are taking blood thinner medication.
- You are currently smoking or have a smoking history within 1 year of the study (defined as more than one pack of cigarettes in the past year) or have a greater than/equal to a 5 pack year smoking history.
- You are less than 18 years old or greater than 55 years old

- You have diabetes.
- You have cancer.
- You are currently taking estrogen replacement therapy.
- You are pregnant, attempting to become pregnant or breastfeeding.
- You have an allergy to latex.

Additionally, you should **NOT** participate if you are unable to comply with the following requirements:

- No over-the-counter pain medications such as aspirin, Advil, Aleve or other non-steroidal anti-inflammatory medications ("NSAIDS") for 48 hr prior to the exposure and post-exposure visits. Acetaminophen, eg, Tylenol, is permitted.
- Avoid smoke and fumes for 24 hours before all visits.
- Avoid drinking alcohol 24 hours before all visits.
- Avoid strenuous exercise for 24 hours prior to and after all visits.
- Eat a light breakfast on the exposure days.
- Not consume caffeine for 1-2 hours prior to the exposures on days 1 & 2 and post-exposure visits.
- Stop taking vitamin C or E or medications which may impact the results of the exposures at least 2 weeks prior to the study and for the duration of the study. Medications not specifically mentioned here may be reviewed by the investigators prior to your inclusion in this study.
- Avoid the use of ozone-based home air purifiers during study participation

How many people will take part in this study?

If you decide to be in this study, you will be one of approximately 15 people who will complete this research study.

How long will your participation in this study last?

You will have up to 13 visits to the research facility over approximately about 10 weeks if you are eligible for the study (see attached study design flow chart).

Your participation in this study will include one training session (today) for about 3 hours, 4 exposure regimens, each of which will consist of 2 consecutive exposure days and 1 follow-up visit approximately 18 hrs after the last exposure. Each exposure day will last approximately 8 hours and the follow-up visit will be approximately 3 hrs long. The 4 exposure regimens will occur at least 13 days apart.

Storage of some of your blood samples in this study may be indefinite.

What will happen if you take part in the study?

During the course of this study, the following will occur:

Training:

You should have already undergone a general physical examination to ensure that you are a candidate for this study. If you are a female participating in this study, you should have been asked about your menstrual history and will be given a pregnancy test.

Today's visit is expected to last about 3 hours. Today you will familiarize yourself with some of the techniques you will perform for the study. These include instructions on the use of the stationary bicycle to be used during the study, how to perform spirometry, on a portable spirometer and dry seal digital spirometer, how to give a saliva and an exhaled breath sample, , and you will be shown the heart rate variability (HRV) and blood pressure (BP) monitors.

After satisfactorily completing the training session, you will be scheduled for your first exposure through a company contracting with the US EPA (currently Westat).

You will be exposed to mixtures of air pollutants in 4 different regimens. Each regimen will last about 2 ½ days. During the regimens, a number of physiological and biochemical measurements will be made. **With your permission, during one of your blood draws DNA from your blood cells will also be genotyped for specific genes related to adverse health effects associated with air pollution exposure. Unwillingness to have samples genotyped will NOT exclude you from participating in this study. If you do not wish for your blood to be used for genotyping, but do wish to participate in the study, sign the section at the end of this consent form titled *Subject's Agreement to Participate in the Research Study WITHOUT Genoptyping Consent.* With your permission, we may also store some of your blood we obtain during the study for yet-to-be-determined tests in the future.**
You will have the opportunity to complete all 4 regimens separated by at least 2 weeks. The first day of each regimen you will be exposed to either clean air, diesel exhaust at about 300 micrograms of particles/meter^3, ozone at about 0.3 parts per million (ppm), or diesel exhaust mixed with ozone. The second day of the regimen, you will be exposed to approximately 0.3 ppm ozone. The third day of each regimen, you will not be exposed to any air pollutants, but will have follow up measurements made.

You may terminate your participation from this study at any time. You will be monitored for symptoms that you may develop during the exposure and over the following 24 hour period. The symptoms may include chest pain, difficulty breathing, light-headness, pale skin color, and significant irregular heart beats. In addition, analyses of blood samples taken after exposure will be monitored for abnormalities, including signs of cell damage, changes in clotting factors, as well as increases in inflammation. The study physicians will stop the study if symptoms and/or changes detected in the blood samples that are considered clinically significant.

Below is a description of what will be required from you and a summary of the measurements to be made on you on each day of each exposure regimen:

Day 1:

We will call you a few days before the exposure session to remind you of your scheduled visit. We will also remind you to refrain from alcohol, NSAID medications, excessive amounts of caffeine, and from any activities where you could be exposed to high levels of pollutants (e.g., cigarette smoke, paint fumes) for a couple of days before your visit. Please report any pollutant

exposure to the study personnel so you can be rescheduled if necessary. You will be rescheduled if you have experienced a respiratory tract illness within the past 4 weeks or any other illness within the past week.

You will be asked to eat a light breakfast and arrive at the EPA medical station at approximately 8 am. There will be an on-time bonus of $25 for arriving by 8:05 a.m. You will need to wear comfortable clothes and shoes and bring a change of clothes.

Pre-exposure measurements:

Prior to the day 1 exposures, you will be asked to do the following:

- Answer a questionnaire on stress
- Have your vital signs checked (heart rate, respiratory rate, blood pressure, and oxygen saturation level, and for women, a pregnancy test).
- Have your baseline heart rate viability (HRV) measured by a Holter monitor. You will have several ECG leads attached to your chest. It may be necessary to clean and shave the areas of your chest where these leads will be placed. Excessive deodorant, skin lotions, and body sprays may interfere with the function of some of these leads so we will ask you not apply these to your chest area on the day you report to the HSF. The leads will be connected to 2 monitors (small recording devices about the size and weight of a portable tape player) to obtain readings of your heart rate and rhythm. One of these monitors will be removed at the end of the day and the other monitor may be kept on you for the next two days and will be removed on Day 3 of the exposure session. You will be asked to recline quietly and breathe at a constant rate for 20 minutes, after which the ECG monitor will take a 10-minute measurement of your heart rhythm. It is important that you do not fall asleep during this 30-minute period. The morning of the follow up visit (Day 3), there may be a 30 minute measurement of your heart rate and then the monitor will be removed.
- Blood pressure (BP) may be measured intermittently by a BP monitor. A blood pressure cuff and a monitor which is about the size of the Holter monitor may be fitted and will remain in place most of the time until Day 3. You will be asked to keep your arm relaxed and still when the pressure cuff is inflating.
- Have about 25 ml blood drawn (~5 teaspoons).
- Have a breathing test (spirometry). You will breathe through a filter into the machine. We will coach you, and you will be asked to take a full breath in and then blow it out as hard and fast as you can. We will ask you to do this several times. This procedure will be repeated on a portable devise as well.
- Be asked to provide a urine sample; if you are female it will be tested to see if you are pregnant.
- We will collect your breath and saliva.
- You will be asked to collect your urine for the next 24 hrs
- Have a second breathing test on a portable spirometry instrument, but in a similar manner as the first.

During the Day 1 exposure you will:

- Enter an exposure chamber.

- Be exposed to clean air or air pollutants for 2 hours. You will be asked to perform intermittent moderate exercise in an exposure chamber.
- At certain times during the exposure, you may be asked to breathe into a mouthpiece so that your rate of breathing can be measured. In addition, you will be asked to breathe into a portable spirometer so that your lung function can be measured. Exposure may be terminated if you show a larger than expected decrement in lung function. A staff member will be seated outside the chamber to observe you at all times and a physician will be available during the entire exposure session. During the exposure, your heart rhythm and rate, blood pressure, and the amount of oxygen in your blood will be monitored. If it appears you are having heart rhythm or breathing problems, or you develop a severe headache, nausea or vomiting the exposure will be terminated immediately.

Immediately following the Day 1 exposure you will:

- Have your vital signs checked.
- Perform spirometry. You will breathe through a filter into the machine. We will coach you, and you will be asked to take a full breath in and then blow it out as hard and fast as you can. We will ask you to do this several times about 1 assessment each hour
- We will collect your breath and saliva
- You will recline quietly for 20 minutes, after which the ECG monitor will take a 10-minute measurement of your heart rhythm.
- Have blood drawn (about 25 ml; ~5 teaspoons).
- Provide a urine sample.

Later in the day, you will:

- Have spirometry assessed for up to 4 hr post exposure
- Be assessed for adverse responses and discharged by the nursing staff. You will spend about 8 hours at the EPA facility.
- You will be given a cooler containing 1 L plastic bottles and verbal instructions for how to collect and record the time of the urine samples.

Importantly, because you will be asked to wear the portable ECG monitor attached to your chest and a blood pressure monitor cuff on your arm for the following two nights, we will give you instructions on how to care for and remove the monitors when necessary.

Day 2:

You will return to the HSF the next morning at 8:00 a.m. and you will perform testing similar to the first day.

Pre-exposure measurements and procedures will be performed as on Day 1, with the exception of the stress questionnaire. You will then enter the exposure chamber.

During the exposure on Day 2 you will be exposed to ozone at a concentration of approximately 0.3 ppm for 2 hours with intermittent moderate exercise in an exposure chamber. Again, your heart rhythm and rate, blood pressure, the amount of oxygen in your blood, your breathing rate, and lung function will be monitored while you are inside the chamber.

- **Similar measurements and procedures will be performed with you during and following the Day 2 exposure as on Day 1.** However, you will only be asked to collect spot urine samples at the EPA facility. You will be assessed for adverse responses and you will be discharged by the nursing staff. You will spend about 8 hours at the EPA facility.

Day 3:

Follow up Visit:
Similar procedures and measurements will be made as the pre-exposure measurements of the two previous days. The Holter monitor attached to you will be removed. You will be assessed for adverse responses and you will be discharged by the nursing staff. You will spend about 3 hours at the EPA facility.

If there are remaining samples after our analysis, we would like to continue to store your samples for as yet undesignated studies. This allows us to make the best use of the samples we collect from you. You will be given a separate consent form for this storage, and you do not have to allow your samples to be stored in order to participate in this study.

What are the possible benefits from being in this study?
You will not benefit directly from being in this research study, though by participating in screening for this study you will have received a medical examination that included blood work, respiratory test, and ECG monitoring of heart at no charge. However, this is not a substitute for a routine doctor visit. The medical staff will explain to you any remarkable findings regarding your overall health status. In addition, if we observe changes in your health status as a consequence of exposure to air pollutants, you may elect to use this information to avoid exposure on high pollution days.

This research is designed to benefit society in general by gaining new knowledge. Given that every member of American society is currently exposed to these pollutants, this study has the potential to contribute to devising effective strategies aimed at protecting millions from the untoward effects of these pollutants.

What are the possible risks or discomforts involved with being in this study?
This study might involve the following risks and/or discomforts to you:

If you have any tendency to become uncomfortable in small closed spaces, it is possible that you may become uncomfortable during this study. You will be taken to the exposure chamber when you are first evaluated for suitability for the study to allow you an opportunity to see where you will sit and what the chamber looks like.

Diesel exhaust exposure: Exposure to air pollution particles can cause cough, shortness of breath, chest discomfort, eye irritation, and headache. These symptoms typically last no more than a few hours, but could last longer if you are especially sensitive. Eye wear protection goggles are available during the exposures to reduce possible eye irritation. There is a chance that exposure to particles can increase the likelihood that you will be more likely to come down with a respiratory infection within several days of the exposure. Diesel exhaust, even when diluted in this study, may have an unpleasant odor. Exposure to the air pollution particle concentrations used in this study for short periods of time has not been found to cause permanent health effects. However, some studies suggest that older people, particularly those with underlying cardiovascular diseases, are at increased risk for getting sick and even dying during episodes of high air pollution. While we can not exclude the possibility that you may have an adverse reaction to breathing these exhausts, you will only be exposed to them for 2 hours. You could be potentially inhale a similar amount if you visited a large city such Los Angeles, New York, or Mexico City on a smoggy day.

You will be monitored continuously during the exposure session through a window in the chamber or by closed-circuit television, and can communicate with a staff member via an intercom. Your heart rate and rhythm will also be constantly monitored for any adverse changes brought about by the exposure. A licensed physician is always on the premises (i.e., within the building facility) during exposures, and is available to respond in an emergency.

Ozone exposure: Potential risks may include mild decrements in lung function spirometric volume, irritation to the nose, eyes, throat and airways, pain on deep inspiration and cough. These symptoms typically disappear 2 to 4 hours after exposure, but may last longer for particularly sensitive people. Ozone may induce an inflammatory reaction that may last for about 24 hours after exposure and may increase your chance of catching a cold.

Diesel exhaust and ozone exposure combined: Because this exposure scenario has not been conducted at our facilities or elsewhere before, we do not yet know whether or not this exposure will include the same risks as diesel exhaust and ozone exposures alone. It is possible that the combination of diesel exhaust and ozone exposures will increase the effects of each pollutant individually, and it is also possible that it will not. We are doing this study in order to find out the answer.

Heart rhythm monitoring: There is little risk associated with monitoring your heart by ECG or blood oxygen by pulse oximetry. However, preparing your skin for placement of ECG electrodes and removing the electrodes the next day may cause some irritation or skin discoloration, itching, or burning in some people. If this occurs during your visit, you should tell the nursing staff. If irritation occurs while you are home, you should remove the electrodes, wash gently with mild soap and water, and tell the study coordinator or nursing staff in the morning.

Blood pressure monitoring: Similar to the regular blood pressure measurement, the risk associated with blood pressure monitor is considered minimal.

Venous blood sampling: The risks associated with taking blood samples are considered minimal. A well-trained member of the staff will draw the blood. Drawing blood could cause some bruising or minor pain, which usually resolves quickly. Occasionally fainting or light-headedness occurs, and injury is minimized by having you seated. Also, a rare complication is skin infection or an infection of the vein in which the blood has been drawn. The risk of getting infection is minimized by the use of sterile technique. If you do have signs of infection at the site (redness, warmth, painful skin, and swelling) after completion of the procedure, you will need to contact the EPA medical station.

Exhaled breath collection: Minimal risk is associated with these procedures. Sensitive individuals may become light-headed. You will be seated in a chair during collections and technicians are always available during this procedure in case you become light-headed.

Breathing tests (spirometry): You may cough or become dizzy during these tests. You will be seated in a chair, and if these symptoms occur, they are usually only temporary. You will be exposed to a low dose of acetylene for a brief period of time (single breath in and breath out), thus the risk will be quite low.

In addition, there may be uncommon or previously unrecognized risks that might occur. If you do notice any unusual symptoms occurring during the study you should call the EPA medical station or the on-call physician to report them. We will give the number of the physician on-call before you leave the building.

Genotyping: If given permission to collect genetic information, a federal law called the Genetic Information Nondiscrimination Act (GINA) generally makes it illegal for health insurance companies, group health plans and most employers to discriminate against you based on your genetic information. GINA does not protect you against genetic discrimination by companies that sell life insurance, disability insurance or long term care insurance. GINA dose not protect you against discrimination based on an already diagnosed genetic condition or disease.

What if we learn about new findings or information during the study?

You will be given any new information gained during the course of the study that might affect your willingness to continue your participation.

How will your privacy be protected?

You will be given a study code number. All electronic documents will only have that number. The paper records that the coordinators and medical doctors use may have your name. Your information can be linked to your personal information by the study number, however only study personnel have access to your personal information. Paper records that use your name are kept in a locked file cabinet in the EPA Medical Station of the Human Studies Facility. The Medical Station is locked when not attended by study staff, and the EPA Human Studies Facility has

limited access to authorized individuals only, 24 hours/day for 7 days/week. Blood samples will be stored at the EPA Human Studies Facility.

Research studies may be done at many places at the same time. Your personal identifying information will never be sent to outside researchers.

No subjects will be identified in any report or publication about this study. Although every effort will be made to keep research records private, there may be times when federal or state law requires the disclosure of such records, including personal information. This is very unlikely, but if disclosure is ever required, UNC-Chapel Hill will take steps allowable by law to protect the privacy of personal information. In some cases, your information in this research study could be reviewed by representatives of the University, research sponsors, or government agencies for purposes such as quality control or safety.

What will happen if you are injured by this research?

All forms of human health research involve some risk of injury or illness. Despite our high level of precaution, you may develop an injury or illness due to participating in this study. If you develop an injury or illness determined by an appointed US EPA physician to be due to your participation in this research, the US EPA will reimburse your medical expenses to treat the injury or illness up to $5000. If you believe your injury or illness was due to a lack of reasonable care or other negligent action, you have the right to pursue legal remedy. The Federal Tort Claims Act, 28 U.S.C. 2671 et. Seq., provides for money damages against the United States when personal injury or property loss results from the negligent or wrongful act or omission of any employee of the EPA while acting within the scope of his or her employment. Signing this consent form does not waive any of your legal rights or release the investigator, the sponsor, the institution, or its agents from liability for negligence.

If a research related injury or illness occurs, you should contact the Director of the EPA NHEERL Human Research Protocol Office at (919) 966-6217.

What if you want to stop before your part in the study is complete?

You can withdraw from this study at any time, without penalty. The investigators also have the right to stop your participation at any time. This could be because you have had an unexpected reaction, or have failed to follow instructions, or because the entire study has been stopped.

Will you receive anything for being in this study?

You will be paid approximately $12 per hour for your participation in this study and the total compensation for completion of this study will be approximately $3,738.00

We will give you parking coupons to cover the cost of parking. If you live beyond Chapel Hill you will be reimbursed for mileage at the US Government mileage rate in effect at the time. Money received by participants in research studies is normally treated as ordinary income by taxing authorities and we will report payments made to you to the Internal Revenue Service as required by law. Payments totaling more than $600 in a year from a single or multiple EPA studies will be reported to the IRS. This summary is to emphasize the importance of all the visits, and to signify the importance of your time and commitment to the research study. Below is a detailed list of compensation for the entire study.

Subject Compensation for Procedures during Diesel and Ozone Exposure Study

Training Day (assume 3 hr @$12/hr)	$36
First Exposure:	
Day 1	
Hourly payment (assume 8 hr @$12/hr)	$96
On-time bonus (8 a.m.)	$25
Stress questionnaire	$2.50
Blood Draw (twice)	$30
24 hr Urine Collection	$60
Exhaled breath and saliva collection (twice)	$10
24 hr Holter Monitoring	$100
24 hr Blood Pressure Monitoring	$50
Lung function (6x)	$60
Lunch	$5
Day 2	
Hourly payment (assume 8 hr @$12/hr)	$96
On-time bonus (8 a.m.)	$25
Blood Draw (twice)	$30
Urine Sample (3x)	$15
Exhaled breath and saliva collection (twice)	$10
24 hr Holter Monitoring	$100
24 hr Blood Pressure Monitoring	$50
Lung function (6x)	$60
Lunch	$5
Day 3	
Hourly payment (assume 3 hr @$12/hr)	$36
Blood Draw	$15
Exhaled breath and saliva collection	$5
Urine Sample	$5
Lung function	$10
[Total payment First Exposure]	$900.50
Second Exposure	$900.50
Third Exposure	$900.50

Fourth Exposure	$900.50
Completion Bonus (for completing all 4 exposure sessions)	$100
APPROXIMATE TOTAL (including training day)	$3,738.00

Additional blood draws ($10 each)
Additional hours ($12 per hour)

You should understand that your participation is voluntary. You may terminate your participation in the study at any time without penalty. If you voluntarily elect to withdraw from the study at any time or you fail to maintain compliance with eligibility requirements, you will be paid for that portion of the study that has been completed. Subjects who are dismissed by the investigators after enrollment in the study but prior to completion for involuntary reasons, will be compensated for his/her participation up to that point and will receive compensation at the hourly rate of $12 per hour for the scheduled 3 day study session for a total of $228.

In the event a scheduled study activity must be cancelled by the investigators with less than 72 hours prior notice, the subject will be paid at the standard hourly rate for the time scheduled and canceled, and will be paid 50% of procedure fees up to a total maximum of $100 for canceled procedures. You will be paid in full for any procedures that may have been started during the current visit. Cancellations could occur due to adverse weather conditions, equipment failure, or other unforeseen events. When feasible, you will be rescheduled.

Will it cost you anything to be in this study?

There will be no cost to you for participating in the study. However, if you are deemed not eligible to participate in the study for medical reasons, we may suggest that you seek follow-up care from your own health care provider for abnormalities discovered during the screening history, physical examination, or the study. **Such care is entirely at your own expense. EPA will not provide reimbursement for any follow-up care.**

All study procedures will be paid for by the study. We will give you parking coupons to cover the cost of parking. If you live beyond Chapel Hill you will be reimbursed for mileage at the US Government mileage rate in effect at the time.

This study will take approximately 10 weeks to complete. The study duration is based on 4 exposure regimes separated by at least 2 weeks. The total amount of time at this facility will be ~79 hr.

What if you are a UNC student?

You may choose not to be in the study or to stop being in the study before it is over at any time. This will not affect your class standing or grades at UNC-Chapel Hill. You will not be offered or receive any special consideration if you take part in this research.

What if you are a UNC employee?
Taking part in this research is not a part of your University duties, and refusing will not affect your job. You will not be offered or receive any special job-related consideration if you take part in this research.

Who is sponsoring this study?
This research is funded by The U.S. Environmental Protection Agency. This means that the research team is being paid by the sponsor for doing the study. The researchers do not, however, have a direct financial interest with the sponsor or in the final results of the study.

What if you have questions about this study?
You have the right to ask, and have answered, any questions you may have about this research. If you have further questions regarding this study, you should call one of the listed investigators:
Michael Madden, PhD 919-966-6257 Tina Stevens, PhD 919-843-8031

If you feel a research-related injury has occurred, please contact the HSF medical station or one of the investigators listed above. In addition, you should contact the Human Studies Division Human Research Officer and Director of the National Health Effects and Environmental Research Laboratory Human Research Protocol Office at 919-966-6217.

What if you have questions about your rights as a research subject?
All research on human subjects is reviewed by a committee that works to protect your rights and welfare. If you have questions or concerns about your rights as a research subject you may contact, anonymously, if you wish, the Institutional Review Board at 919-966-3113 or by email to IRB_ subjects@unc.edu and/or the EPA Director of the National Health and Environmental Effects Human Research Laboratory Protocol Office at 919-966-6217.

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IRB Study #_09-1344___**Title of Study:** Cardiopulmonary Responses to Exposure to Ozone and Diesel Exhaust with Moderate Exercise in Healthy Adults

Principal Investigator: Tina Stevens, PhD

Subject's Agreement to Participate in the Research Study WITHOUT Genotyping Consent

I have read the information provided above. I have asked all questions I have at this time. I voluntarily AGREE to participate in this study and I REFUSE to have my cells genotyped for any genes decided by the study investigators.

_____ _____
Signature of Research Subject Date

_____
Printed Name of Research Subject

_____ _____
Signature of Person Obtaining Consent Date

_____
Printed Name of Person Obtaining Consent

.....

Subject's Agreement to Participate in the Research Study Genotyping Consent

I have read the information provided above. I have asked all questions I have at this time. I voluntarily AGREE to participate in this study and I voluntarily AGREE to have my cells genotyped for any genes decided by the study investigators to be related to adverse health effects associated with pollution exposure.

_____ _____
Signature of Research Subject Date

_____
Printed Name of Research Subject

_____ _____
Signature of Person Obtaining Consent Date

_____
Printed Name of Person Obtaining Consent

THIS CONSENT DOCUMENT SHOULD BE USED ONLY
BETWEEN 12-10-10 AND 12-5-11
APPROVED BY
INSTITUTIONAL REVIEW BOARD, UNC-CHAPEL HILL

University of North Carolina at Chapel Hill
Consent for Storing Biological Specimens With Identifying Information

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IRB Study # 09-1344
Consent Form Version Date: 11/16/10

Title of Study: Cardiopulmonary Responses to Exposure to Ozone and Diesel Exhaust with Moderate Exercise in Healthy Adults

Principal Investigator: Tina Stevens, PhD

UNC-Chapel Hill Department: N/A
UNC-Chapel Hill Phone number: (919)843-8031, **Fax:** 919-966-6367
Email Address: stevens.tina@epa.gov

Co-Investigators: Michael Madden, PhD; David Diaz-Sanchez, PhD Howard Kehrl, MD
stevens.tina@epa.gov; Diaz-Sanchez.David@.epa.gov; kehrl.howard@epa.gov;

Funding Source and/or Sponsor: US Environmental Protection Agency Intramural Federal Research

Study Contact telephone number: (919) 966-6257 (Michael Madden)
Study Contact email: madden.michael@epa.gov

What are some general things you should know about research?
Research is designed to gain scientific information that may help other people in the future. You may not receive any direct benefit from participating. There also may be risks.

You may refuse to take part in research.

Details are discussed below. It is important that you understand this information so that you can make an informed choice. You will be given a copy of this consent form. You should ask the researchers named above, or staff members who may assist them, any questions you have about this study at any time.

What is the purpose of this specimen repository or "biobank?"
Research with blood, tissue, cells or body fluids (specimens) can help researchers understand how the human body works. Research can also answer other questions by using specimens. Researchers may develop new tests to find diseases, or new ways to treat diseases. In the future,

research may help to develop new products, such as drugs. Specimens are commonly used for genetic research. Sometimes researchers collect and store many specimens together and use them for different kinds of research, or share them with other scientists; this is called a specimen repository or "biobank."

All specimens for this study will be labeled with your study subject number that does not include personal identification information and will be stored in a repository where only project members will have access to the specimens. There is a need to store specimens in such a repository because this will be an ongoing study where specimens from subjects will be collected over an extended period of time. Storing of specimens allows for all specimens to be processed at the same time.

It also makes it possible to keep any remaining specimens in our biobank indefinitely and allows our scientists the opportunity to further study these specimens with as yet unknown questions and techniques. Research studies and questions in which the specimens may be used have not yet been determined. These studies may involve genetic research. Genetic research is about finding the specific location of genes, learning how genes work, and investigating relationships between a certain gene and the environment or people's habits and diets, and different diseases.

How will the specimens be collected?

Your specimens will be collected during the research study listed on the first page of this consent. No additional specimens will be collected from you.

What will happen to the specimens?

Study specimens will be stored in a secure room with restricted access at the U.S. Environmental Protection Agency Human Studies Facility located in Chapel Hill, North Carolina. The specimen will be prepared, labeled with the study subject identification number, and stored indefinitely in a freezer for future testing under *IRB# 07-1768, Repository for Storage of Human Specimens*. Names of subjects associated with ID numbers will be archived and locked; only medical and scientific personnel directly associated with this study will have access to this information. No personal identifying information will be attached to the biologic fluid specimen. Portions of the specimen may be shared with researchers at other scientific institutions, however, only coded specimens will be sent and the investigator will employ a data use agreement. Under no circumstances will any identifying information be sent along with specimens. The decision to destroy the specimens may be made by the investigator or by you if you notify the investigator in writing that you no longer want the specimens stored.

What are the possible benefits to you?

Benefits to you are unlikely. Research is designed to benefit society by gaining new knowledge. You will not benefit personally from having your specimens stored in this biobank.

What are the possible risks or discomforts involved with the use of your specimens?

Risk of breach of confidentiality is minimal. You will be assigned a study number which will be used for data – not your name. The study number is all that will be entered into computer databases. All paper files which may contain your name or screening number are secure in locked file cabinets in the EPA building which has limited access 24 hours/day. A numeric coding system will be used to ensure that you cannot be directly identified from the specimens alone. If we collect genetic information from the stored specimens, there is also a potential risk for some of your relatives and other members of your ethnic group, since they share some of your genetic makeup.

Will there be any cost to you for storage of the specimens?

There will be no cost to you for the storage and use of the specimens for research purposes.

Will you receive anything for the use of your specimens?

You will not receive any additional compensation for having your specimens stored in this biobank.

Who owns the specimens?

Any blood, body fluids, cell or tissue specimens obtained for the purpose of this study become the exclusive property of The U.S. Environmental Protection Agency and will be stored under *IRB# 07-1768, Repository for Storage of Human Specimens*. The researchers may retain, preserve or dispose of these specimens and may use these specimens for research that may result in commercial applications. There are no plans to compensate you for any future commercial use of these specimens.

How will your privacy be protected?

You will be assigned a study identification number. Names of subjects associated with ID numbers will be archived and locked; only medical and scientific personnel associated with this study will have access to this information. No personal identifying information will be attached and/or recorded in the data log sheets, biologic specimens, or electronic data sets. No subjects will be identified in any report or publication about this study. Although every effort will be made to keep research records private, there may be times when federal or state law requires the disclosure of such records, including personal information. This is very unlikely, but if disclosure is ever required, the U.S. Environmental Protection Agency and UNC-Chapel Hill will take steps allowable by law to protect the privacy of personal information. In some cases, your information in this research study could be reviewed by representatives of the University, research sponsors, or government agencies for purposes such as quality control or safety.

Study specimens will be stored in a secure room with restricted access. The sample will be prepared and stored indefinitely in a freezer for future testing. Portions of the specimens may be shared with researchers at other scientific institutions, however, only coded specimens will be sent. Under no circumstances will any identifying information be sent along with specimens to outside investigators. All medical records generated during this study will be kept in the medical records office at the EPA Human Studies Facility. The Medical Station is locked when not

attended by study staff, and the EPA Human Studies Facility has limited access to authorized individuals only, 24 hours/day for 7 days/week.

If genetic information is obtained from your stored specimens, A Federal law called the Genetic Information Nondiscrimination Act (GINA) generally makes it illegal for health insurance companies, group health plans, and most employers to discriminate against you based on your genetic information. GINA does not protect you against genetic discrimination by companies that sell life insurance, disability insurance, or long-term care insurance. GINA also does not protect you against discrimination based on an already-diagnosed genetic condition or disease.

Will researchers seek approval from you to do future studies involving the specimens?
By signing this consent form, you are giving your permission for researchers to use your specimens as described above. Current and future research is overseen by a committee called the Institutional Review Board (IRB). The role of the IRB is to protect the rights and welfare of research participants. In some cases, the IRB may require that you be re-contacted and asked for your consent to use your specimens in a specific research study. You have the right, at that future time, not to participate in any research study for which your consent is sought. Refusal to participate will not affect your medical care or result in loss of benefits to which you are entitled.

Will you receive results from research involving your specimens?
Most research with your specimens is not expected to yield new information that would be meaningful to share with you personally. There are no plans to re-contact you or other subjects with information about research results.

Can you withdraw the specimens from the research repository?
If you decide that you no longer wish for the specimens to be stored, you should contact the researchers on the front page of this form. It is best to make your request in writing.

Any analysis in progress at the time of your request or already performed prior to your request being received by the researcher will continue to be used as part of the research study. Once the researchers have been notified, your remaining specimens would be destroyed. If you do not make such a request, the specimens may be stored forever. The researchers may choose to destroy the specimens at any time.

What will happen if you are injured by this research?
All forms of human health research involve some risk of injury or illness. Despite our high level of precaution, you may develop an injury or illness due to participating in this study. If you develop an injury or illness determined by an appointed US EPA physician to be due to your participation in this research, the US EPA will reimburse your medical expenses to treat the injury or illness up to $5000. If you believe your injury or illness was due to a lack of reasonable care or other negligent action, you have the right to pursue legal remedy. The Federal Tort Claims Act, 28 U.S.C. 2671 et. Seq., provides for money damages against the United States when personal injury or property loss results from the negligent or wrongful act or omission of any employee of the EPA while acting within the scope of his or her employment. Signing this

consent form does not waive any of your legal rights or release the investigator, the sponsor, the institution, or its agents from liability for negligence.

If a research related injury or illness occurs, you should contact the Director of the EPA NHEERL Human Research Protocol Office at (919) 966-6217.

Who is sponsoring this research?
This research is funded by the United States Environmental Protection Agency. Several of the investigators including the Principal Investigator are federal employees. The researchers do not, however, have a direct financial interest in the final results of the study.

What if you have questions about this research?
You have the right to ask, and have answered, any questions you may have about this research. If you have questions, you should contact the researchers listed on the first page of this form.

What if you have questions about your rights as a research subject?
All research on human volunteers is reviewed by a committee that works to protect your rights and welfare. If you have questions or concerns about your rights as a research subject you may contact, anonymously if you wish, the Institutional Review Board at 919-966-3113 or by e-mail to IRB_ subjects@unc.edu. You may also contact the Director of the EPA NHEERL Human Research Protocol Office at 919-966-6217.

Attachment #1 The Sheldon Cohen Self-Perceived Stress Questionnaire (from www.mindgarden.com)

APPROVED - IRB. UNC-CH

Perceived Stress Scale

DEC 1 0 2010

The questions in this scale ask you about your feelings and thoughts **during the last month**. In each case, you will be asked to indicate by circling *how often* you felt or thought a certain way.

Name _____ Date _____

Age _____ Gender (*Circle*): M F Other _____

0 = Never 1 = Almost Never 2 = Sometimes 3 = Fairly Often 4 = Very Often

1. In the last month, how often have you been upset because of something that happened unexpectedly?	0	1	2	3	4
2. In the last month, how often have you felt that you were unable to control the important things in your life?	0	1	2	3	4
3. In the last month, how often have you felt nervous and "stressed"?	0	1	2	3	4
4. In the last month, how often have you felt confident about your ability to handle your personal problems?	0	1	2	3	4
5. In the last month, how often have you felt that things were going your way?	0	1	2	3	4
6. In the last month, how often have you found that you could not cope with all the things that you had to do?	0	1	2	3	4
7. In the last month, how often have you been able to control irritations in your life?	0	1	2	3	4
8. In the last month, how often have you felt that you were on top of things?	0	1	2	3	4
9. In the last month, how often have you been angered because of things that were outside of your control?	0	1	2	3	4
10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?	0	1	2	3	4

Protocol title: "Cardiopulmonary Responses to Exposure to Ozone and Diesel Exhaust with Moderate Exercise in Healthy Adults"; T. Stevens PI

July 27, 2009 version

Attachment# 2 Newspaper Advertisement from Westat Inc, the recruitment contractor for US EPA Studies

APPROVED - IRB, UNC-CH

DEC 1 0 2010

The US Environmental Protection Agency is seeking

Adult Volunteers

For Research Study

Now recruiting healthy non-smoking adults ages 18 to 55 for a study about ozone, diesel exhaust & exercise. Study requires screening plus 13 visits over about 10 weeks and pays up to $3,558.

919-966-0604 or 1-888-279-9353
www.epastudies.org

The Human Studies Facility is located on the UNC-CH campus

Attachment# 3 Web Site Announcement of this specific Study (IRB# 09-1344) at the US EPA Studies Webpage (www.epastudies.org)

==========

DEPOZ Study, IRB Study #09-1344
Web Site Announcement
www.epastudies.org

APPROVED - IRB, UNC-CH
DEC 1 0 2010

DEPOZ

What is the purpose of the research study?

The purpose of this research is to find out how the air pollution that causes the haze seen in some polluted cities affects the heart, blood vessels and lungs of healthy adults.

Can I take part in the study?
You may be able to be in the study if you

- Are between 18 and 55 and
- Do not smoke and
- Do not have any heart or lung problems

What will I be asked to do?

- Have a free physical exam
- Have blood drawn
- Take part in several different breathing tests, including spirometry (explanation link provided)
- Have your heart rate (explanation link provided) and blood pressure monitored
- Use an exercise bike during testing
- Come in for a training visit, and then come in 3 days in a row generally every other week for 4 times.
- On the first day of each 3-day study session you will have tests and
  - Breathe clean air, or
  - Breathe air polluted with a carefully controlled amount of diesel exhaust, or
  - Breathe air polluted with carefully controlled amount of ozone, or
  - Breathe a combination of diesel exhaust and ozone,
- On the second day of each 3-day study session you will have tests and breathe air with ozone only
- On the third day of each 3-day study session you will have more tests

The polluted air that you breathe will be a lot like air you might breathe in a city like Los Angeles, New York, or Mexico City on a smoggy day

How long will it take?

- After screening there will be 13 visits, including 1 training visit and 4 sets of 3-day exposure visits, each set separated by at least 13 days
- In total, the study will take about 79 hours over about 10 weeks.

What will I get for volunteering?

- If you complete all visits and procedures, we will pay you $3,738.

How can I sign up or get more information?
Call or send an email (link provided). Our office hours are Monday-Friday from 8 am to 5 pm EST. After hours please leave a message on voice mail, and we will return your call promptly.

- (919 966-0604 (local)
- 1-888-279-9353 (toll free)
- **recruitment@epa.gov**

APPROVED - IRB, UNC-CH
DEC 1 0 2010

Attachment# 4 Email Advertisement from Westat Inc, the recruitment contractor for US EPA Studies, of this study (IRB# 09-1344) to current participants in EPA studies

DEPOZ Study E-mail to Current Volunteers

(these are people who are already participating in other EPA studies)

IRB #09-1344

E-mail Subject Line: EPA Research Study about Ozone, Diesel Exhaust and Exercise.

Dear _____,

You have been pre-qualified for a study called "DEPOZ" which will begin [date to be decided]. This research study is for healthy non-smokers between 18 and 55. The purpose of this study is to find out how air pollution – the kind that often causes the haze seen on smoggy days in polluted cities – affects the heart, blood vessels and lungs of healthy young adults. This study involves up to 13 visits after screening over about 10 weeks. It requires a commitment of about 79 hours, including four 2 ½ consecutive day sessions generally every other week. If all visits and procedures are completed this study pays $3,738. If you are interested in learning more about the study and/or in scheduling a repeat physical exam (if needed) please call us at 919-966-0604 (or 888-279-9353). Please also visit **www.epastudies.org** for more information.

We look forward to hearing from you!
[Recruiter's name]

APPROVED - IRB, UNC-CH
DEC 1 0 2010

Attachment# 5 Email Advertisement from Westat Inc, the recruitment contractor for US EPA Studies, of this study (IRB# 09-1344) to potential participants (ie, not participating currently in EPA studies)

DEPOZ Study E-mail Announcement

(intended for targeted lists, such as that provided by UNC to subscribers)

SUBJECT: INFORMATIONAL: Research Study about Ozone, Diesel Exhaust and Exercise.

This research study is for healthy non-smokers between 18 and 55. The purpose of this study is to find out how air pollution – the kind that often causes the haze seen on smoggy days in polluted cities – affects the heart, blood vessels and lungs of healthy young adults. This study involves up to 13 visits after screening over about 10 weeks. It requires a commitment of about 79 hours, including four 2 ½ consecutive day sessions generally every other week. If all visits and procedures are completed this study pays $3,738. Please visit **www.epastudies.org** for more information or call the Westat EPA Recruiting Office at 919-966-0604.

Approved [date], by the Office of Human Research Ethics Biomedical Institutional Review Board. IRB # 09-1344: Cardiopulmonary responses to exposure to ozone and diesel exhaust with moderate exercise in healthy adults.

This email is sponsored by: U.S. Environmental Protection Agency Human Studies Division, located on the UNC-Chapel Hill campus.

APPROVED - IRB, UNC-CH
DEC 1 0 2010

Attachment# 6 Recruitment Script describing this specific study (IRB# 09-1344) from Westat Inc, the recruitment contractor for US EPA Studies, to potential participants

Study Name: DEPOZ
IRB Study # 09-1344

Title
Cardiopulmonary responses to exposure to ozone and diesel exhaust with moderate exercise in healthy adults.

Purpose
The purpose of this research study is to find out how the air pollution that causes the haze seen in some polluted cities (like Los Angeles, New York, and Mexico City) affects the heart, blood vessels and lungs of healthy young adults. This study is for people ages 18 to 55 who are able to exercise.

Procedures and Payment

The study will require two screening visits to the EPA Human Studies Facility (one to complete medical history paperwork, and the other for a physical exam), followed by a 3-hour training session and four 3-day study sessions. Study sessions are generally about two weeks apart, so this study requires 13 visits after screening over about 10 weeks. On the first day of each segment you will be exposed for 2 hours to either clean air, or air polluted with a carefully controlled amount of diesel exhaust or ozone, or both. Then the next day you will come back for another 2-hour exposure just to ozone. Each exposure day will last 8 hours. The third day of each segment will last about 3 hours.

During exposure sessions you will be asked to give blood, urine and breath samples, ride an exercise bike at 15-minute intervals during exposures, and perform several different breathing tests. You will also wear heart and blood pressure monitors during the study sessions and over night. Additionally, you will be asked to collect urine samples over night after the first exposure of each session. The total amount of time is about 79 hours over about 10 weeks. Since each set of exposures is separated generally by 2 weeks, you will spend 2½ days at the clinic every other week, 4 times. Does this seem like something that your schedule can handle?

If you complete the training visit and all four 2½ day sessions, you will be paid $3,738.00.

Study Schedule

Screening, 2 visits, as needed: 3 hours
Training visit, *days & times to be decided*: 3 hours
Segment 1, Day 1, 8 AM, *days to be decided*: 8 hours
Segment 1, Day 2, 8 AM, day after Day 1, 8 hours
Segment 1, Day 3, 8 AM, day after Day 2, 3 hours

Study Restrictions
In addition to meeting all study eligibility criteria (*in the IRB application*), volunteers must be willing to adhere to the following restrictions as well:

- No over the counter pain medications such as aspirin, Advil, Aleve, or other non-steroidal anti-inflammatory medications including those used for allergies for 48 hours prior to the exposure and post-exposure visits

- Medications not specifically mentioned here may be reviewed by the investigators prior to your inclusion in the study
- No Vitamins C or E, or supplements containing C or E, for at least 2 weeks prior to and throughout the study.
- Avoid smoke and fumes for 24 hours before all visits
- Avoid drinking alcohol 24 hours before all visits
- Avoid strenuous exercise for 24 hours prior to and after all visits
- Avoid the use of ozone-based home air purifiers during study participation.
- Eat a light breakfast on the exposure day
- Do not consume caffeine for 2 hours prior to the exposure on days 1 & 2 and post-exposure visits

APPROVED - IRB, UNC-CH

DEC 1 0 2010

Attachment# 7 Reminder sheet from Westat Inc, the recruitment contractor for US EPA Studies, of this study (IRB# 09-1344) to accepted participants

---

TO:

RE: **Your appointment at the EPA Human Studies Facility**

STUDY: **DEPOZ STUDY, IRB # 09-1344**

DATE:

TIME:

PARKING is available on Mason Farm Rd directly in front of the EPA Human Studies building. Please park in Visitor Spaces only. Enter the building, give your name to the Guard, and request a Visitor Permit.

If the EPA lot is full you may also park in [provide current parking availability information]. Use Patient/Visitor spaces only. If you are a UNC Student or are UNC staff or faculty and must use the Dogwood Deck or ACC Lot you MUST print this appointment slip and display it on the dashboard in your car. If you do not display it, you will be ticketed.

May be folded here for display

Study Instructions

Illness
If you are sick or have been sick or injured in the last 4 weeks, please call Recruitment at 966-0604 or 888-279-9353. This includes sore throats, coughs, colds, and cold sores.

Active Allergies or Hay Fever
If you have had seasonal allergy symptoms in the past week, please call Recruitment to reschedule.

Medications
- No over the counter pain medications such as aspirin, Advil, Aleve, or other non-steroidal anti-inflammatory medications, including those taken for allergies, for 48 hours prior to the exposure and post-exposure visits. Tylenol is permitted.

Diet and Exercise
- No Vitamins C or E, or supplements containing C or E, for at least 2 weeks prior to and throughout the study.
- No drinking alcohol 24 hours before all visits
- No strenuous exercise for 24 hours prior to and after all visits
- No caffeine for 2 hours before to the exposure on days 1 & 2 and post-exposure visits.
- Eat a light breakfast on exposure days.

Other
- No smoke and fumes for 24 hours before all visits
- No ozone-based home air purifiers throughout the study
- Wear comfortable clothes and shoes suitable for exercise and bring a change of clothes

- Shower only in the morning before exposures, following the medical staff's instructions for removing and reattaching monitors.

If you are unable to keep your appointment, please call Recruitment. Please be on time!

Thank You! Westat EPA Support Services

APPROVED - IRB, UNC-CH
DEC 1 0 2010

Reminders for the breathing test

- Click on the file for the correct time point. We will remind you of which one you need.
- Click the button that says "close".
- Click on the 2nd button on the menu bar, the red on that looks like a breathing test.
- Press the space bar.
- (The very first time a box comes up, press the "OK" button).
- A red bar across the bottom will appear.
- Wait till the red bar turns black.
- Make sure you have your noseclip on.
- Breathe normal (tidal volume) for two breaths
- Take a deep breath, and press the space bar while you are taking that breath.
- Blow as hard and fast as you can till you are "empty".
- Another box will come up with numbers. Please tell us what the value is for "FEV1".
- Click "yes" to accept this test.
- Repeat the test.
- When completely finished, click the disk icon (save) at the top, between the middle and the left.
- This closes the box, and brings you back to the main menu.
- Click on the button at the top with the 2 people on it.
- Select the file for the time point you need and repeat the sequence. We will tell you when.
- If you have any questions, please be sure to ask!

Response to Minor Stipulations
Renewal

Receipt Date : 11/16/2010 Expiration Date : 1/10/2011 Previous Review Type: **Initial Full Board**

IRB: Biomedical PI: Tina Stevens IRB ID : 09-1344 IRB Admin : Joy Bryde

Title: Cardiopulmonary Responses to Exposure to Ozone and Diesel Exhaust With Moderate Exercise in Healthy Adults

☑ Full Board Review ☐ Not Full Board Review

Findings

Based on the information provided, the IRB has determined that HIPAA does not apply to this study.

Study Description :

Purpose: The purpose of this study is to measure cardiopulmonary responses in healthy young adults before, during, and after exposure to combinations of ozone (03) and diesel exhaust (DE) for 2 hours with moderate exercise and to primarily investigate whether DE modulates the 03-induced effects on the lung and cardiovascular systems. Participants: Fifteen (15 healthy) young men and women in the age of 18-55 years Procedures (methods): Each subject will be exposed in environmentally controlled exposure chambers to 4 exposure regimens. Each regimen will require a 2 hr exposure with intermittent, moderate exercise on 2 consecutive days. Day 1 exposure will consist of a combined exposure to DE and 03, 03 only (i.e., no DE), or DE only, or clean air (CA) only. For all 4 regiments, subjects will return the next day (Day 2) to be exposed to 03 alone and again on Day 3 for a follow up visit. Each regimen will be separated by at least 2 weeks. Techniques measuring lung and cardiac physiology will be performed pre, during, and post exposure. Blood, urine, and breath samples will also be obtained and analyzed for immune and inflammatory markers, possible genotyping, clotting factors, susceptibility factors, and exposure markers.

Submission Description :

PROCESSING STEPS (OFFICE USE ONLY):

- ☐ Reviewer Checklist completed
- ☐ Minor Stipulation letter:
  - ☐ Draft letter prepared
  - ☐ Approved by chair as attached (Initials/Date:)
  - ☐ Approved by chair, see edits (Initials/Date:)
  - ☐ Email copy sent
  - ☐ Hard copy sent
- ☑ Approval letter:
  - ☑ Draft letter prepared DMB 12/10/10
  - ☑ Approved by chair as attached (Initials/Date: 12/10/10)
  - ☐ Approved by chair, see edits (Initials/Date:)
  - ☑ Email copy sent
  - ☑ Hard copy sent
- Consent forms attached: 2
- Other attachments: 8

FINAL ACTIONS:

- ☑ Approved 12/10/10
- ☐ Approved with Minor Stipulations
- ☐ NHSR
- ☐ Return to Full IRB
- ☐ Return to sender
- ☐ Closure

RECEIVED
DEC 09 2010
IRB UNC-CH

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
NATIONAL HEALTH & ENVIRONMENTAL EFFECTS RESEARCH LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
RESEARCH TRIANGLE PARK, NC 27711

MD# 58B, Human Studies Division, Clinical Research Branch
104 Mason Farm Road, CB# 7315
US EPA Human Studies Facility
Chapel Hill, NC 27599-7315
919-843-8031 (Office) 919-966-6271(FAX)
stevens.tina@epa.gov

December 9th 2010

Biomedical Research IRB Committee Members
UNC Office of Human Research Ethics
CB# 7097, Med. Building 52

RE: Minor Contingencies to be addressed following Full Board IRB Review on 12/06/2010

Submission Type: Renewal

Study #: 09-1344

Study Title: Cardiopulmonary Responses to Exposure to Ozone and Diesel Exhaust With Moderate Exercise in Healthy Adults

Dear Committee Members:

I am addressing the requested changes to the renewal form made on 12/07/2010.

Study Specific Details:

1. Renewal form, #2c: The answer in this area should be a number, even if zero. Please provide a number answer.

   I replaced the N/A with 0.

Respectfully,

Tina Stevens

Tina Stevens, Ph.D.

Research Biologist, U.S. Environmental Protection Agency, EPH Division & Clinical Research Branch

OFFICE OF HUMAN RESEARCH ETHICS
Institutional Review Board
REQUEST FOR RENEWAL OF IRB APPROVAL OR STUDY CLOSURE
Version August 26, 2009

RECEIVED
DEC 09 2010
IRB UNC-CH

If the research is continuing:

- Check the relevant items.
- Include two collated sets of copies (sorted in the order listed) of checked items.

→ **Submissions will be returned if these instructions are not followed.**

Check	Item	Total No. of Copies
□	1. This form (renewal or closure).	2
□	2. Any items specifically requested in questions # 4 through 9 (in that order).	2
□	3. The most recent application submitted for IRB approval. This application should be updated to include any modifications since the study was initially approved or last renewed. **If there are any new modifications included with this renewal, highlight the proposed modifications by underlining.**	2
□	4. Clean copies of all consent document(s) to be used in the upcoming approval period, for stamping.	2
□	5. Only for those study personnel *not* in the online UNC-CH ethics training database (http://cfx3.research.unc.edu/training_comp/): Documentation of required training in human research ethics.	1

IRB study #: 09-1344 **Date:** 12/9/2010

Title of Study: Cardiopulmonary Responses to Exposure to Ozone and Diesel Exhaust with Moderate Exercise in Healthy Adults

Principal Investigator: Tina Stevens, PhD **Faculty advisor** (if applicable): N/A

For industry sponsored research (if applicable):
Sponsor's master protocol version #: Version date:
Investigator Brochure version #: Version date:
Any other details you need documented on IRB approval:

1. In a few sentences, describe the past year's work, and describe what you plan for the upcoming year, including data analysis, if relevant.

We began enrolling participants in August 2010. To date, we have enrolled 9 subjects, none have completed all 4 arms, 1 withdrew, 1 disqualified, and 7 subjects are in progress. Data analysis will not be performed until at least 10 subjects have completed all 4 arms. We had 3 amendments, including the attached modification, all with minor changes such as wording, personnel, additional endpoints, and increase in safety measures.

2. Number of subjects involved through direct contact or use of their data (for multi-site studies, include only subjects covered by this IRB) (Note: **b+d** should not be larger than **a**)
   a. Total projected number as approved by IRB: 15
   b. Total number of subjects involved to date (for clinical trials include "screen failures"): 9
   c. Number of subjects added since last renewal: 0

Answer the following questions based on information since initial approval or last renewal. Only include subjects covered by this IRB.

3. Have there been any modifications approved since the last review? If your IRB application has not already been updated to reflect these changes, do so now and attach any revised documents, including application and/or consent documents.	_x yes __ no
4. Have any subjects withdrawn voluntarily or been withdrawn from the study? **If yes, explain**; give number and reasons for withdrawals. One subject withdrew because she relocated to a new area after acquiring a new job.	_x yes __ no
5. Have there been any complaints about the research from subjects or others? **If yes, explain**	__ yes x no
6. Have there been any findings (e.g., publications, new information) that alter the risk/benefit ratio or otherwise impact the study? **If yes, explain, including whether these new findings are relevant to participants' willingness to continue.**	__ yes x no
7. Have there been any relevant multi-center reports? **If yes, provide a copy of the report.**	__ yes x no
8. Does this study have a Data and Safety Monitoring Committee (DSMC or DSMB)? **If yes, provide a report** from the DSMC.	__ yes x no
9. Have there been unanticipated problems or serious adverse events since the last renewal? **If yes, include all copies** of local Adverse Event reports with this submission.	__yes _x no
10. Has this study been audited by external sponsor or monitor since approved or last renewed? **If yes, include a copy** of the audit report.	__ yes x no
11. Are you requesting any changes to the study or consent documents? **If yes, include the form** requesting *Modification of Approved Human Subjects Research* and underline the proposed change in the updated application and/or consent documents.	x yes __ no
12. Will you be enrolling, consenting or re-consenting subjects in the upcoming approval period? **If yes, include clean copies** of consents/assents/fact sheets to be used to receive a new stamp. **Include any new recruitment materials** to be used with subjects.	xyes __ no

Action requested by Principal Investigator (choose only one):

Renew approval:

__ Study has always involved *only* analysis of existing data or specimens. Continue as approved.

Study involves(ed) direct interaction/intervention or contact with subjects:

x Continue as approved: Enrollment of new subjects continues.

__ Enrollment of new subjects closed; interaction/intervention with previously enrolled subjects continues.

__ Direct interaction with subjects completed but subsequent monitoring or follow up continues.

__ Subjects' involvement completed but renewal is requested for data analysis.

Closure of Study:

__ Research completed: Identifiable data or human biological specimens are stored according to plan already approved by the IRB.

__ Research completed: All data or human biological specimens are deidentified.

__ Lack of funding or other *(specify):*

Signature of Principal Investigator

12/9/10
Date

Signature of Faculty Advisor (if applicable)

Date

THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL

OFFICE OF HUMAN RESEARCH ETHICS
Medical School Building 52
Mason Farm Road
CB #7097
Chapel Hill, NC 27599-7097
(919) 966-3113
Web site: ohre.unc.edu
https://my.research.unc.edu for IRB status
Federalwide Assurance (FWA) #4801

To: Tina Stevens
Epa
CB:7315, MD58A USEPA , 104 Mason Farm Rd , Chapel Hill , NC , 27599

From: Biomedical IRB 12/7/10

Date: 12/07/2010
RE: Minor Contingencies to be addressed following Full Board IRB Review on 12/06/2010
Submission Type: Renewal
Study #: 09-1344
Study Title: Cardiopulmonary Responses to Exposure to Ozone and Diesel Exhaust With Moderate Exercise in Healthy Adults

This submission has been reviewed by the above IRB at a convened meeting. This is not an IRB approval. You may not implement the research activities described in your submission until you have received a memo indicating final IRB approval. The IRB determined that this submission MAY BE APPROVED, pending stipulated change(s) and/or clarification(s) as detailed below.

Please address these contingencies in a revised submission, and provide a memo that includes a point-by-point response to the item(s) listed. **When you respond, please be sure to cite the IRB study number noted above, and indicate that you are responding to this memo as dated above; failure to link your response to this study, in general, and this memo, in particular, may result in delays.** Any additional changes (including new materials) must also be listed and discussed in the memo. If the application or any study materials must be revised, please submit 2 copies of all revised materials, one in which all changes are underlined and the other a "clean" copy with no underlining.

Study Specific Details:

1. Renewal form, #2c: The answer in this area should be a number, even if zero. Please provide a number answer.

CC: Michael Madden, Environmental Protection Agency; Michael Schmitt; David Diaz-Sanchez; Howard Kehrl, Medicine; Howard Kehrl, (EPA), Non-IRB Review Contact

R12

Full Committee Review
Renewal

Receipt Date : 11/16/2010 Expiration Date : 1/10/2011 Previous Review Type: **Initial Full Board**

IRB: Biomedical PI: Tina Stevens IRB ID : 09-1344 IRB Admin :

Title: Cardiopulmonary Responses to Exposure to Ozone and Diesel Exhaust With Moderate Exercise in Healthy Adults

Agenda Date 12/06/2010 Reviewer 1: **Lea, James** Reviewer 2: **Weber, David J.** (chair)

Additional Findings and/or Special Populations: ☐ Children ☐ Prisoners ☐ Pregnant Women

☐ Sensitive Info ☐ IND ☐ IDE ☐ DNA/Gene transfer ☑ Genetics ☐ GCRC ☐ ORC ☐ LAR

Findings

Based on the information provided, the IRB has determined that HIPAA does not apply to this study.

Meeting Notes and Required Findings : W/MOD

CONSENTS: ADULT
SPEC

SCALE, ADS, REMINDERS Answer.

2e

CA

PROCESSING STEPS (OFFICE USE ONLY):

☐ Reviewer Checklist completed
☐ Minor Stipulation letter:
- ☑ Draft letter prepared JMB 12/7/10
- ☑ Approved by chair as attached (Initials/Date: DW 12/7/10)
- ☐ Approved by chair, see edits (Initials/Date:)
- ☐ Email copy sent
- ☐ Hard copy sent

☐ Approval letter:
- ☐ Draft letter prepared
- ☐ Approved by chair as attached (Initials/Date:)
- ☐ Approved by chair, see edits (Initials/Date:)
- ☐ Email copy sent
- ☐ Hard copy sent

Consent forms attached:
Other attachments:

FINAL ACTIONS:

☐ Approved
☐ Approved with Minor Stipulations
☐ NHSR
☐ Deferred
☐ Disapproved
☐ Return to sender
☐ Closure

OFFICE OF HUMAN RESEARCH ETHICS
Institutional Review Board

REQUEST FOR RENEWAL OF IRB APPROVAL OR STUDY CLOSURE

Version August 26, 2009

RECEIVED
NOV 16 2010
IRB UNC-CH

W/Mod

If the research is continuing:

- Check the relevant items.
- Include two collated sets of copies (sorted in the order listed) of checked items.

→ **Submissions will be returned if these instructions are not followed.**

Check	Item	Total No. of Copies
□	1. This form (renewal or closure).	2
□	2. Any items specifically requested in questions # 4 through 9 (in that order).	2
□	3. The most recent application submitted for IRB approval. This application should be updated to include any modifications since the study was initially approved or last renewed. **If there are any new modifications included with this renewal, highlight the proposed modifications by underlining.**	2
□	4. Clean copies of all consent document(s) to be used in the upcoming approval period, for stamping.	2
□	5. Only for those study personnel *not* in the online UNC-CH ethics training database (http://cfx3.research.unc.edu/training_comp/): Documentation of required training in human research ethics.	1

IRB study #: 09-1344 **Date:** 11/16/2010

Title of Study: Cardiopulmonary Responses to Exposure to Ozone and Diesel Exhaust with Moderate Exercise in Healthy Adults

Principal Investigator: Tina Stevens, PhD **Faculty advisor** (if applicable): N/A

For industry sponsored research (if applicable):

Sponsor's master protocol version #: Version date:
Investigator Brochure version #: Version date:
Any other details you need documented on IRB approval:

1. In a few sentences, describe the past year's work, and describe what you plan for the upcoming year, including data analysis, if relevant.

We began enrolling participants in August 2010. To date, we have enrolled 9 subjects, none have completed all 4 arms, 1 withdrew, 1 disqualified, and 7 subjects are in progress. Data analysis will not be performed until at least 10 subjects have completed all 4 arms. We had 3 amendments, including the attached modification, all with minor changes such as wording, personnel, additional endpoints, and increase in safety measures.

2. Number of subjects involved through direct contact or use of their data (for multi-site studies, include only subjects covered by this IRB) (Note: **b+d** should not be larger than **a**)
   a. Total projected number as approved by IRB: 15
   b. Total number of subjects involved to date (for clinical trials include "screen failures"): 9
   c. Number of subjects added since last renewal: N/A

d. Number to be included in upcoming year: 6

Answer the following questions based on information since initial approval or last renewal. Only include subjects covered by this IRB.

3. Have there been any modifications approved since the last review? If your IRB application has not already been updated to reflect these changes, do so now and attach any revised documents, including application and/or consent documents.	_x yes __ no
4. Have any subjects withdrawn voluntarily or been withdrawn from the study? **If yes, explain**; give number and reasons for withdrawals. One subject withdrew because she relocated to a new area after acquiring a new job.	_x yes __ no
5. Have there been any complaints about the research from subjects or others? **If yes, explain**	__ yes x no
6. Have there been any findings (e.g., publications, new information) that alter the risk/benefit ratio or otherwise impact the study? **If yes, explain, including whether these new findings are relevant to participants' willingness to continue.**	__ yes x no
7. Have there been any relevant multi-center reports? **If yes, provide a copy of the report.**	__ yes x no
8. Does this study have a Data and Safety Monitoring Committee (DSMC or DSMB)? **If yes, provide a report** from the DSMC.	__ yes x no
9. Have there been unanticipated problems or serious adverse events since the last renewal? **If yes, include all copies** of local Adverse Event reports with this submission.	__yes _x no
10. Has this study been audited by external sponsor or monitor since approved or last renewed? **If yes, include a copy** of the audit report.	__ yes x no
11. Are you requesting any changes to the study or consent documents? **If yes, include the form** requesting *Modification of Approved Human Subjects Research* and underline the proposed change in the updated application and/or consent documents.	x yes __ no
12. Will you be enrolling, consenting or re-consenting subjects in the upcoming approval period? **If yes, include clean copies** of consents/assents/fact sheets to be used to receive a new stamp. **Include any new recruitment materials** to be used with subjects.	xyes __ no

Action requested by Principal Investigator (choose only one):

Renew approval:

__ Study has always involved *only* analysis of existing data or specimens. Continue as approved.

Study involves(ed) direct interaction/intervention or contact with subjects:

x Continue as approved: Enrollment of new subjects continues.

__ Enrollment of new subjects closed; interaction/intervention with previously enrolled subjects continues.

__ Direct interaction with subjects completed but subsequent monitoring or follow up continues.

__ Subjects' involvement completed but renewal is requested for data analysis.

Closure of Study:

__ Research completed: Identifiable data or human biological specimens are stored according to plan already approved by the IRB.

__ Research completed: All data or human biological specimens are deidentified.

__ Lack of funding or other *(specify):*

Signature of Principal Investigator

11/10/10
Date

Signature of Faculty Advisor (if applicable)

Date

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OFFICE OF HUMAN RESEARCH ETHICS
Institutional Review Board
MODIFICATION OF APPROVED
HUMAN SUBJECTS RESEARCH
Version May 22, 2009

Include the items indicated, where applicable:

- *Check* the relevant items below and include one copy of all checked items 1-5 in the order listed.
- Also include one additional collated set of copies (sorted in the order listed) for items 1 and 2.

→ **Applications will be returned if these instructions are not followed.**

Check	Item	Total No. of Copies
□	1. A concise summary of the requested modification using this form. List and describe each proposed change to aid in IRB review. Add pages as necessary. Provide a concise summary of changes when submitting an updated Investigator Brochure or Master Protocol.	2
□	2. New or revised consent forms, questionnaires, surveys, recruitment materials, advertisements, etc. One copy should have changes highlighted by underlining, and the other clean copy will be used for stamping.	1 highlighted 1 clean
□	3. If you have made substantive changes to the study design or procedures, submit a revised full IRB application with changes highlighted by underlining. If you are making changes only to the first page, just submit that page.	2
□	4. The sponsor's document describing the amendment, if any.	1
□	5. If adding personnel, include name, location (UNC or specific outside location), role, and email address for each person who should receive electronic copies of IRB correspondence to PI. For those study personnel *not* in the online UNC-CH ethics training database (http://cfx3.research.unc.edu/training_comp/) include documentation of required training in human research ethics.	1

1 **List and describe each proposed change:**

Summary:

1. **For safety reasons, lung function will be monitored in the chamber during exposures using a portable spirometer. If FEV1 decreases by 40% from baseline, as measured by the portable spirometer, the subject will be removed from the chamber and the exposure will be terminated.**
2. **Added Personnel:** Martha Almond, RN; Carol Robinette, RN; Margaret Herbst, RN; Lynne Newlin-Clapp, RN
3. **Added the collection of saliva as an endpoint**
4. **In the storage consent form, we changed the information under "What will happen if you are injured by this research?" to agree with our policy.**

Application for IRB approval of human subjects research:

Added project personnel:
Martha Almond, RN; Carol Robinette, RN; Margaret Herbst, RN; Lynne Newlin-Clapp, RN

Page 11. Measurements and Collections:
Secondary endpoints from additional blood, breath, saliva, and urine samples….

Page 12. Added additional lung function collection time points to Figure 1.
Page 13. .....and urine, blood, saliva, and exhaled breath collected.....

Lung function measurements, including FEV1, will be obtained for safety precautions using a portable spirometer in the chamber during the exposure period.

....and blood, saliva, and breath collected immediately post expsosure.

Spirometry will be performed for safety measures on a portable spirometer during exposures in the chamber and as a primary endpoint on a dry seal digital spirometer to record

Page 14. **Saliva**: subjects will be asked to spit into a cup or tube for comparison of inflammation/immune system constituents and exposure markers with exhaled breath. Up to about 5 ml will be collected.

Page 15. Added project personnel
Martha Almond, RN; Carol Robinette, RN; Margaret Herbst, RN; Lynne Newlin-Clapp, RN

Page 16. #5 Ozone exposure: Potential risks may include mild decrements in lung function spirometric volume

Page 19. #5 Lung function will be monitored in the chamber during exposures using a portable spirometer. If FEV1 decreases by 40% from baseline, as measured by the portable spirometer, the subject will be removed from the chamber and the exposure will be terminated.

Page 29 & 30. Exhaled breath and saliva collection (twice)

Page 40. Attachment#8 Instruction for handheld portable spirometer. *See attachment*

Consent Form:
Page 4: ....., on a portable spirometer and dry seal digital spirometer, how to give a saliva and an exhaled breath sample,.....

Page 5: This procedure will be repeated on a portable devise as well.

We will collect your breath and saliva.

Have a second breathing test on a portable spirometry instrument, but in a similar manner as the first.

Page 6: In addition, you will be asked to breathe into a portable spirometer so that your lung function can be measured. Exposure may be terminated if you show a larger than expected decrement in lung function.

We will collect your breath and saliva

Page7: Again, your heart rhythm and rate, blood pressure, the amount of oxygen in your blood, your breathing rate, and lung function will be monitored while you are inside the chamber.

Page8: **Ozone exposure:** .....decrements in lung function spirometric volume

Page 11: Exhaled breath and saliva collection (twice)

Storage Consent Form:

Page 4: **What will happen if you are injured by this research?**

All forms of human health research involve some risk of injury or illness. Despite our high level of precaution, you may develop an injury or illness due to participating in this study. If you develop an injury or illness determined by an appointed US EPA physician to be due to your participation in this research, the US EPA will reimburse your medical expenses to treat the injury or illness up to $5000. If you believe your injury or illness was due to a lack of reasonable care or other negligent action, you have the right to pursue legal remedy. The Federal Tort Claims Act, 28 U.S.C. 2671 et. Seq., provides for money damages against the United States when personal injury or property loss results from the negligent or wrongful act or omission of any employee of the EPA while acting within the scope of his or her employment. Signing this consent form does not waive any of your legal rights or release the investigator, the sponsor, the institution, or its agents from liability for negligence.

If a research related injury or illness occurs, you should contact the Director of the EPA NHEERL Human Research Protocol Office at (919) 966-6217.

2. **Is this modification being submitted in response to an unanticipated problem/adverse event or new findings?** _ yes _x_ no
   If yes, explain, including whether these events or findings are relevant to participants' willingness to continue.

3. **Do any of the proposed changes increase risk?** ___yes x no If yes, explain.

IRB study #: 09-1344 **Date:** 11/16/10

Title of Study: Cardiopulmonary Responses to Exposure to Ozone and Diesel Exhaust with Moderate Exercise in Healthy Adults

Principal Investigator: Tina Stevens, PhD

Faculty advisor: N/A
(if applicable)

For industry sponsored research (if applicable):

Sponsor's master protocol version #: Version date:

Investigator Brochure version #: Version date:

Any other details you need documented on IRB approval:

Tina Stevens 11/16/10

Signature of Principal Investigator or designee Date

Signature of Faculty Advisor (if applicable) Date

OFFICE OF HUMAN RESEARCH ETHICS
Institutional Review Board

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NOV 16 2010
IRB UNC-CH

APPLICATION FOR IRB APPROVAL OF
HUMAN SUBJECTS RESEARCH
Version9 September 29th

Part A.1. Contact Information, Agreements, and Signatures

Date: November 16, 2010~~July 30, 2010~~

Title of Study: Cardiopulmonary Responses to Exposure to Ozone and Diesel Exhaust with Moderate Exercise in Healthy Adults

Name and degrees of Principal Investigator: Tina Stevens, Ph.D.
Department: US EPA Mailing address/CB #: 104 Mason Farm Rd.
Chapel Hill, NC
27599-7315
Phone #: (919) 843-8031 Fax #: (919) 966-6367 Email Address: stevens.tina@epa.gov

Name and degrees of Co-Investigator: Michael Madden, Ph.D, David Diaz-Sanchez, Ph.D., Howard Kehrl, MD

For trainee-led projects: __ undergraduate __ graduate __ postdoc __ resident __ other
Name of faculty advisors: N/A

Department: Mailing address/CB #:

Phone #: Fax #: Email Address:

Department: Mailing address/CB #:

Phone #: Fax #: Email Address:

Center, institute, or department in which research is based if other than department(s) listed above:

Name of Project Manager or Study Coordinator (if any):
Department: Martin Case Mailing address/CB #: 104 Mason Farm Rd.
Chapel Hill, NC
27599-7315

Phone #: (919) 966-0647 Email Address: case.martin@epa.gov

List **all other project personnel** including co-investigators, and anyone else who has contact with subjects or identifiable data from subjects. **Include email address for each person who should receive electronic copies of IRB correspondence to PI:**
Co-PI: David Diaz-Sanchez, PhD (diaz-sanchez.david@epa.gov); Michael Madden, PhD (madden.michael@epa.gov); Howard Kehrl, MD (kehrl.howard@epa.gov)
Robert Devlin, Ph.D; Maryann Bassett, RN; Martha Sue Carraway, MD; Martin Case, BS; Andrew Ghio MD; Tracey Montilla, RN; Ana Rappold, PhD; Joachim Pleil, Ph.D; Michael Schmitt, MS; and Heidi Hiers, RN; Wayne Cascio, MD; Martha Almond, RN; Carol Robinette, RN; Margaret Herbst, RN; Lynne Newlin-Clapp, RN

Name of funding source or sponsor (*please do not abbreviate*): Environmental Protection Agency
__ not funded x_ Federal __ State __ industry __ foundation __ UNC-CH
__ other (specify):
Sponsor or award number: N/A

RAMSeS number (from Office of Sponsored Research):
For industry sponsored research (if applicable):
Sponsor's master protocol version #: Date:
Investigator Brochure version: Date:
Any details you need documented on IRB approval:

Checklist of Items to Include with Your Submission

Include the following items with your submission, where applicable.

- Check the relevant items below and include one copy of all checked items 1-11 in the order listed.
- Also include two additional collated sets of copies (sorted in the order listed) for items 1-6.

Applications must "stand alone" and should provide all information requested, i.e., complete answers must be contained in the application. While you may reference other documents with supporting information, do not respond solely by stating "see attached."

Applications will be returned if these instructions are not followed.

Check	Item	Total No. of Copies
□	1. This application. One copy must have original PI signatures.	3
□	2. Consent and assent forms (include DHHS-approved sample, when one exists), fact or information sheets, phone and verbal consent scripts.	3
□	3. HIPAA authorization addendum to consent form.	3
□	4. All recruitment materials including final copies of printed advertisements, audio/video taped advertisements, scripts, flyers, letters, and emails.	3
□	5. Questionnaires, focus group guides, scripts used to guide phone or in-person interviews, etc.	3
□	6. Documentation of reviews from any other committees (e.g., Clinical and Translational Research Center (CTRC), Oncology Protocol Review Committee, or local review committees in Academic Affairs).	3
□	7. Protocol, grant application or proposal supporting this submission, if any (e.g., extramural grant application to NIH or foundation, industry protocol, student proposal). This must be submitted if an external funding source or sponsor is checked on the previous page.	1
□	8. Addendum for Multi-Site Studies where UNC-CH is the Lead Coordinating Center.	1
□	9. Data use agreements (may be required for use of existing data from third parties).	1
□	10. Only for those study personnel *not* in the online UNC-CH human research ethics training database (http://cfx3.research.unc.edu/training_comp/): Documentation of required training in human research ethics.	1
□	11. For drug studies, Investigator Brochure if one exists. If none, include package insert for previously approved uses..	1

Principal Investigator: I will personally conduct or supervise this research study. I will ensure that this study is performed in compliance with all applicable laws, regulations and University policies regarding human subjects' research. I will obtain IRB approval before making any changes or additions to the project. I will notify the IRB of any other changes in the information provided in this application. I will provide progress reports to the IRB at least annually, or as requested. I will report promptly to the IRB all unanticipated problems or serious adverse events involving risk to human subjects. I will follow the IRB approved consent process for all subjects. I will ensure that all collaborators, students and employees assisting in this research study are informed about these obligations. All information given in this form is accurate and complete.

_____

Tina Stevens, Signature of Principal Investigator Date

Faculty Advisor if PI is a Student or Trainee Investigator: I accept ultimate responsibility for ensuring that this study complies with all the obligations listed above for the PI.

_____

David Diaz-Sanchez, Signature of Faculty Co-Advisor Date

_____

Michael Madden, Signature of Faculty Co-Advisor Date

Part A.2. Summary Checklist *Are the following involved?*	Yes	No
A.2.1. Existing data, research records, patient records, and/or human biological specimens?	__	x
A.2.2. Surveys, questionnaires, interviews, or focus groups with subjects?	x	__
A.2.3. Videotaping, audiotaping, filming of subjects, or analysis of existing tapes?	__	x
A.2.4. Do you have specific plans to enroll subjects from these vulnerable or select populations:		
a. UNC-CH students or UNC-CH employees?	x	__
b. Non-English-speaking?	__	x
c. Decisionally impaired?	__	x
d. Patients?	__	x
e. Prisoners, others involuntarily detained or incarcerated, or parolees?	__	x
f. Pregnant women?	__	x
g. Minors (less than 18 years)? ***If yes***, give age range: to years	__	x
A.2.5. a. Are sites outside UNC-CH engaged in the research?	__	x
b. Is UNC-CH the sponsor or lead coordinating center for a multi-site study?	__	x
If yes, include the ***Addendum for Multi-site Studies***.		
If yes, will any of these sites be outside the United States?	__	__
If yes, is there a local ethics review committee agency with jurisdiction? (provide contact information)	__	__
A.2.6. Will this study use a data and safety monitoring board or committee?	__	x
If yes: UNC-CH NC TraCS DSMB? (must apply separately)	__	__
Lineberger Cancer Center DSMC?	__	__
Other? Specify:	__	__
A.2.7. a. Are you collecting sensitive information such as sexual behavior, HIV status, recreational drug use, illegal behaviors, child/physical abuse, immigration status, etc?	__	__
b. Do you plan to obtain a federal Certificate of Confidentiality for this study?	__	x
c. Is this research classified (e.g., requires security clearance)?	__	x
A.2.8. a. Investigational drugs? (provide **IND #**)	__	x
b. Approved drugs for "non-FDA-approved" conditions?	__	x
All studies testing substances in humans must provide a letter of acknowledgement from the UNC Health Care Investigational Drug Service (IDS).		
A.2.9. Placebo(s)?	__	x
A.2.10. Investigational devices, instruments, machines, software? (provide **IDE #**)	__	x
A.2.11. Fetal tissue?	__	x
A.2.12. Genetic studies on subjects' specimens?	x	__
A.2.13. Storage of subjects' specimens for future research? ***If yes***, *see instructions for* ***Consent for Stored Samples***.	x	__
A.2.14. Diagnostic or therapeutic ionizing radiation, or radioactive isotopes, which subjects would not receive otherwise? ***If yes***, *approval by the* ***UNC-CH Radiation Safety Committee*** *is required.*	__	x
A.2.15. Recombinant DNA or gene transfer to human subjects? ***If yes***, *approval by the* ***UNC-CH Institutional Biosafety Committee*** *is required.*	__	x
A.2.16. Does this study involve UNC-CH cancer patients? ***If yes***, *submit this application directly to the* ***Oncology Protocol Review Committee***.	__	x
A.2.17. Will subjects be studied in the Clinical and Translational Research Center (CTRC) or is the CTRC involved in any other way with this study? If yes, obtain the ***CTRC Addendum*** *and submit completed application (IRB application and Addendum) directly to the CTRC. The CTRC includes facilities located on the 3rd floor of the Main Hospital (formerly GCRC) and Ground floor Burnett-Womack (formerly CCCT).*	__	x
A.2.18. Will gadolinium be administered as a contrast agent?	__	x
A.2.19. Will subjects' Social Security Number (SSN) be collected for:		
a. processing payments greater than $200 per year, to support IRS reporting (see also B.6)?	x	__
b. processing payments of any amount through UNC-CH Accounts Payable?	__	x
c. use as a unique identifier for study tracking purposes for national registry or database?	__	x

Part A.3. Conflict of Interest Questions and Certification

The following questions apply to **all investigators and study staff** engaged in the design, conduct, or reporting results of this project **and/or their immediate family members.** For these purposes, "family" includes the individual's spouse and dependent children. "Spouse" includes a person with whom one lives together in the same residence and with whom one shares responsibility for each other's welfare and shares financial obligations.

A.3.1. Currently or during the term of this research study, does any member of the research team or his/her family member have or expect to have:		
(a) A personal financial interest in or personal financial relationship (including gifts of cash or in-kind) with the sponsor of this study?	__ yes	__x no
(b) A personal financial interest in or personal financial relationship (including gifts of cash or in-kind) with an entity that owns or has the right to commercialize a product, process or technology studied in this project?	__ yes	_x_ no
(c) A personal financial interest in or personal financial relationship (including gifts of cash or in-kind) with an entity engaged in the performance of this project as a subcontractor, sub-recipient or vendor?	__ yes	_x_ no
(d) A board membership of any kind or an executive position (paid or unpaid) with the sponsor of this study or with an entity that owns or has the right to commercialize a product, process or technology studied in this project?	__ yes	_x_ no
A.3.2. Has the University or has a University-related foundation received a cash or in-kind gift from the sponsor of this study for the use or benefit of any member of the research team?	__ yes	__x no
A.3.3. Has the University or has a University-related foundation received a cash or in-kind gift for the use or benefit of any member of the research team from an entity that owns or has the right to commercialize a product, process or technology studied in this project?	__ yes	_x_ no

If the answer to ANY of the questions above is *yes*, the affected research team member(s) must complete and submit the form, which is accessible online at http://coi.unc.edu. List name(s) of all research team members for whom any answer to the questions above is *yes*:

_____

Certification by Principal Investigator: By submitting this IRB application, I (the PI) certify that the information provided above is true and accurate regarding my own circumstances, that I have inquired of every UNC-Chapel Hill employee or trainee who will be engaged in the design, conduct or reporting of results of this project as to the questions set out above, and that I have instructed any such person who has answered "yes" to any of these questions to complete and submit for approval a Conflict of Interest Evaluation Form. I understand that as Principal Investigator I am obligated to ensure that any potential conflicts of interest that exist in relation to my study are reported as required by University policy.

_____ _____

Tina Stevens Date

Faculty Advisor if PI is a Student or Trainee Investigator: I accept ultimate responsibility for ensuring that the PI complies with the University's conflict of interest policies and procedures.

_____ _____

Signature of Faculty Advisor Date

Part A.4. Questions Common to All Studies

For all questions, if the study involves only secondary data analysis, focus on your proposed design, methods and procedures, and not those of the original study that produced the data you plan to use.

A.4.1. **Brief Summary**. Provide a *brief* non-technical description of the study, which will be used in IRB documentation as a description of the study. Typical summaries are 50-100 words. *Please reply to each item below, retaining the subheading labels already in place, so that reviewers can readily identify the content.*

Purpose: The purpose of this study is to measure cardiopulmonary responses in healthy young adults before, during, and after exposure to combinations of ozone (O3) and diesel exhaust (DE) for 2 hours with moderate exercise and to primarily investigate whether DE modulates the O3-induced effects on the lung and cardiovascular systems.

Participants: Fifteen (15) healthy young men and women in the age range of 18 – 55 years

Procedures (methods): Each subject will be exposed in environmentally controlled exposure chambers to 4 exposure regimens. Each regimen will require a 2 hr exposure with intermittent, moderate exercise on 2 consecutive days. Day 1 exposure will consist of a combined exposure to DE and O3, O3 only (i.e., no DE), or DE only, or clean air (CA) only. For all 4 regimens, subjects will return the next day (Day 2) to be exposed to O3 alone and again on Day 3 for a follow up visit. Each regimen will be separated by at least 13 days. Techniques measuring lung and cardiac physiology will be performed pre, during, and post exposure. Blood, urine, and breath samples will also be obtained and analyzed for immune and inflammatory markers, clotting factors, susceptibility factors, and exposure markers.

A.4.2. **Purpose and Rationale**. Provide a summary of the background information, state the research question(s), and tell why the study is needed. If a complete rationale and literature review are in an accompanying grant application or other type of proposal, only provide a brief summary here. If there is no proposal, provide a more extensive rationale and literature review, including references.

Numerous epidemiological studies have demonstrated an association between acute and chronic exposure to air pollution and various adverse cardiopulmonary effects including mortality, respiratory tract infections, exacerbation of asthma symptoms, chronic bronchitis, ischemic heart disease, and stroke [1] and other health effects. Understanding the components responsible for these effects is difficult because ambient air pollution is a complex mixture of gases and particulate matter (PM). In this complex mixture of ambient air pollution, ozone (O3) and diesel exhaust (DE) are generally major and important components. Controlled exposures of volunteers to either pollutant have resulted in biological effects such as lung physiological changes. However it is not known if co-exposure to both pollutants, similar to polluted ambient air, can induce additive or synergistic effects. Additionally it is also uncertain if exposure to DE, or DE with O3, can alter a subsequent exposure to O3. This study proposes to examine whether co-exposures to O3 and DE, at doses in the upper range of those encountered in urbanized settings, can induce additive or synergistic effects, and whether a previous DE exposure alters a response upon subsequent exposure to O3. The data obtained from this study will contribute to the overall assessment of air pollution effects in the U.S. and thereby may influence future health policy.

One of the best studied gas phase pollutants is ozone (O3). Effects of O3 exposure in a controlled exposure setting have been well documented particularly for decrements of lung function [2-12] and an influx of neutrophils and other markers of inflammation [13-17] at concentrations as low as 0.08 ppm in a dose-response manner. Repeated exposure of healthy adolescents to about 0.5 ppm O3 for 2 hrs on 5 consecutive days has shown a decrement in lung function after the first exposure, an even greater

decrement after a second day exposure, but then increasing attenuated lung function decrements for the next 3 exposure days [18-21]. Hence the greatest lung function decrement is after 2 days exposure, with an adaptation occurring after the first two exposures. The adaptation is associated with attenuation of some soluble biochemical mediators collected by lung lavage (eg, PGE2), but not others (eg, IL-8), after 5 consecutive days of exposure [22].

A wide variation in lung function and lung cellular response to O3 exposure has been observed among individuals with no clear understanding in the susceptibility factors involved. NSAID usage has been shown to attenuate O3-induced lung function decrements [23]. Recent reports have linked certain genetic polymorphisms to possible sensitivities to O3. For example, exercising individuals had greater lung function decrements as a group when they possessed a glutathione-S-transferase M1 (GSTM1) null genotype. Field studies over 3 years have shown increased respiratory breathing problems in children living in Mexico City who were GSTM1 null [24, 25], but no increased respiratory problems were associated with those children who were GSTP1 null.

PM exposure has been associated primarily with premature mortality [26, 27], but also with morbidity such as increased hospitalizations for cardiopulmonary problems including lung infection, asthma symptoms, and heart attacks [28-30]. Controlled ambient PM exposure studies of humans have been used to examine biological responses as surrogates for understanding the health effects and mechanisms involved in the responses. These controlled exposures have utilized inhalation of ambient PM that was concentrated to achieve increased mass concentrations (average 120 ± 14 $\mu g/m^3$ for PM2.5, with a maximum of 207 $\mu g/m^3$) at our EPA facility in Chapel Hill [31]. The controlled exposure studies have demonstrated no changes in lung physiological measurements. However, a dose-dependent increase in total number of cells, neutrophils, and monocytes was observed in the lavage fluid. Cardiac measurements showed no changes (standard deviation of normal to normal beat intervals (SDNN), percentage of normal to normal beat interval differences > 50 ms (PNN50), the high frequency domain (HF), the low frequency domain (LF), or the ratio of HF/LF) either immediately following PM2.5 exposure and 24 hrs after exposure. Animal studies have suggested that long-term exposure to low concentration of PM altered vasomotor tone, induces vascular inflammation, and potentiates atherosclerosis [32].

Diesel exhaust is a component of air pollution in urban settings, and contributes both PM and gaseous phase compounds to the atmosphere. Diesel exhaust fumes contain primarily fine (≤ 2.5 μm) and ultrafine (≤ 0.1 μm) carbonaceous particulates generated by incomplete combustion of fuel. The composition of the DE PM and the gases can vary depending on the type and age of engine, quality of fuel and additives, emission controls, load characteristics, and after treatment. Few controlled human exposures to diesel exhaust have been performed. Healthy human volunteers exposed to 300 $\mu g/m^3$ diesel exhaust for one hour with intermittent exercise resulted in marked systemic and redox-sensitive pulmonary inflammatory responses [33, 34], and vascular dysfunction and impaired endogenous fibrinolysis that links diesel exhaust inhalation to the pathogenesis of atherothrombosis and acute myocardial infarction [35, 36]. Despite a decade of intensive studies, much about the PM health effects problem, especially the cardiovascular effect, is still not well understood.

There are few studies looking at lung responses with combined O3 and DE in a controlled exposure setting. One study using healthy, young adults showed that a sequential exposure to 300 $\mu g/m^3$ DE for 1 hr followed 5 hr later by exposure to 0.2 ppm O3 induced more lung inflammation (eg. neutrophils collected by induced sputum) than DE alone with no O3 exposure [37]. The same research group, using similar exposure regimen exposure levels and timing, showed that diesel exhaust increased O3-induced lung inflammation (i.e., neutrophils collected by bronchoscopy) relative to O3 exposure alone [38]. Few studies with controlled O3 exposures have examined changes induced in extrapulmonary responses, including cardiac physiology and blood clotting and inflammatory factors. One study showed an increased diastolic blood pressure in healthy adults exposed to concentrated ambient particular matter

(CAPs; ~147 μg/m^3) and O3 (~0.12 ppm) simultaneously compared to clean air responses [39]. However, no separate exposure to O3 alone, or CAPs alone, were performed.

The purpose of this study is, first, to examine whether DE can alter lung and cardiovascular responses to O3 exposure when given a day before or during O3 exposure; second, to investigate if co-exposure of DE and O3 on day 1 augments the lung function decrements following a subsequent O3 exposure (day 2); third, to investigate if two consecutive days of O3 affect individual cardiovascular responses such as changes in heart rate variability (HRV) and blood pressure (BP), to ozone in young healthy adults. We will measure spirometric lung function in association with 2-hour exposures to O3. Results will be analyzed for effects of each or combinations of the above on changes in lung function. We hypothesize that an exposure to DE with O3 (day 1) or DE exposure (day 1) given prior to O3 exposure (day2) will not induce a significant decrement in lung function in healthy young adults as a group relative to O3 alone. We further hypothesize that an O3 exposure (on day 2) after the DE and O3 co-exposure (day 1) will cause significant cardiopulmonary responses in healthy young adults. Finally, we hypothesize that two consecutive days of O3 exposure will affect cardiovascular responses.

A.4.3. **Subjects.** *You should describe the subject population even if your study does not involve direct interaction (e.g., existing records).* Specify number, gender, ethnicity, race, and age. Specify whether subjects are healthy volunteers or patients. If patients, specify any relevant disease or condition and indicate how potential subjects will be identified. Researchers are reminded that additional approvals may be needed from relevant "gatekeepers" to access subjects (e.g., school principals, facility directors, hospital or healthcare system administrators).

A group of 15 healthy adults (men and women) between the ages of 18 and 55 years will participate and complete the study. However, because of potential dropouts and early terminations we will recruit as many as needed to have 15 individuals complete all 4 exposure regimens. Enrollment in this study will not be restricted to any specific races and ethnicities. All subjects will be non-smokers for at least a year, with no active cardiac or respiratory disease, or active medical problems of any kind. Pregnant women, those trying to become pregnant, and those breast-feeding, will not be accepted. All potential subjects will undergo screening procedures (previously approved 95-EPA-66 Phase I and II), including a medical history form, physical examination and routine chemical and hematologic screens. All subjects are required to be moderately active so that they could sustain a prolonged period of moderate exercise. All subjects will be recruited without regard to their genetic profiles; however, they will be genotyped and classified for presence or absence of polymorphisms of select genes.

A.4.4. **Inclusion/exclusion criteria.** List required characteristics of potential subjects, and those that preclude enrollment or involvement of subjects or their data. Justify exclusion of any group, especially by criteria based on gender, ethnicity, race, or age. If pregnant women are excluded, or if women who become pregnant are withdrawn, specific justification must be provided.

Inclusion Criteria:

1. Healthy men and women between 18 and 55 years of age
2. Physical conditioning allowing intermittent, moderate exercise for 2 hours
3. Normal lung function:
    a. FVC > 75 % of that predicted for gender, ethnicity, age and height.
    b. FEV_1 > 75 % of that predicted for gender, ethnicity, age and height.
    c. FEV_1/FVC ratio > 75 % of predicted values.
4. Oxygen saturation > 96 %.

Exclusion Criteria:

1. A history of acute and chronic cardiovascular disease, chronic respiratory disease, diabetes, rheumatologic diseases, immunodeficiency state, and acute respiratory illness within 4 weeks.
2. Subjects who are asthmatic or have a history of asthma.
3. Allergic to chemical vapors or gases.
4. Any allergic symptoms during the time of participation in the study
5. Female subjects who are currently pregnant, attempting to become pregnant, or breastfeeding
6. Subjects unwilling or unable to stop taking vitamin C or E or medications which may impact the results of the ozone challenge (such as, systemic steroids and beta blockers) at least 2 weeks prior to the study and for the duration of the study. Medications not specifically mentioned here may be reviewed by the investigators prior to a subject's inclusion in the study.
7. Current and past smokers within 1 year.
8. Uncontrolled hypertension (> 150 systolic, > 90 diastolic).
9. Subjects who do not understand or speak English
10. Subjects unable to perform the moderately active exercise required for the study.
11. Subjects with a history of skin allergies to adhesives used in securing heart rate monitor electrodes.
12. Unspecified diseases or conditions, which in the judgment of the investigator might influence the responses to the exposures, will be a basis for exclusion.
13. Subjects unwilling to stop taking over-the-counter pain medications such as aspirin, Advil, Aleve or other non-steroidal anti-inflammatory medications ("NSAIDS") for 48 hr prior to the exposures and post-exposure visits.
14. Subjects with a marked baseline prolongation of QT/QTc interval (e.g., repeated demonstration of a QTc interval >450 milliseconds (ms))

A.4.5. **Full description of the study design, methods and procedures.** Describe the research study. Discuss the study design; study procedures; sequential description of what subjects will be asked to do; assignment of subjects to various arms of the study if applicable; doses; frequency and route of administration of medication and other medical treatment if applicable; how data are to be collected (questionnaire, interview, focus group or specific procedure such as physical examination, venipuncture, etc.). Include information on who will collect data, who will conduct procedures or measurements. Indicate the number and duration of contacts with each subject; outcome measurements; and follow-up procedures. If the study involves medical treatment, distinguish standard care procedures from those that are research. If the study is a clinical trial involving patients as subjects and use of placebo control is involved, provide justification for the use of placebo controls.

This is a randomized crossover single blind study with 4 arms separated by at least 13 days. In this study we will measure cardiopulmonary responses to O3 (approximately mean concentration of 0.3 ppm over the 2 hr exposure period) and diesel exhaust (DE; ~300 $\mu g/m^3$) combined exposure and singularly, and clean air control in healthy adults undergoing moderate intermittent exercise (minute ventilation = ~ 25 liters/min/m^2 BSA). [See figure 1].

Each subject will be exposed randomly to all 4 exposure regimes separated by at least 13 days. For all regimes, the subject will be exposed to the pollutant or clean air for 2 hrs with moderate exercise during the exposures. Moderate exercise will involve riding a stationary bike in the chamber for 15 min intervals beginning after the first 15 min of exposure and resting for 15 min after each time for a total of 1 hr of moderate exercise per chamber exposure. Ventilation rate measurements will be taken at ~ 6 min into each exercise session to ensure ventilation rates are within the appropriate parameters [target ~25 L/min/ m2 BSA, which in most subjects is ~ 50 L/min.]. For the DE and O3 co-exposure, there is a potential for the O3 to interact with the DE, but the O3 concentration will be maintained at a final mean concentration of about 0.3 ppm.

All exposures will be carried out at the EPA Human Studies Facility on the UNC campus. Subjects will be monitored continuously by the EPA personnel. A duty physician will be available. The subjects will

be able to end their exposure and exit the chamber at any time if they choose to end their participation in the study. Total exposure times will be 2 hours. The exposure atmosphere will be at approximately 40 ± 10% RH and approximately 22 ± 2 °C. Clean air will be passed through an air purification system to ensure no presence of pollutant gases (O_3, NO, NO_2, SO_2, CO) in the air. Ozone and DE concentrations will be monitored continuously. The DE will be generated from a diesel engine used to power an air compressor that is located outside the Human Studies Facility, and subsequently introduced into the exposure chamber after different dilutions with clean HEPA and charcoal filtered and humidified air to give a chamber concentration of approximately 300 $\mu g/m^3$. The monitoring analyzer registers a concentration in real time. Exposures will be terminated at values $\geq$ 400 $\mu g/m^3$ during runs in which the exposure targets 300 $\mu g/m^3$ DE. This safety limit will prevent an inhalational exposure greater than 1,080 µg, which assumes that the subject, only resting for 1 hr, exercising for 1 hr, will inhale 2.7 m^3 during the 120 min exposure. It is expected that 75 to 95% of the diesel exhaust PM from this type of engine will be approximately 0.05-0.2 µm. Preliminary testing has shown the mean particle size to be approximately 0.15 ± 0.05 µm. Levels of carbon monoxide (CO), and oxides of nitrogen (NOx; mainly NO, and some NO_2), will be kept under 10 ppm CO, 15 ppm NO, and 3.5 ppm NO_2 or the exposure will be terminated. [The OSHA 8 hr time-weighted average for these substances are: CO=50 ppm; NO=25 ppm; NO_2=5 ppm; Diesel fuel used for the study will be purchased as a commercial ultra low sulfur fuel. This certified fuel represents diesel fuel composition that is typically available at gas stations for most regions of the country except for California. Subjects will enter the exposure chamber. Particle mass will be measured in real time and validated further by weighing filters after the 2 hr exposure is finished. Particle size distribution will be determined at regular intervals. Filter samples will also be analyzed for chemical composition of particles. Minute ventilation will be measured during the exercise periods of exposure.

Lung Function Test:

Primary endpoints for evaluating health effects are changes in lung functions, mainly FEV_1, FVC and FEV_1/FVC before, immediately after, and approximately every hour for up to 4 hrs post exposure.

Measurements and Collections:

Blood pressure, telemetry, and oxygen saturation will be monitored during the exposure period. Other primary endpoints for evaluating health effects, in addition to lung function, are heart rate variability (HRV) and markers of inflammation including total and differential cell counts as well as pro-inflammatory cytokines and immune system mediators and clotting factors from collected blood. Secondary endpoints from additional blood, breath, saliva, and urine samples will serve as indicators of the exposure based on the levels of metals (eg, Zn) and organics (eg, PAHs) and other components that may be derived from DE deposition. From the collected blood samples, additional parameters and indices may be obtained as analysis tools become available. Genetic analysis may also be performed on collected blood samples for susceptibility factors. A questionnaire measuring perceived stress by the subject at the beginning of an exposure regimen will be performed. Some of the supplemental spirometric measurements and secondary endpoints may not be obtained if they are deemed unnecessary.

In order to participate in this study, subjects will be asked to:

- Avoid smoke and fumes for 24 hours before all visits.
- Avoid drinking alcohol 24 hours before all visits.
- Avoid strenuous exercise for 24 hours prior to and after all visits.
- Avoid the use of ozone-based home air purifiers during study participation.
- On the exposure days, eat a light breakfast.
- Refrain from all over the counter anti-inflammatory agents including those for allergies for a period of 48 hrs prior to exposure.

Figure 1

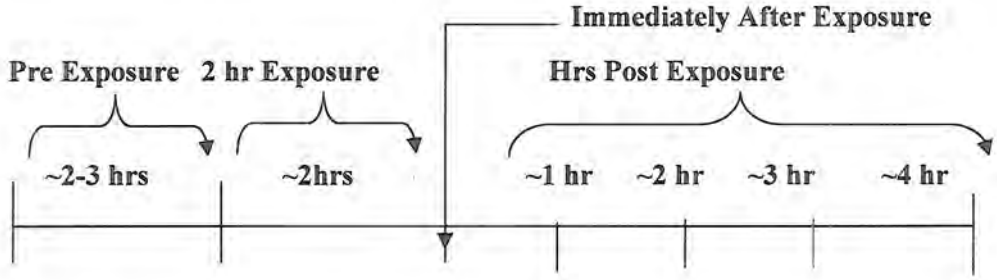
Experimental design:

	Day 1 2 hr exposure	Day 2 2hr exposure	Day 3
Exposure Regime 1	DE + O3	O3	follow up (no exposure)
Exposure Regime 2	O3	O3	follow up (no exposure)
Exposure Regime 3	DE	O3	follow up (no exposure)
Exposure Regime 4	Clean Air	O3	follow up (no exposure)

Figure 2

Endpoints:

Day 1



Measurements & Collections	*			*				
Lung Function	*	*	* * *	*	*	*	*	*

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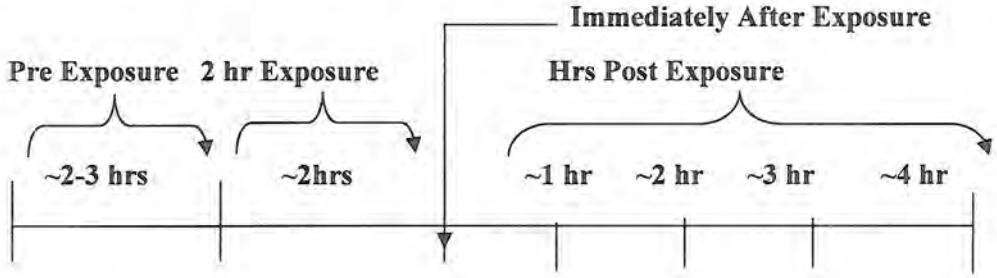
Day 2



Measurements & Collections	*			*				
Lung Function	*	*	* * *	*	*	*	*	*

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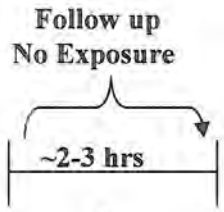
Day 3



Measurements & Collections	*
Lung Function	*

Protocol: Written consent will be obtained. The subjects will be trained (on D0) in techniques for obtaining lung function measurements. Subjects also will exercise on a bicycle, and appropriate settings (the speed and grade of incline) required to produce a desired value of minute ventilation will be determined. On the first day of exposure, subjects will be assessed for vital signs (blood pressure, pulse, temperature and respiratory rate) at the check-in. Subjects may perform pre-exposure baseline lung functions in clean air, have resting heart rate variability (HRV) assessed, and urine, blood, saliva, and exhaled breath collected for later analyses of soluble mediators such as clotting factors, inflammatory proteins, and lipids and blood cell types and numbers. These samples may also serve to determine biomarkers of exposure, such as the concentration of PAHs. A questionnaire measuring perceived stress by the subject at the beginning of an exposure regimen will be filled out; this is included as Attachment #1. [Information about grading the questionnaire (Sheldon Cohen Perceived Stress Scale) is described at www.mindgarden.com].The subject then will enter the chamber already set for the appropriate conditions (DE & O3, DE alone, O3 alone, or clean air), and after 15 min begin exercising on a stationary bicycle. Each exposure session will consist of 4 periods of 15 rest/15 min exercise at a level of approximately 25 liters/min/m^2 body surface area (BSA) in minute ventilation. Lung function measurements, including FEV1, will be obtained for safety precautions using a portable spirometer in the chamber during the exposure period. Measurements of lung function will also~~may~~ be obtained immediately after, and every hour for up to 4 hr post exposure using the dry seal digital spirometer. Resting HRV may be recorded, and blood, urine, saliva, and breath collected immediately post exposure. Following the day 1 exposure, the subject may remain at the Medical Station for follow up measurements of lung function for approximately 2-4 hr. The subjects will go home with a heart rate monitor and blood pressure cuff. On Day 2, the subject will report to the medical station in the morning. The same measurements (resting HRV, lung function; symptoms; venipuncture performed) as Day 1 may be done pre- and post- exposure to O3. Subjects will return on Day 3 for follow up measurements but with no exposures.

Experimental procedures:
Medical history will be collected, including current medications and any recent illness.

Vital signs will be measured to include height, weight, heart rate, respiratory rate, blood pressure, oxygen saturation, and temperature. In addition a pregnancy test will be given to all women before each exposure regime.

Spirometry will be performed for safety measures on a portable spirometer during exposures in the chamber and as a primary endpoint on a dry seal digital spirometer to record~~including the~~ forced expiratory maneuver, forced vital capacity (FVC), forced expired volume in the first second (FEV_1), and FEV_1/FVC.

Exhaled Breath Collection: The participant will be asked to breathe into a cooled tube for up to 15 minutes. Collected breath condensate may be analyzed for markers of airway inflammation and immune

system alterations and exposure markers. Additionally a small Tedlar bag of uncooled, exhaled breath will be collected (up to 5 min) to examine gas phase exposure and inflammation/immune system constituents.

For exercise measurements the subjects breathe for up to 3 min through a pneumotachograph while performing exercise and ventilation parameters including the minute ventilation, tidal volume and breathing frequency will be obtained. Heart rate will be monitored throughout exposure using a telemetry monitor.

Cardiac measurements: Heart Rate Variability monitoring (ambulatory ECG) monitoring: On the day 1 and day 2 of each of the exposure regimes we will mount a Holter monitor to the participants. The skin may be shaved (men only) and prepped. ECG electrodes are attached and connected to the beeper-sized Holter monitor, which participants wear around their waist. After mounting the monitor onto participants, they will be asked to relax for 20 minutes in a reclined position after which a 10-minute resting HRV measurement will be obtained. Participants are released while wearing the Holter monitor and return to the HSF the next morning (day 2 of the study segment) to obtain the Holter monitor information and change the batteries, if necessary. The monitor will be worn for day 2 and removed on day 3. We will analyze time and frequency as well as re-polarization parameters. Participants will be given instructions for the removal of the monitor in case it becomes necessary.

Blood pressure (BP) measurements: BP will be monitored during the study. A BP cuff may be worn to measure BP intermittently. A pressure cuff and a monitor which is about the size of the Holter monitor will be placed and will remain in place until the subjects leave for the day. The subjects will be instructed to keep arm relaxed and still when the pressure cuff is inflated. The subjects may wear the cuff for day 1 and 2 of the study session and have it removed on day 3. Participants will be given instructions for the removal of the monitor in case it becomes necessary.

Venipuncture: Up to approximately 500 ml of blood will be collected for the 8 exposure days over a minimum of 8 weeks. This translates to approximately 50 ml of blood for each exposure day and 25 ml on the follow up day. A portion of the sample will be used for genotyping to examine sensitivity in selected blood types. Blood will be analyzed for, but not limited to, clotting/coagulation and inflammation factors and biomarkers of immune response.
A portion of the peripheral blood sample will be used for genetic testing, to identify potential polymorphisms that may make subjects more susceptible to air pollutants. In addition, samples may be stored for as yet undesignated research. Unwillingness to have samples used for genotyping or stored will NOT exclude a subject from the panel study. Consent for genotyping will be included with the general consent form.

Saliva: subjects will be asked to spit into a cup or tube for comparison of inflammation/immune system constituents and exposure markers with exhaled breath. Up to about 5 ml will be collected.

Urine: Participants will collect their urine on days 1, 2, and 3 for each arm of the study. Day 1 will be a 24 hr collection. Urine collection on days 2 and 3 will be limited to subject's stay in the facility. It is estimated that there will be on average seven urine voids collected per person for a 24 hr sampling period [40]. Each urine void will be collected in a separate 1 L polypropylene container (*not pooled*) for this study. In addition, each urine void will be analyzed separately for exposure reconstruction purposes.

For collection of a 24 hr urine sample, each participant will start collecting their individual urine samples on day 1 at the medical station (~8:00 a.m.) and collect through the first morning void the next day (i.e. day 2). The participants will collect each urine void in a separate 1 L polypropylene container and record the time the sample was collected and the time of their last urine void. Then, they will place the container in a provided thermoelectric cooler. The participant will return the cooler containing the 24 hr urine

collection samples in the morning at the HSF on day 2, for each arm of the study. On day 2, a urine sample before and immediately after exposure will be collected. On day 3, one urine sample will be collected. For each person, it is estimated that about 40 samples (~10 urine samples per exposure session X 4 exposure sessions) will be collected from them during the study.

Urine will be examined for markers of exposure (e.g. PAHs) and effect (e.g. IL8 as a marker of inflammation), plus normalization factors (e.g. creatinine).

Likely Personnel assignment	
Subject recruitment and payment	Westat Corporation (Protocol #950518)
Chamber setup and maintenance	TRC Environmental Corporation
Subject surveillance during exposure	Martin Case, BS, Mike Madden, PhD, Tina Stevens, PhD, Howard Kehrl, MD, David Diaz-Sanchez PhD, Medical Station personnel
Lung function testing	Martin Case, BS, Mike Madden PhD, Tina Stevens, PhD Howard Kehrl, MD, Martha Almond, RN, Carol Robinette, RN, Margaret Herbst, RN, Lynne Newlin-Clapp, RN
Blood sampling	Human Studies Facility Medical Station personnel
Subject screening tests	Human Studies Facility Medical Station personnel
Genomic assay	Michael Schmitt, MS

A.4.6. **Benefits to subjects and/or society.** Describe any potential for direct benefit to individual subjects, as well as the benefit to society based on scientific knowledge to be gained; these should be clearly distinguished. Consider the nature, magnitude, and likelihood of any direct benefit to subjects. If there is no direct benefit to the individual subject, say so here and in the consent form (if there is a consent form). Do not list monetary payment or other compensation as a benefit.

The results of this study will contribute to the overall assessment of air pollution effects in the U.S. and thereby influence health policy. The subjects will not benefit personally from being in this research study other than by undergoing a free limited physical examination and screening.

A.4.7. **Full description of risks and measures to minimize risks.** Include risk of psychosocial harm (e.g., emotional distress, embarrassment, breach of confidentiality), economic harm (e.g., loss of employment or insurability, loss of professional standing or reputation, loss of standing within the community) and legal jeopardy (e.g., disclosure of illegal activity or negligence), as well as known side effects of study medication, if applicable, and risk of pain and physical injury. Describe what will be done to minimize these risks. Describe procedures for follow-up, when necessary, such as when subjects are found to be in need of medical or psychological referral. If there is no direct interaction with subjects, and risk is limited to breach of confidentiality (e.g., for existing data), state this.

This study might involve the following risks and/or discomforts:

1. Blood sampling will be performed by well-trained personnel, and entails only a risk of mild discomfort with the infrequent possibility of lightheadedness, fainting, infection or developing

a bruise. Subjects are closely monitored for any signs of faintness, and only allowed to leave the facility after a 15-min waiting period.

2. Breathing tests (spirometry): There pulmonary function tests are standard clinical tests that are commonly performed in hospitals and entail little or no risk to the subjects. However, cough or dizziness may occur during these tests. If these symptoms occur, they are usually temporary. Subjects will remain seated in a chair until symptoms disappear. There is an extremely small chance that the subject could have a bronchospasm or faint upon performing a forced breath expiratory maneuver for spirometry.
3. Exhaled breath condensate and exhaled breath gas: Minimal risk is associated with these procedures. The subject is seated in a chair during these collections and the technician is always available during this procedure in case the participant becomes light-headed due to hyperventilation.
4. Moderate exercise on a stationary bicycle entails the potential, although minimal, risk of occasional muscle soreness, cramps or general fatigue. These discomforts are temporary and not harmful. Heart rate and rhythm will be monitored continuously. Heart rate will be kept below age related maximum (i.e., 220 bpm – age in years). Exercise will be terminated at any time upon the request of the subject or if the investigator/medical staff observes problems while monitoring the ECG readout.
5. Ozone exposure: Potential risks may include mild decrements in lung function spirometric volume~~airway obstruction~~, irritation to the nose, eyes, throat and airways, pain on deep inspiration and cough. These symptoms typically disappear 2 to 4 hours after exposure, but may last longer for particularly sensitive people. Ozone may induce an inflammatory reaction that may last for about 24-48 hours after exposure and may increase the chance of catching a cold.
6. ECG and heart rate variability are standard non-invasive techniques commonly used for heart rate and rhythm analysis and entail little or no risk to the subject. There is the possibility that preparation of the skin for electrode placement and removal may cause skin irritation, itching, or soreness in some subjects.
7. Blood pressure and heart rate measurement: Similar to the regular blood pressure measurement, the risk associated with blood pressure monitor is considered minimal.
8. Diesel exhaust (DE) exposure: The amount of DE (target of 300 $\mu g/m^3$) used in this study would be equivalent to concentrations of DE particulate matter that would be encountered at busy intersections in large urban areas and in occupational exposures. Occupational levels for some truck drivers are generally about 100-300 $\mu g/m^3$ and average ~900 $\mu g/m^3$ for some mines where diesel powered machinery are used. A recent study demonstrated diesel exhaust particulate matter concentrations during drive-by incidents averaged about 125 and199 μg/m3 at the height of an adult pedestrian and a child in a stroller, respectively. Using a 2006 diesel engine, (generally recognized as emitting less PM mass than most older models currently on the road), it was demonstrated that an average DEP concentration up to 364 ug/m^3 (over ~9 sec) could be generated at near roadside monitoring stations at head level during drive by simulations with a peak concentration of 860 ug/m^3. [41].

   Controlled, acute DE exposure studies in Sweden, using about 300 $\mu g/m^3$ of DEP, have shown lung inflammatory effects not unlike effects observed with numerous ozone exposure studies performed here at the EPA facility on the UNC campus during the past 20 yr. DE particles contain some probable carcinogenic polycyclic aromatic hydrocarbons and other components, which in high enough concentrations and/or with repeated exposures may induce tumors. Diesel exhaust also contains aldehydes, some of which are possibly carcinogenic in high enough dose and with long enough exposure. However, the exposure time and concentrations to be used in this protocol are minimal

relative to the durations required to induce lung cancer. Overall, there are no known long-term health risks in healthy individuals acutely exposed to DE at the PM concentrations given in this study. Short-term health effects include slight alterations in blood clotting, oxygen diffusion capacity and changes in heart rate variability. These symptoms typically disappear within 24 hrs of exposure. During exposure, subjects will be monitored by direct observation or via closed-circuit television. Subjects will have EKG leads attached during the exposure to monitor cardiac function during exercise. Subjects will be aware that they can terminate their exposure for any reason and still receive compensation for their participation up to that point. The investigators or duty physician will end the exposure if the subject is found to be suffering from any significant adverse effect. No major adverse effects were observed in a completed diesel exhaust study of healthy adults (ages 18-40; entitled "Physiological, Cellular, and Biochemical Effects of Diesel Exhaust in Healthy Young Adults"; Mike Madden, PI; UNC IRB # # 99-0842) where the PM concentration averaged 106 ug/m3. No major adverse health effects were observed in a completed study that exposed subjects (18-35 yr old, healthy volunteers) to concentrated Chapel Hill air particles here at the EPA facility (Physiological and Biochemical Changes Associated with Exposure to Air Pollution Particles; Andrew Ghio, MD, PI; UNC IRB# 95-EPA-310). The maximum PM concentration reached 311 $\mu g/m^3$ during the exposure. The data from this exposure study suggest that normal healthy subjects tolerate inhalation of concentrated ambient PM fairly well, and support the idea that exposures to lower PM concentrations, including DEP, will be fairly safe in terms of cardiopulmonary responses. For safety reasons, pulse oximetry will be performed during the exposures and the subject withdrawn from the chamber if the O_2 saturation value is $\leq 92\%$. Additionally subjects will have carboxyhemoglobin values determined within 1 hr after an exposure and kept at the Medical Station if levels are >20% (where performance of everyday cognitive tasks may be jeopardized) until levels become <20%; but because the CO levels are expected to be 2-4 ppm [based on preliminary chamber characterizations], levels are expected to be < 5%.

A duty physician is always onsite to respond to an emergency. Fully equipped resuscitation equipment is available for use in the event of a cardiac or pulmonary emergency. Physicians at the University of North Carolina (UNC) Hospitals Emergency Room are also available to assist in treatment of an emergency.

Heart rate and rhythm, and pulse oximetry will be monitored continuously. Subjects will also be monitored for significant respiratory distress or dyspnea, chest pain, significant cardiac arrhythmias, pallor, and ataxia. Subjects will be aware that they can terminate their exposure for any reason and still receive compensation for the entire exposure session. The investigator or duty physician will end the exposure if the subject is found to be suffering from any adverse effect.

9. Effects of combined ozone and diesel exhaust exposure: Because this exposure scenario has not been conducted at our facilities or elsewhere before, we do not yet know whether or not this exposure will include the same risks as diesel exhaust and ozone exposures alone. It is possible that the combination of diesel exhaust and ozone exposures will increase the effects of each pollutant individually, and it is also possible that it will not. We are doing this study in order to find out the answer.

10. Confidentiality: Risk of breach of confidentiality is minimal. All subjects will be assigned a study number which will be used for data recording – not the subject's name. The study number is all that will be entered into computer databases. All paper files that may contain the subject's name or screening number are secure in a locked cabinet in a locked room at the US EPA facility. Any abnormal medical findings (CBC, ECG, spirometry) will be discussed with the volunteer and the volunteer will be counseled to seek treatment from his/her personal physician. Samples will be stored at the U.S. EPA HSF. A numeric coding system will be used to ensure that subjects cannot be directly identified from the samples alone.

In addition, there may be uncommon or previously unknown risks that might occur. During all testing, subjects will be monitored continuously by the EPA personnel. A duty physician will be available in response to an emergency. A group of physicians employed by EPA and UNC Center for Environmental Medicine, Asthma & Lung Biology have primary responsibility for medical coverage of studies conducted in the EPA Human Exposure Facility. This facility is also equipped with an emergency "crash cart" with standard emergency medications, IV fluids and a defibrillator in the unlikely event of a medical emergency for any challenge or exposure study.

A.4.8. **Data monitoring and analysis.** Tell how the qualitative and/or quantitative data will be analyzed. Explain how the sample size is sufficient to achieve the study aims. This might include a formal power calculation or explanation of why a small sample is sufficient (e.g., qualitative research, pilot studies). Describe the provisions for monitoring the data to ensure the safety of participants. These plans could range from the investigator monitoring subject data for any safety concerns to a sponsor-based DSMB, depending on the study.

The research objective of this study is to determine if healthy volunteers safely exposed to low levels of O3 and DE alone or in combination, will show changes in cardiopulmonary endpoints including modest decrements in lung function. The study will follow a randomized, repeated measures design with each subject exposed to 4 different exposure regimens (see Figures 1 and 2 above). The data analysis will be focused on changes in lung function measurements, primarily FVC and FEV_1, between pre and post 2hr exposure for each exposure, but also blood endpoints include inflammatory factors (eg IL-6), blood clotting factors (eg fibrinogen), and susceptibility factors (eg specific genotypes such as glutathione-S-transferase M1 (GSTM1) null).

In evaluating exposure effects of O3 and DE, alone or in combination, upon lung function, the difference between the pre-exposure and post-exposure FEV1 will be calculated and the pre-post differences for the air and the exposures will be compared utilizing repeated measures ANOVA parametric test. Clinically significant change is determined to be a 10% decrease in FEV1 measured prior to and immediately after the exposure compared to the pre exposure value. For a conservative sample size calculation, we used one sided test for a single sample under the assumption of normal distribution with Type I error of 5% and Type II error of 20%. Therefore, a ρ value of 0.05 or less will be considered significant and the proposed sample size will provide adequate (80%) power for detecting a 10% decrease in ΔFEV1.

Sample size calculation was based on the Forced Expiratory Volume in 1 Second (FEV1) in response to the O3 exposure. Data for the power calculation were obtained from results of FEV_1 [42] for a constant acute exposure to 0.3 ppm O_3 versus clean air (CA). In 22 subjects, the pre exposure FEV_1 was 4.608 ± 0.514 (mean ± SEM) in CA exposure and 4.656 ± 0.592 in O_3. The post exposure FEV_1 was 4.64 ± 0.476 in CA exposure and 3.856± 0.687 in O_3. We used 0.687 as an estimate of standard deviation after

the ozone exposure and estimated 10% decrease in pre-exposure FEV1 levels to be 0.46 ml. Based on these data and the test for the mean of a normal distribution with a one-sided alternative the required sample size is 14 subjects. We will recruit 15 subjects for this study to ensure the statistical power that can analyze small differences expected from low concentration exposures.

Although EPA does not have an official Data Safety Monitoring Board, we do have measures in place to insure the safety of our subjects. Adverse events will be reported to Bob Truckner, the EPA/NHEERL human research protection officer of the IRB.

Precautions taken to minimize risk to the subject include:

1. subject monitoring via direct observation or CCTV during exposure
2. Cardiac function will be assessed throughout the exposures. Evidence in 2 individuals of a QTc interval >450 milliseconds (ms) will prompt a pause in the study. The length of the QT period was chosen as the primary endpoint to examine as a marker of cardiac toxicity in part based on this marker's use in Phase 1 Clinical Trials where possible cardiac toxicity was monitored via ECG. In addition, QTc interval increases greater than 60 ms from baseline will also prompt a pause in the study.
3. Pulse oximetry will be performed during the exposures and the subject withdrawn from the chamber if the oxygen saturation value is $\leq 92\%$.
4. Subjects will be aware of their right to terminate their participation in the study without prejudice.
5. Lung function will be monitored in the chamber during exposures using a portable spirometer. If FEV1 decreases by 40% from baseline, as measured by the portable spirometer, the subject will be removed from the chamber and the exposure will be terminated.

~~5.~~6. Any exposure will be stopped upon evidence of any adverse effects suffered by the subject during the exposure

~~6.~~7. Full resuscitation equipment will be available at all times during exposures and used if needed

~~7.~~8. In the event of an emergency, after initial medical assessment, patients will be transported to the UNC Hospitals Emergency Room for continued treatment

~~8.~~9. A formal pause to the study will be performed by the medical station staff after 4 subjects complete the 4 exposure regimes to assess whether highly adverse effects occurred with respect to lung and cardiac physiology responses. If no highly adverse effects are observed, the study will continue.

A.4.9. **Will you collect or receive any of the following identifiers?** Does not apply to consent forms.

__ No _x_ Yes *If yes, check all that apply:*

a. _x_ Names
b. _x_ Telephone numbers
c. _x_ Any elements of dates (other than year) for dates directly related to an individual, including birth date, admission date, discharge date, date of death. For ages over 89: all elements of dates (including year) indicative of such age, except that such ages and elements may be aggregated into a single category of age 90 and older
d. _x_ Any geographic subdivisions smaller than a State, including street address, city, county, precinct, zip code and their equivalent geocodes, except for the initial three digits of a zip code
e. __ Fax numbers
f. _x_ Electronic mail addresses
g. __ Social security numbers
h. _x_ Medical record numbers
i. __ Health plan beneficiary numbers
j. __ Account numbers
k. __ Certificate/license numbers
l. __ Vehicle identifiers and serial numbers (VIN), including license plate numbers
m. __ Device identifiers and serial numbers (e.g., implanted medical device)
n. __ Web universal resource locators (URLs)
o. __ Internet protocol (IP) address numbers
p. __ Biometric identifiers, including finger and voice prints
q. __ Full face photographic images and any comparable images
r. __ Any other unique identifying number, characteristic or code, other than dummy identifiers that are not derived from actual identifiers and for which the re-identification key is maintained by the health care provider and not disclosed to the researcher

A.4.10. **Identifiers in research data**. Are the identifiers in A.4.9 above linked or maintained with the research data?

__ yes __x no

A.4.11. **Confidentiality of the data**. Describe procedures for maintaining confidentiality of the data you will collect or will receive. Describe how you will protect the data from access by those not authorized. How will data be transmitted among research personnel? Where relevant, discuss the potential for deductive disclosure (i.e., directly identifying subjects from a combination of indirect IDs).

All individuals who have been granted access to the data to perform their research-related duties have received full ethics training. Computer data files are password protected and subjects are coded as an unrelated subject identifying number. The participant's actual identity cannot be ascertained exclusively from these data. The participant's name will not be used in any publications. Access to the records of this study will be provided by the identifying number only and given only to those individuals associated with the study who require access to the data to perform their duties. All such individuals will be bound by this agreement of confidentiality. All records are maintained in a locked room in the medical records office of the USEPA Human Studies Facility.

A.4.12. **Data sharing.** With whom will *identifiable* (contains any of the 18 identifiers listed in question A.4.9 above) data be shared outside the immediate research team? For each, explain confidentiality measures. Include data use agreements, if any.

_x_ No one
__ Coordinating Center:
__ Statisticians:
__ Consultants:
__ Other researchers:
__ Registries:
__ Sponsors:
__ External labs for additional testing:
__ Journals:
__ Publicly available dataset:
__ Other:

A.4.13. **Data security for storage and transmission.** Please check all that apply.

For electronic data stored on a desk top computer:
__x Secure network __x Password access __x Data encryption __x Password protected file(s)
__ Other comparable safeguard (describe):

For portable computing devices/external storage devices (e.g. laptop computer, PDA, CDs, memory sticks):
__x Power-on password __x Automatic log-off __x Data encryption __x Password protected file(s)
__ Other comparable safeguard (describe):

For hardcopy data (including human biological specimens, CDs, tapes, etc.):
__ Data de-identified by research team (stripped of the 18 identifiers listed in question A.4.9 above)
__ Locked suite or office __ x Locked cabinet
__x Data coded by research team with a master list secured and kept separately
__ Other (describe):

A.4.14. **Post-study disposition of identifiable data or human biological materials.** Describe your plans for disposition of data or human biological specimens that are identifiable in any way (directly or via indirect codes) once the study has ended. Describe your plan to destroy identifiers, if you will do so.

The study data will be archived with identifiers by storage in a locked closet in the secured USEPA HSF building. If offsite storage space is ever required for the data, the data will be transferred to offsite storage according to the USEPA's record keeping guideline.

Specimens from subjects who consent for his/her samples to be stored will remain stored in a repository and will be released to investigators for use. Specimens from subjects who opt not to allow for storage will be destroyed at the end of the study.

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Part A.5. The Consent Process and Consent Documentation (including Waivers)

The standard consent process is for all subjects to sign a document containing all the elements of informed consent, as specified in the federal regulations. Some or all of the elements of consent, including signatures, may be altered or waived under certain circumstances.

- If you will obtain consent in any manner, complete **section A.5.1**.
- If you are obtaining consent, but requesting a waiver of the requirement for a signed consent document, complete **section A.5.2**.
- If you are requesting a waiver of any or all of the elements of consent, complete **section A.5.3**.
- If you need to access Protected Health Information (PHI) to identify potential subjects who will then be contacted, you will need a *limited waiver of HIPAA authorization*. This is addressed in section B.2.

You may need to complete more than one section. For example, if you are conducting a phone survey with verbal consent, complete sections A.5.1, A.5.2, and possibly A.5.3.

A.5.1. **Describe the process of obtaining informed consent from subjects.**
Describe who will be obtaining consent (or permission) and from whom. Include discussion, as relevant, any waiting period between the initial consent discussion and obtaining consent, and steps that will be taken to minimize coercion or undue influence. If children will be enrolled as subjects, describe the provisions for obtaining parental permission and assent of the child. If decisionally impaired adults are to be enrolled, describe the provision for obtaining surrogate consent from a legally authorized representative (LAR). If non-English speaking people will be enrolled, explain how consent in the native language will be obtained. Address both written translation of the consent and the availability of oral interpretation. It is expected that the information in the consent document(s) will be communicated to participants or their LAR. *After you have completed this part A.5.1, if you are not requesting a waiver of any type, you are done with Part A.5.; proceed to Part B.*

Prior to participation, all volunteers will be required to read and sign the consent form which asserts that they have read and understood the following: 1.) Subject participation is strictly voluntary; 2.) The

purpose of the study; 3.) The nature and extent of subject participation; 4.) The subject's rights to withdraw at any time; 5.) The subject's right to privacy, 6.) The risks associated with participation; 7.) The method and schedule of compensation; and 8.) The limits of the EPA, University and PI's liability. The PI, co-PIs or study coordinator will briefly describe the study and answer any questions that each subject might have about the study. Subjects will have the opportunity to ask questions at any time during the study by contacting the PI and/or the study coordinators. The subject will be given a copy of the signed consent form for his/her records.

A.5.2. **Justification for a waiver of *written* (i.e., signed) consent**. *The default is for subjects to sign a written document that contains all the elements of informed consent.* Under limited circumstances, the requirement for a signed consent form may be waived by the IRB if either of the following is true. *Choose only one:*

a. The only record linking the subject and the research would be the consent document and the principal risk would be potential harm resulting from a breach of confidentiality (e.g., study topic is sensitive so that public knowledge of participation could be damaging). *Participants should be asked whether they want documentation linking them with the research and the participants' wishes will govern whether they sign the form.* Note: This justification cannot be used in FDA-regulated research. __ yes __ no __ yes __ no

Explain.

b. The research presents no more than minimal risk of harm to subjects and involves no procedures for which written consent is normally required outside of the research context (e.g., phone survey).

Explain.

If you checked "yes" to either (and you are not requesting a waiver in section A.5.3) consent must be obtained orally, by delivering a fact sheet, through an online consent form, or be incorporated into the survey itself. Include a copy of the consent script, fact sheet, online consent form, or incorporated document.

→ If you have justified a waiver of written (signed) consent (A.5.2), you should complete A.5.3 *only* if your consent process will not include all the other elements of consent.

A.5.3. **Justification for a full or partial waiver of consent.** *The default is for subjects to give informed consent.* A waiver might be requested for research involving only existing data or human biological specimens (see also Part C). More rarely, it might be requested when the research design requires withholding some study details at the outset (e.g., behavioral research involving deception). In limited circumstances, parental permission may be waived. This section should also be completed for a waiver of HIPAA authorization if research involves Protected Health Information (PHI) subject to HIPAA regulation, such as patient records.

__ Requesting **waiver of some elements** (specify; see SOP 28 on the IRB web site):
__ Requesting **waiver of consent entirely**

If you check either of the boxes above, answer items a-f.. To justify a full waiver of the requirement for informed consent, you must be able to answer "yes" (or "not applicable" for question c) to items a-f. **Insert brief explanations that support your answers.**

a. Will the research involve no greater than minimal risk to subjects or to their privacy? __ yes __ no

Explain.

b. Is it true that the waiver will *not* adversely affect the rights and welfare of subjects? *(Consider the right of privacy and possible risk of breach of confidentiality in light of the information you wish to gather.)* __ yes __ no
Explain.

c. When applicable to your study, do you have plans to provide subjects with pertinent information after their participation is over? *(e.g., Will you provide details withheld during consent, or tell subjects if you found information with direct clinical relevance? This may be an uncommon scenario.)* __ yes __ not applicable
Explain.

d. Would the research be impracticable without the waiver? *(If you checked "yes," explain how the requirement to obtain consent would make the research impracticable, e.g., are most of the subjects lost to follow-up or deceased?).* __ yes __ no
Explain.

e. Is the risk to privacy reasonable in relation to benefits to be gained or the importance of the knowledge to be gained? __ yes __ no
Explain.

If you are accessing patient records for this research, you must also be able to answer "yes" to item f to justify a waiver of HIPAA authorization from the subjects.

f. Would the research be impracticable if you could not record (or use) Protected Health Information (PHI)? *(If you checked "yes," explain how* not *recording or using PHI would make the research impracticable).* __ yes __ no
Explain.

Part B. Questions for Studies that Involve Direct Interaction with Human Subjects

→ *If this does not apply to your study, do not submit this section.*

B.1. **Methods of recruiting.** Describe how and where subjects will be identified and recruited. Indicate who will do the recruiting, and tell how subjects will be contacted. Describe efforts to ensure equal access to participation among women and minorities. Describe how you will protect the privacy of potential subjects during recruitment. *For prospective subjects whose status (e.g., as patient or client), condition, or contact information is not publicly available (e.g., from a phone book or public web site), the initial contact should be made with legitimate knowledge of the subjects' circumstances. Ideally, the individual with such knowledge should seek prospective subjects' permission to release names to the PI for recruitment. Alternatively, the knowledgeable individual could provide information about the study, including contact information for the investigator, so that interested prospective subjects can contact the investigator.* Provide the IRB with a copy of any document or script that will be used to obtain the patients' permission for release of names or to introduce the study. Check with the IRB for further guidance.

Subjects may be recruited for this study by the Westat Corporation, which has recruited for studies at the U.S. EPA HSF since 1998. The manner in which this will be done is similar to that of past U.S. EPA studies and specific recruitment procedures as per the previously UNC IRB-approved protocol, "Recruitment and Screening of Potential Subjects for EPA Studies" (95-0518; Howard Kehrl, PI). Subjects may be identified from mass emailing for recruits, website [https://www.epastudies.org/ with contact phone numbers listed as 919-966-0604 and toll free 888-279-9353] and newspaper and brochure advertising by Westat Corporation [a recent, advertisement brochure for subject recruitment is included as Attachment #2], and from the Westat database for subjects. These documents (email recruitment wording to current subjects from other studies and potentially new subjects , newspaper advertisement, a study description handout, study reminder notices to subjects, are attached in the appendix section of this application as Attachments 2-7. Every effort will be made to recruit women and members of racial minority groups into this study. Subjects will be asked to call the recruitment office. During the telephone interview, the subjects will receive information regarding the study and their eligibility for the study will be assessed. Subjects who provide responses which indicate that they are likely to meet the criteria will be scheduled for an appointment in the Westat recruitment office in the U.S. Human Studies Facility. At that time the study protocol will be outlined, and a medical history form will be administered.

B.2. **Protected Health Information (PHI).** If you need to access Protected Health Information (PHI) to identify potential subjects who will then be contacted, you will need a *limited waiver of HIPAA authorization*. If this applies to your study, please provide the following information and complete Section C.

a. Will the information collected be limited only to that necessary to contact the subjects to ask if they are interested in participating in the study?

b. How will confidentiality/privacy be protected prior to ascertaining desire to participate?

c. When and how will you destroy the contact information if an individual declines participation?

B.3. **Duration of entire study and duration of an individual subject's participation, including follow-up evaluation if applicable.** Include the number of required contacts and approximate duration of each contact.

This study will take approximately 18 months (actual study time) to complete. The study duration is based on 1-2 exposure days per week and 1 subject on each exposure day. This scheduling, however, is subject to change depending on the availability of study subjects and the number of concurrent studies requiring the same chamber facility.

All subjects will have at least 13 visits to the research facility over approximately 3 months. On the first visit, the subject will go through a consent process and then a training session for approximately 3 hours. During each of three subsequent visits (exposure days), subjects are required to check in by about 8:00 am and will be discharged approximately at 4:00 pm. Therefore, subjects will remain in the research facility for approximately 8 hours on exposure day 1. The following day, subjects are required to check in by 8:00 am and will be discharged approximately at 4:00 pm. Therefore, subjects will remain in the research facility for approximately 8 hours on exposure day 2. The 3rd day the subjects are required to check in by 8:00 am and will be discharged approximately at 11:00 am, for a total of approximately 3 hrs. Subjects will come back for the next 3 regimes following the same schedule for days 1-3 with 13 or more days between each regime. The total amount of time at this facility will be ~79 hr

B.4. **Where will the subjects be studied?** Describe locations where subjects will be studied, both on and off the UNC-CH campus.

All subjects will be studied in the USEPA Human Studies Facility located at 104 Mason Farm Road in Chapel Hill on the UNC Campus.

B.5. **Privacy.** Describe procedures that will ensure privacy of the subjects in this study. Examples include the setting for interviews, phone conversations, or physical examinations; communication methods or mailed materials (e.g., mailings should not indicate disease status or focus of study on the envelope).

All interviews and phone conversations will be conducted from either the Westat Recruiting office or the Medical Station in the U.S. EPA Human Studies Facility. This facility is guarded and only individuals working in the building have access beyond the guard's desk without an escort. Physical exams and other procedures will occur in appropriate clinical areas of the EPA. Occasionally 2 subjects may be seen in the clinical area at one time; however, sensitive information is only discussed in private (medication use, pregnancy test results). The subjects will be scheduled with the TRC (Chamber operators) group using a study number; however TRC only maintains a single separate log with the study number and the subject's number but not personal identifying information. Subjects may be contacted by email to schedule/remind them about study visits or to answer specific questions. Any information sent via US mail or campus mail will simply have a return address, no other study specific information.

B.6. **Inducements for participation.** Describe all inducements to participate, monetary or non-monetary. If monetary, specify the amount and schedule for payments and if/how this will be prorated if the subject withdraws (or is withdrawn) from the study prior to completing it. For compensation in

foreign currency, provide a US$ equivalent. Provide evidence that the amount is not coercive (e.g., describe purchasing power for foreign countries). Be aware that payment over a certain amount may require the collection of the subjects' Social Security Numbers. If a subject is paid more than $200.00 per year, collection of subjects' Social Security Number is required (University policy—see SSN Guidance) using the Social Security Number collection consent addendum found under forms on the IRB website (look for Study Subject Reimbursement Form).

Subjects will receive monetary compensation for their time ($12 per hour) and some procedures in the study (See below). In addition, subjects traveling from areas beyond Chapel Hill will be reimbursed for travel expenses commensurate with the US Government mileage rate in effect at the time. Parking will be provided or costs will be paid. Payments will be made after each segment of the study, unless the subject requests otherwise.

A subject who is unable to complete the study for voluntary reasons or failure to comply with eligibility requirements will receive full compensation for his/her participation up to that point. Subjects who are dismissed by the investigators after enrollment in the study but prior to completion for involuntary reasons will be compensated for his/her participation up to that point and will receive compensation at the hourly rate of $12 per hour for that particular scheduled 3 day study session.

In the event a scheduled study activity must be cancelled by the investigators with less than 72 hours prior notice, the subject will be paid at the standard hourly rate for the time scheduled and canceled, and will be paid 50% of procedure fees up to a total maximum of $100 for canceled procedures. Cancellations could occur due to adverse weather conditions, equipment failure, or other unforeseen events. When feasible, the subject will be rescheduled.

Money received by participants in research studies is normally treated as ordinary income by taxing authorities and payments made to you to the Internal Revenue Service as required by law. The money is not intended to coerce completion or participation, but to emphasize the importance of all the visits, and to signify the importance of your time and commitment to the research study.

Subject Compensation for Procedures during Diesel and Ozone Exposure Study

Training Day (assume 3 hr @$12/hr)	$36
First Exposure:	
Day 1	
Hourly payment (assume 8 hr @$12/hr)	$96
On-time bonus (8 a.m.)	$25
Stress questionnaire	$2.50
Blood Draw (twice)	$30
24 hr Urine Sample	$60
Exhaled breath and saliva collection (twice)	$10
24 hr Holter Monitoring	$100
24 hr Blood Pressure Monitoring	$50
Lung function (6x)	$60
Lunch	$5
Day 2	
Hourly payment (assume 8 hr @$12/hr)	$96

On-time bonus (8 a.m.)	$25
Blood Draw (twice)	$30
Urine Sample (3x)	$15
Exhaled breath and saliva collection (twice)	$10
24 hr Holter Monitoring	$100
24 hr Blood Pressure Monitoring	$50
Lung function (6x)	$60
Lunch	$5
Day 3	
Hourly payment (assume 3 hr @$12/hr)	$36
Blood Draw	$15
Exhaled breath and saliva collection	$5
Urine Sample	$5
Lung function	$10

[Total payment First Exposure]	$900.50
Second Exposure	$900.50
Third Exposure	$900.50
Fourth Exposure	$900.50
Completion Bonus (for completing all 4 exposure sessions)	$100
APPROXIMATE TOTAL (including training day)	$3,738.00

Other Possible Costs:
Extra Blood sticks ($10 each)
Extra hours ($12 per hour)
Travel from out of town (based on mileage)

B.7. **Costs to be borne by subjects.** Include child care, travel, parking, clinic fees, diagnostic and laboratory studies, drugs, devices, all professional fees, etc. If there are no costs to subjects other than their time to participate, indicate this.

There will be no cost to the subject excluding child and dependent care. Parking fees are covered by the study in the form of parking vouchers. All study related diagnostic tests such as pregnancy tests, pulmonary function test and labs are covered by the study. Westat subjects are primarily recruited from the Chapel Hill area. Volunteers who come from outside this area may be reimbursed for mileage at the current government rate.

University of North Carolina-Chapel Hill
Consent to Participate in a Research Study
Adult Subjects
Biomedical Form—

IRB Study # 09-1344 GCRC #: N/A
Consent Form Version Date: ~~July 30, 2010~~November 16, 2010

Title of Study: Cardiopulmonary Responses to Exposure to Ozone and Diesel Exhaust with Moderate Exercise in Healthy Adults
Principal Investigator: Tina Stevens, PhD
UNC-Chapel Hill Department: US Environmental Protection Agency
UNC-Chapel Hill Phone number: (919) 843-8031
Email Address: stevens.tina@epa.gov
Co-Investigators: Michael Madden, PhD; David Diaz-Sanchez, PhD; Howard Kehrl, MD
UNC-Chapel Hill Phone number: (919)966-6257, (919) 966-0676, (919) 966-6208
Email Address: madden.michael@epa.gov; diaz-sanchez.david@.epa.gov; kehrl.howard@epa.gov;
Faculty Advisor: N/A

Funding Source: US Environmental Protection Agency Intramural Federal Research

Study Contact telephone number: (919) 966-6257 (Michael Madden)
Study Contact email: madden.michael@epa.gov

What are some general things you should know about research studies?
You are being asked to take part in a research study. To join the study is voluntary. You may refuse to join, or you may withdraw your consent to be in the study, for any reason at any time.

Research studies are designed to obtain new knowledge that may help other people in the future. You may not receive any direct benefit from being in the research study. There also may be risks to being in research studies.

Your participation is voluntary. Deciding not to be in the study or leaving the study before it is completed will not affect your relationship with the researcher, your health care provider, or the University of North Carolina-Chapel Hill. If you are a patient with an illness, you do not have to be in the research study in order to receive health care.

Details about this study are discussed below. It is important that you understand this information so that you can make an informed choice about being in this research study. You will be given a copy of this consent form. You should ask the researchers named above, or staff members who may assist them, any questions you have about this study at any time.

What is the purpose of this study?

We breathe a complex mixture of air pollution, and ozone and diesel exhaust are generally the major and important components. Controlled exposures of volunteers to either pollutant have resulted in biological effects such as lung physiological changes. However it is not known if co-exposure to both pollutants, similar to inhaling polluted air, can induce effects than either pollutant alone. Additionally it is also uncertain if exposure to diesel exhaust alone, or diesel exhaust mixed with ozone, can alter the body's responses to breathing ozone the following day. This study proposes to examine whether exposure to both ozone and diesel exhaust can cause more of an effect than either pollutant alone. This study will also determine if breathing diesel exhaust can change a response upon exposure to ozone the day after. The purpose of this study is to measure cardiopulmonary responses in healthy young adults before, during, and after exposure to combinations of ozone (O3) and diesel exhaust for 2 hours with moderate exercise and to primarily investigate whether diesel exhaust modulates the O3-induced effects on the lung and cardiovascular systems.

This study will examine whether co-exposures to ozone and diesel exhaust, at doses in the upper range of those encountered in urbanized settings, can induce additive or synergistic effects, and whether a previous DE exposure alters a response upon subsequent exposure to ozone.

The data obtained from this study will contribute to the overall assessment of air pollution effects in the U.S. and thereby may influence future health policy. The ambient permissible concentrations of both ozone and diesel exhaust are currently regulated individually by the US EPA, but the Agency is moving towards regulating pollutant mixtures. Results from this study may increase the understanding of how gaseous and particulate air pollutants (which causes the haze seen in some polluted cities) may adversely affect the functioning of the heart, blood vessels, and lungs. This understanding may be especially important for patients with diseases of the heart and lungs.

Are there any reasons you should not be in this study?

You should not participate in this study if…

- You have a history of chest pain, irregular heart beats, a heart attack or coronary bypass surgery.
- You have a heart pacemaker.
- You have untreated high blood pressure (> 150 systolic, > 90 diastolic).
- You have a history of an EKG finding called QT/QT_C prolongation [a marked baseline prolongation of QT/QTc interval (e.g., repeated demonstration of a QTc interval > 450 milliseconds)]
- You have a history of lung disease and/or active allergy including: hay fever, dust allergies, rhinitis, asthma, chronic bronchitis, chronic obstructive pulmonary disease, tuberculosis, coughing up blood, recurrent pneumonia, chronic or allergic rhinitis or acute or chronic sinusitis.
- You cannot perform moderate exercise
- You cannot remain in a small exposure chamber for about 2 hours
- You are currently taking β-blockers (such as atenolol, metoprolol, propanolol, and acebutolol).
- You have a history of bleeding or coagulation disorders or are taking blood thinner medication.
- You are currently smoking or have a smoking history within 1 year of the study (defined as more than one pack of cigarettes in the past year) or have a greater than/equal to a 5 pack year smoking history.
- You are less than 18 years old or greater than 55 years old

- You have diabetes.
- You have cancer.
- You are currently taking estrogen replacement therapy.
- You are pregnant, attempting to become pregnant or breastfeeding.
- You have an allergy to latex.

Additionally, you should **NOT** participate if you are unable to comply with the following requirements:

- No over-the-counter pain medications such as aspirin, Advil, Aleve or other non-steroidal anti-inflammatory medications ("NSAIDS") for 48 hr prior to the exposure and post-exposure visits. Acetaminophen, eg, Tylenol, is permitted.
- Avoid smoke and fumes for 24 hours before all visits.
- Avoid drinking alcohol 24 hours before all visits.
- Avoid strenuous exercise for 24 hours prior to and after all visits.
- Eat a light breakfast on the exposure days.
- Not consume caffeine for 1-2 hours prior to the exposures on days 1 & 2 and post-exposure visits.
- Stop taking vitamin C or E or medications which may impact the results of the exposures at least 2 weeks prior to the study and for the duration of the study. Medications not specifically mentioned here may be reviewed by the investigators prior to your inclusion in this study.
- Avoid the use of ozone-based home air purifiers during study participation

How many people will take part in this study?

If you decide to be in this study, you will be one of approximately 15 people who will complete this research study.

How long will your participation in this study last?

You will have up to 13 visits to the research facility over approximately about 10 weeks if you are eligible for the study (see attached study design flow chart).

Your participation in this study will include one training session (today) for about 3 hours, 4 exposure regimens, each of which will consist of 2 consecutive exposure days and 1 follow-up visit approximately 18 hrs after the last exposure. Each exposure day will last approximately 8 hours and the follow-up visit will be approximately 3 hrs long. The 4 exposure regimens will occur at least 13 days apart.

Storage of some of your blood samples in this study may be indefinite.

What will happen if you take part in the study?

During the course of this study, the following will occur:

Training:

You should have already undergone a general physical examination to ensure that you are a candidate for this study. If you are a female participating in this study, you should have been asked about your menstrual history and will be given a pregnancy test.

Today's visit is expected to last about 3 hours. Today you will familiarize yourself with some of the techniques you will perform for the study. These include instructions on the use of the stationary bicycle to be used during the study, how to perform spirometry, on a portable spirometer and dry seal digital spirometer, how to give a saliva and an exhaled breath sample, ~~and an exhaled breath collection~~, and you will be shown the heart rate variability- (HRV) and blood pressure (BP) monitors.

After satisfactorily completing the training session, you will be scheduled for your first exposure through a company contracting with the US EPA (currently Westat).

You will be exposed to mixtures of air pollutants in 4 different regimens. Each regimen will last about 2 ½ days. During the regimens, a number of physiological and biochemical measurements will be made. **With your permission, during one of your blood draws DNA from your blood cells will also be genotyped for specific genes related to adverse health effects associated with air pollution exposure. Unwillingness to have samples genotyped will NOT exclude you from participating in this study. If you do not wish for your blood to be used for genotyping, but do wish to participate in the study, sign the section at the end of this consent form titled *Subject's Agreement to Participate in the Research Study WITHOUT Genoptyping Consent.* With your permission, we may also store some of your blood we obtain during the study for yet-to-be-determined tests in the future.**
You will have the opportunity to complete all 4 regimens separated by at least 2 weeks. The first day of each regimen you will be exposed to either clean air, diesel exhaust at about 300 micrograms of particles/meter^3, ozone at about 0.3 parts per million (ppm), or diesel exhaust mixed with ozone. The second day of the regimen, you will be exposed to approximately 0.3 ppm ozone. The third day of each regimen, you will not be exposed to any air pollutants, but will have follow up measurements made.

You may terminate your participation from this study at any time. You will be monitored for symptoms that you may develop during the exposure and over the following 24 hour period. The symptoms may include chest pain, difficulty breathing, light-headness, pale skin color, and significant irregular heart beats. In addition, analyses of blood samples taken after exposure will be monitored for abnormalities, including signs of cell damage, changes in clotting factors, as well as increases in inflammation. The study physicians will stop the study if symptoms and/or changes detected in the blood samples that are considered clinically significant.

Below is a description of what will be required from you and a summary of the measurements to be made on you on each day of each exposure regimen:

Day 1:

We will call you a few days before the exposure session to remind you of your scheduled visit. We will also remind you to refrain from alcohol, NSAID medications, excessive amounts of caffeine, and from any activities where you could be exposed to high levels of pollutants (e.g.,

cigarette smoke, paint fumes) for a couple of days before your visit. Please report any pollutant exposure to the study personnel so you can be rescheduled if necessary. You will be rescheduled if you have experienced a respiratory tract illness within the past 4 weeks or any other illness within the past week.

You will be asked to eat a light breakfast and arrive at the EPA medical station at approximately 8 am. There will be an on-time bonus of $25 for arriving by 8:05 a.m. You will need to wear comfortable clothes and shoes and bring a change of clothes.

Pre-exposure measurements:

Prior to the day 1 exposures, you will be asked to do the following:

- Answer a questionnaire on stress
- Have your vital signs checked (heart rate, respiratory rate, blood pressure, and oxygen saturation level, and for women, a pregnancy test).
- Have your baseline heart rate viability (HRV) measured by a Holter monitor. You will have several ECG leads attached to your chest. It may be necessary to clean and shave the areas of your chest where these leads will be placed. Excessive deodorant, skin lotions, and body sprays may interfere with the function of some of these leads so we will ask you not apply these to your chest area on the day you report to the HSF. The leads will be connected to 2 monitors (small recording devices about the size and weight of a portable tape player) to obtain readings of your heart rate and rhythm. One of these monitors will be removed at the end of the day and the other monitor may be kept on you for the next two days and will be removed on Day 3 of the exposure session. You will be asked to recline quietly and breathe at a constant rate for 20 minutes, after which the ECG monitor will take a 10-minute measurement of your heart rhythm. It is important that you do not fall asleep during this 30-minute period. The morning of the follow up visit (Day 3), there may be a 30 minute measurement of your heart rate and then the monitor will be removed.
- Blood pressure (BP) may be measured intermittently by a BP monitor. A blood pressure cuff and a monitor which is about the size of the Holter monitor may be fitted and will remain in place most of the time until Day 3. You will be asked to keep your arm relaxed and still when the pressure cuff is inflating.
- Have about 25 ml blood drawn (~5 teaspoons).
- Have a breathing test (spirometry). You will breathe through a filter into the machine. We will coach you, and you will be asked to take a full breath in and then blow it out as hard and fast as you can. We will ask you to do this several times. <u>This procedure will be repeated on a portable devise as well.</u>
- Be asked to provide a urine sample; if you are female it will be tested to see if you are pregnant.
- We will collect your breath <u>and saliva</u>.
- You will be asked to collect your urine for the next 24 hrs
- <u>Have a second breathing test on a portable spirometry instrument, but in a similar manner as the first.</u>

During the Day 1 exposure you will:

- Enter an exposure chamber.
- Be exposed to clean air or air pollutants for 2 hours. You will be asked to perform intermittent moderate exercise in an exposure chamber.
- At certain times during the exposure, you may be asked to breathe into a mouthpiece so that your rate of breathing can be measured. In addition, you will be asked to breathe into a portable spirometer so that your lung function can be measured. Exposure may be terminated if you show a larger than expected decrement in lung function. A staff member will be seated outside the chamber to observe you at all times and a physician will be available during the entire exposure session. During the exposure, your heart rhythm and rate, blood pressure, and the amount of oxygen in your blood will be monitored. If it appears you are having heart rhythm or breathing problems, or you develop a severe headache, nausea or vomiting the exposure will be terminated immediately.

Immediately following the Day 1 exposure you will:

- Have your vital signs checked.
- Perform spirometry. You will breathe through a filter into the machine. We will coach you, and you will be asked to take a full breath in and then blow it out as hard and fast as you can. We will ask you to do this several times about 1 assessment each hour
- We will collect your breath and saliva
- You will recline quietly for 20 minutes, after which the ECG monitor will take a 10-minute measurement of your heart rhythm.
- Have blood drawn (about 25 ml; ~5 teaspoons).
- Provide a urine sample.

Later in the day, you will:

- Have spirometry assessed for up to 4 hr post exposure
- Be assessed for adverse responses and discharged by the nursing staff. You will spend about 8 hours at the EPA facility.
- You will be given a cooler containing 1 L plastic bottles and verbal instructions for how to collect and record the time of the urine samples.

Importantly, because you will be asked to wear the portable ECG monitor attached to your chest and a blood pressure monitor cuff on your arm for the following two nights, we will give you instructions on how to care for and remove the monitors when necessary.

Day 2:

You will return to the HSF the next morning at 8:00 a.m. and you will perform testing similar to the first day.

Pre-exposure measurements and procedures will be performed as on Day 1, with the exception of the stress questionnaire. You will then enter the exposure chamber.

During the exposure on Day 2 you will be exposed to ozone at a concentration of approximately 0.3 ppm for 2 hours with intermittent moderate exercise in an exposure chamber. Again, your heart rhythm and rate, blood pressure, the amount of oxygen in your blood, your breathing rate, and lung function will be monitored while you are inside the chamber.

- **Similar measurements and procedures will be performed with you during and following the Day 2 exposure as on Day 1.** However, you will only be asked to collect spot urine samples at the EPA facility.You will be assessed for adverse responses and you will be discharged by the nursing staff. You will spend about 8 hours at the EPA facility.

Day 3:

Follow up Visit:
Similar procedures and measurements will be made as the pre-exposure measurements of the two previous days. The Holter monitor attached to you will be removed. You will be assessed for adverse responses and you will be discharged by the nursing staff. You will spend about 3 hours at the EPA facility.

If there are remaining samples after our analysis, we would like to continue to store your samples for as yet undesignated studies. This allows us to make the best use of the samples we collect from you. You will be given a separate consent form for this storage, and you do not have to allow your samples to be stored in order to participate in this study.

What are the possible benefits from being in this study?
You will not benefit directly from being in this research study, though by participating in screening for this study you will have received a medical examination that included blood work, respiratory test, and ECG monitoring of heart at no charge. However, this is not a substitute for a routine doctor visit. The medical staff will explain to you any remarkable findings regarding your overall health status. In addition, if we observe changes in your health status as a consequence of exposure to air pollutants, you may elect to use this information to avoid exposure on high pollution days.

This research is designed to benefit society in general by gaining new knowledge. Given that every member of American society is currently exposed to these pollutants, this study has the potential to contribute to devising effective strategies aimed at protecting millions from the untoward effects of these pollutants.

What are the possible risks or discomforts involved with being in this study?
This study might involve the following risks and/or discomforts to you:
If you have any tendency to become uncomfortable in small closed spaces, it is possible that you may become uncomfortable during this study. You will be taken to the exposure chamber when you are first evaluated for suitability for the study to allow you an opportunity to see where you will sit and what the chamber looks like.

Diesel exhaust exposure: Exposure to air pollution particles can cause cough, shortness of breath, chest discomfort, eye irritation, and headache. These symptoms typically last no more than a few hours, but could last longer if you are especially sensitive. Eye wear protection goggles are available during the exposures to reduce possible eye irritation. There is a chance that exposure to particles can increase the likelihood that you will be more likely to come down with a respiratory infection within several days of the exposure. Diesel exhaust, even when diluted in this study, may have an unpleasant odor. Exposure to the air pollution particle concentrations used in this study for short periods of time has not been found to cause permanent health effects. However, some studies suggest that older people, particularly those with underlying cardiovascular diseases, are at increased risk for getting sick and even dying during episodes of high air pollution. While we can not exclude the possibility that you may have an adverse reaction to breathing these exhausts, you will only be exposed to them for 2 hours. You could be potentially inhale a similar amount if you visited a large city such Los Angeles, New York, or Mexico City on a smoggy day.

You will be monitored continuously during the exposure session through a window in the chamber or by closed-circuit television, and can communicate with a staff member via an intercom. Your heart rate and rhythm will also be constantly monitored for any adverse changes brought about by the exposure. A licensed physician is always on the premises (i.e., within the building facility) during exposures, and is available to respond in an emergency.

Ozone exposure: Potential risks may include mild decrements in lung function spirometric volume~~airway obstruction~~, irritation to the nose, eyes, throat and airways, pain on deep inspiration and cough. These symptoms typically disappear 2 to 4 hours after exposure, but may last longer for particularly sensitive people. Ozone may induce an inflammatory reaction that may last for about 24 hours after exposure and may increase your chance of catching a cold.

Diesel exhaust and ozone exposure combined: Because this exposure scenario has not been conducted at our facilities or elsewhere before, we do not yet know whether or not this exposure will include the same risks as diesel exhaust and ozone exposures alone. It is possible that the combination of diesel exhaust and ozone exposures will increase the effects of each pollutant individually, and it is also possible that it will not. We are doing this study in order to find out the answer.

Heart rhythm monitoring: There is little risk associated with monitoring your heart by ECG or blood oxygen by pulse oximetry. However, preparing your skin for placement of ECG electrodes and removing the electrodes the next day may cause some irritation or skin discoloration, itching, or burning in some people. If this occurs during your visit, you should tell

the nursing staff. If irritation occurs while you are home, you should remove the electrodes, wash gently with mild soap and water, and tell the study coordinator or nursing staff in the morning.

Blood pressure monitoring: Similar to the regular blood pressure measurement, the risk associated with blood pressure monitor is considered minimal.

Venous blood sampling: The risks associated with taking blood samples are considered minimal. A well-trained member of the staff will draw the blood. Drawing blood could cause some bruising or minor pain, which usually resolves quickly. Occasionally fainting or light-headedness occurs, and injury is minimized by having you seated. Also, a rare complication is skin infection or an infection of the vein in which the blood has been drawn. The risk of getting infection is minimized by the use of sterile technique. If you do have signs of infection at the site (redness, warmth, painful skin, and swelling) after completion of the procedure, you will need to contact the EPA medical station.

Exhaled breath collection: Minimal risk is associated with these procedures. Sensitive individuals may become light-headed. You will be seated in a chair during collections and technicians are always available during this procedure in case you become light-headed.

Breathing tests (spirometry): You may cough or become dizzy during these tests. You will be seated in a chair, and if these symptoms occur, they are usually only temporary. You will be exposed to a low dose of acetylene for a brief period of time (single breath in and breath out), thus the risk will be quite low.

In addition, there may be uncommon or previously unrecognized risks that might occur. If you do notice any unusual symptoms occurring during the study you should call the EPA medical station or the on-call physician to report them. We will give the number of the physician on-call before you leave the building.

Genotyping: If given permission to collect genetic information, a federal law called the Genetic Information Nondiscrimination Act (GINA) generally makes it illegal for health insurance companies, group health plans and most employers to discriminate against you based on your genetic information. GINA does not protect you against genetic discrimination by companies that sell life insurance, disability insurance or long term care insurance. GINA dose not protect you against discrimination based on an already diagnosed genetic condition or disease.

What if we learn about new findings or information during the study?

You will be given any new information gained during the course of the study that might affect your willingness to continue your participation.

How will your privacy be protected?

You will be given a study code number. All electronic documents will only have that number. The paper records that the coordinators and medical doctors use may have your name. Your information can be linked to your personal information by the study number, however only study

personnel have access to your personal information. Paper records that use your name are kept in a locked file cabinet in the EPA Medical Station of the Human Studies Facility. The Medical Station is locked when not attended by study staff, and the EPA Human Studies Facility has limited access to authorized individuals only, 24 hours/day for 7 days/week. Blood samples will be stored at the EPA Human Studies Facility.

Research studies may be done at many places at the same time. Your personal identifying information will never be sent to outside researchers.

No subjects will be identified in any report or publication about this study. Although every effort will be made to keep research records private, there may be times when federal or state law requires the disclosure of such records, including personal information. This is very unlikely, but if disclosure is ever required, UNC-Chapel Hill will take steps allowable by law to protect the privacy of personal information. In some cases, your information in this research study could be reviewed by representatives of the University, research sponsors, or government agencies for purposes such as quality control or safety.

What will happen if you are injured by this research?

All forms of human health research involve some risk of injury or illness. Despite our high level of precaution, you may develop an injury or illness due to participating in this study. If you develop an injury or illness determined by an appointed US EPA physician to be due to your participation in this research, the US EPA will reimburse your medical expenses to treat the injury or illness up to $5000. If you believe your injury or illness was due to a lack of reasonable care or other negligent action, you have the right to pursue legal remedy. The Federal Tort Claims Act, 28 U.S.C. 2671 et. Seq., provides for money damages against the United States when personal injury or property loss results from the negligent or wrongful act or omission of any employee of the EPA while acting within the scope of his or her employment. Signing this consent form does not waive any of your legal rights or release the investigator, the sponsor, the institution, or its agents from liability for negligence.

If a research related injury or illness occurs, you should contact the Director of the EPA NHEERL Human Research Protocol Office at (919) 966-6217.

What if you want to stop before your part in the study is complete?

You can withdraw from this study at any time, without penalty. The investigators also have the right to stop your participation at any time. This could be because you have had an unexpected reaction, or have failed to follow instructions, or because the entire study has been stopped.

Will you receive anything for being in this study?

You will be paid approximately $12 per hour for your participation in this study and the total compensation for completion of this study will be approximately $3,738.00

We will give you parking coupons to cover the cost of parking. If you live beyond Chapel Hill you will be reimbursed for mileage at the US Government mileage rate in effect at the time. Money received by participants in research studies is normally treated as ordinary income by taxing authorities and we will report payments made to you to the Internal Revenue Service as required by law. Payments totaling more than $600 in a year from a single or multiple EPA

studies will be reported to the IRS. This summary is to emphasize the importance of all the visits, and to signify the importance of your time and commitment to the research study. Below is a detailed list of compensation for the entire study.

Subject Compensation for Procedures during Diesel and Ozone Exposure Study

Training Day (assume 3 hr @$12/hr)	$36
First Exposure:	
Day 1	
Hourly payment (assume 8 hr @$12/hr)	$96
On-time bonus (8 a.m.)	$25
Stress questionnaire	$2.50
Blood Draw (twice)	$30
24 hr Urine Collection	$60
Exhaled breath and saliva collection (twice)	$10
24 hr Holter Monitoring	$100
24 hr Blood Pressure Monitoring	$50
Lung function (6x)	$60
Lunch	$5
Day 2	
Hourly payment (assume 8 hr @$12/hr)	$96
On-time bonus (8 a.m.)	$25
Blood Draw (twice)	$30
Urine Sample (3x)	$15
Exhaled breath and saliva collection (twice)	$10
24 hr Holter Monitoring	$100
24 hr Blood Pressure Monitoring	$50
Lung function (6x)	$60
Lunch	$5
Day 3	
Hourly payment (assume 3 hr @$12/hr)	$36
Blood Draw	$15
Exhaled breath and saliva collection	$5
Urine Sample	$5
Lung function	$10
[Total payment First Exposure]	$900.50

Second Exposure	$900.50
Third Exposure	$900.50
Fourth Exposure	$900.50
Completion Bonus (for completing all 4 exposure sessions)	$100
APPROXIMATE TOTAL (including training day)	$3,738.00

Additional blood draws ($10 each)
Additional hours ($12 per hour)

You should understand that your participation is voluntary. You may terminate your participation in the study at any time without penalty. If you voluntarily elect to withdraw from the study at any time or you fail to maintain compliance with eligibility requirements, you will be paid for that portion of the study that has been completed. Subjects who are dismissed by the investigators after enrollment in the study but prior to completion for involuntary reasons, will be compensated for his/her participation up to that point and will receive compensation at the hourly rate of $12 per hour for the scheduled 3 day study session for a total of $228.

In the event a scheduled study activity must be cancelled by the investigators with less than 72 hours prior notice, the subject will be paid at the standard hourly rate for the time scheduled and canceled, and will be paid 50% of procedure fees up to a total maximum of $100 for canceled procedures. You will be paid in full for any procedures that may have been started during the current visit. Cancellations could occur due to adverse weather conditions, equipment failure, or other unforeseen events. When feasible, you will be rescheduled.

Will it cost you anything to be in this study?

There will be no cost to you for participating in the study. However, if you are deemed not eligible to participate in the study for medical reasons, we may suggest that you seek follow-up care from your own health care provider for abnormalities discovered during the screening history, physical examination, or the study. **Such care is entirely at your own expense. EPA will not provide reimbursement for any follow-up care.**

All study procedures will be paid for by the study. We will give you parking coupons to cover the cost of parking. If you live beyond Chapel Hill you will be reimbursed for mileage at the US Government mileage rate in effect at the time.

This study will take approximately 10 weeks to complete. The study duration is based on 4 exposure regimes separated by at least 2 weeks. The total amount of time at this facility will be ~79 hr.

What if you are a UNC student?
You may choose not to be in the study or to stop being in the study before it is over at any time. This will not affect your class standing or grades at UNC-Chapel Hill. You will not be offered or receive any special consideration if you take part in this research.

What if you are a UNC employee?
Taking part in this research is not a part of your University duties, and refusing will not affect your job. You will not be offered or receive any special job-related consideration if you take part in this research.

Who is sponsoring this study?
This research is funded by The U.S. Environmental Protection Agency. This means that the research team is being paid by the sponsor for doing the study. The researchers do not, however, have a direct financial interest with the sponsor or in the final results of the study.

What if you have questions about this study?
You have the right to ask, and have answered, any questions you may have about this research. If you have further questions regarding this study, you should call one of the listed investigators:
Michael Madden, PhD 919-966-6257 Tina Stevens, PhD 919-843-8031

If you feel a research-related injury has occurred, please contact the HSF medical station or one of the investigators listed above. In addition, you should contact the Human Studies Division Human Research Officer and Director of the National Health Effects and Environmental Research Laboratory Human Research Protocol Office at 919-966-6217.

What if you have questions about your rights as a research subject?
All research on human subjects is reviewed by a committee that works to protect your rights and welfare. If you have questions or concerns about your rights as a research subject you may contact, anonymously, if you wish, the Institutional Review Board at 919-966-3113 or by email to IRB_ subjects@unc.edu and/or the EPA Director of the National Health and Environmental Effects Human Research Laboratory Protocol Office at 919-966-6217.

- -

IRB Study #_09-1344___ **Title of Study:** Cardiopulmonary Responses to Exposure to Ozone and Diesel Exhaust with Moderate Exercise in Healthy Adults

Principal Investigator: Tina Stevens, PhD

Subject's Agreement to Participate in the Research Study WITHOUT Genotyping Consent

I have read the information provided above. I have asked all questions I have at this time. I voluntarily AGREE to participate in this study and I REFUSE to have my cells genotyped for any genes decided by the study investigators.

_____ _____
Signature of Research Subject Date

_____
Printed Name of Research Subject

_____ _____
Signature of Person Obtaining Consent Date

_____
Printed Name of Person Obtaining Consent

.....

Subject's Agreement to Participate in the Research Study Genotyping Consent

I have read the information provided above. I have asked all questions I have at this time. I voluntarily AGREE to participate in this study and I voluntarily AGREE to have my cells genotyped for any genes decided by the study investigators to be related to adverse health effects associated with pollution exposure.

_____ _____
Signature of Research Subject Date

_____
Printed Name of Research Subject

_____ _____
Signature of Person Obtaining Consent Date

_____
Printed Name of Person Obtaining Consent

University of North Carolina at Chapel Hill
Consent for Storing Biological Specimens With Identifying Information

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IRB Study # 09-1344
Consent Form Version Date: 11/16/10~~9/29/09~~

Title of Study: Cardiopulmonary Responses to Exposure to Ozone and Diesel Exhaust with Moderate Exercise in Healthy Adults

Principal Investigator: Tina Stevens, PhD

UNC-Chapel Hill Department: N/A
UNC-Chapel Hill Phone number: (919)843-8031, **Fax:** 919-966-6367
Email Address: stevens.tina@epa.gov

Co-Investigators: Michael Madden, PhD; David Diaz-Sanchez, PhD Howard Kehrl, MD
stevens.tina@epa.gov;~~;~~ Diaz-Sanchez.David@.epa.gov; kehrl.howard@epa.gov;

Funding Source and/or Sponsor: US Environmental Protection Agency Intramural Federal Research

Study Contact telephone number: (919) 966-6257 (Michael Madden)
Study Contact email: madden.michael@epa.gov

What are some general things you should know about research?
Research is designed to gain scientific information that may help other people in the future. You may not receive any direct benefit from participating. There also may be risks.

You may refuse to take part in research.

Details are discussed below. It is important that you understand this information so that you can make an informed choice. You will be given a copy of this consent form. You should ask the researchers named above, or staff members who may assist them, any questions you have about this study at any time.

What is the purpose of this specimen repository or "biobank?"
Research with blood, tissue, cells or body fluids (specimens) can help researchers understand how the human body works. Research can also answer other questions by using specimens. Researchers may develop new tests to find diseases, or new ways to treat diseases. In the future,

research may help to develop new products, such as drugs. Specimens are commonly used for genetic research. Sometimes researchers collect and store many specimens together and use them for different kinds of research, or share them with other scientists; this is called a specimen repository or "biobank."

All specimens for this study will be labeled with your study subject number that does not include personal identification information and will be stored in a repository where only project members will have access to the specimens. There is a need to store specimens in such a repository because this will be an ongoing study where specimens from subjects will be collected over an extended period of time. Storing of specimens allows for all specimens to be processed at the same time.

It also makes it possible to keep any remaining specimens in our biobank indefinitely and allows our scientists the opportunity to further study these specimens with as yet unknown questions and techniques. Research studies and questions in which the specimens may be used have not yet been determined. These studies may involve genetic research. Genetic research is about finding the specific location of genes, learning how genes work, and investigating relationships between a certain gene and the environment or people's habits and diets, and different diseases.

How will the specimens be collected?

Your specimens will be collected during the research study listed on the first page of this consent. No additional specimens will be collected from you.

What will happen to the specimens?

Study specimens will be stored in a secure room with restricted access at the U.S. Environmental Protection Agency Human Studies Facility located in Chapel Hill, North Carolina. The specimen will be prepared, labeled with the study subject identification number, and stored indefinitely in a freezer for future testing under *IRB# 07-1768, Repository for Storage of Human Specimens*. Names of subjects associated with ID numbers will be archived and locked; only medical and scientific personnel directly associated with this study will have access to this information. No personal identifying information will be attached to the biologic fluid specimen. Portions of the specimen may be shared with researchers at other scientific institutions, however, only coded specimens will be sent and the investigator will employ a data use agreement. Under no circumstances will any identifying information be sent along with specimens. The decision to destroy the specimens may be made by the investigator or by you if you notify the investigator in writing that you no longer want the specimens stored.

What are the possible benefits to you?

Benefits to you are unlikely. Research is designed to benefit society by gaining new knowledge. You will not benefit personally from having your specimens stored in this biobank.

What are the possible risks or discomforts involved with the use of your specimens?

Risk of breach of confidentiality is minimal. You will be assigned a study number which will be used for data – not your name. The study number is all that will be entered into computer databases. All paper files which may contain your name or screening number are secure in locked file cabinets in the EPA building which has limited access 24 hours/day. A numeric coding system will be used to ensure that you cannot be directly identified from the specimens alone. If we collect genetic information from the stored specimens, there is also a potential risk for some of your relatives and other members of your ethnic group, since they share some of your genetic makeup.

Will there be any cost to you for storage of the specimens?

There will be no cost to you for the storage and use of the specimens for research purposes.

Will you receive anything for the use of your specimens?

You will not receive any additional compensation for having your specimens stored in this biobank.

Who owns the specimens?

Any blood, body fluids, cell or tissue specimens obtained for the purpose of this study become the exclusive property of The U.S. Environmental Protection Agency and will be stored under *IRB# 07-1768, Repository for Storage of Human Specimens*. The researchers may retain, preserve or dispose of these specimens and may use these specimens for research that may result in commercial applications. There are no plans to compensate you for any future commercial use of these specimens.

How will your privacy be protected?

You will be assigned a study identification number. Names of subjects associated with ID numbers will be archived and locked; only medical and scientific personnel associated with this study will have access to this information. No personal identifying information will be attached and/or recorded in the data log sheets, biologic specimens, or electronic data sets. No subjects will be identified in any report or publication about this study. Although every effort will be made to keep research records private, there may be times when federal or state law requires the disclosure of such records, including personal information. This is very unlikely, but if disclosure is ever required, the U.S. Environmental Protection Agency and UNC-Chapel Hill will take steps allowable by law to protect the privacy of personal information. In some cases, your information in this research study could be reviewed by representatives of the University, research sponsors, or government agencies for purposes such as quality control or safety.

Study specimens will be stored in a secure room with restricted access. The sample will be prepared and stored indefinitely in a freezer for future testing. Portions of the specimens may be shared with researchers at other scientific institutions, however, only coded specimens will be sent. Under no circumstances will any identifying information be sent along with specimens to outside investigators. All medical records generated during this study will be kept in the medical records office at the EPA Human Studies Facility. The Medical Station is locked when not

attended by study staff, and the EPA Human Studies Facility has limited access to authorized individuals only, 24 hours/day for 7 days/week.

If genetic information is obtained from your stored specimens, A Federal law called the Genetic Information Nondiscrimination Act (GINA) generally makes it illegal for health insurance companies, group health plans, and most employers to discriminate against you based on your genetic information. GINA does not protect you against genetic discrimination by companies that sell life insurance, disability insurance, or long-term care insurance. GINA also does not protect you against discrimination based on an already-diagnosed genetic condition or disease.

Will researchers seek approval from you to do future studies involving the specimens?
By signing this consent form, you are giving your permission for researchers to use your specimens as described above. Current and future research is overseen by a committee called the Institutional Review Board (IRB). The role of the IRB is to protect the rights and welfare of research participants. In some cases, the IRB may require that you be re-contacted and asked for your consent to use your specimens in a specific research study. You have the right, at that future time, not to participate in any research study for which your consent is sought. Refusal to participate will not affect your medical care or result in loss of benefits to which you are entitled.

Will you receive results from research involving your specimens?
Most research with your specimens is not expected to yield new information that would be meaningful to share with you personally. There are no plans to re-contact you or other subjects with information about research results.

Can you withdraw the specimens from the research repository?
If you decide that you no longer wish for the specimens to be stored, you should contact the researchers on the front page of this form. It is best to make your request in writing.

Any analysis in progress at the time of your request or already performed prior to your request being received by the researcher will continue to be used as part of the research study. Once the researchers have been notified, your remaining specimens would be destroyed. If you do not make such a request, the specimens may be stored forever. The researchers may choose to destroy the specimens at any time.

What will happen if you are injured by this research?
All forms of human health research involve some risk of injury or illness. Despite our high level of precaution, you may develop an injury or illness due to participating in this study. If you develop an injury or illness determined by an appointed US EPA physician to be due to your participation in this research, the US EPA will reimburse your medical expenses to treat the injury or illness up to $5000. If you believe your injury or illness was due to a lack of reasonable care or other negligent action, you have the right to pursue legal remedy. The Federal Tort Claims Act, 28 U.S.C. 2671 et. Seq., provides for money damages against the United States when personal injury or property loss results from the negligent or wrongful act or omission of any employee of the EPA while acting within the scope of his or her employment. Signing this

consent form does not waive any of your legal rights or release the investigator, the sponsor, the institution, or its agents from liability for negligence.

If a research related injury or illness occurs, you should contact the Director of the EPA NHEERL Human Research Protocol Office at (919) 966-6217.
~~All research involves a chance that something bad might happen to you. This may include the risk of personal injury. In spite of all safety measures, you might develop a reaction or injury from having your specimen collected. If such problems occur, the researchers will help you get medical care, but any costs for the medical care will be billed to you and/or your insurance company. The University of North Carolina at Chapel Hill nor the United States Environmental Protection Agency has not set aside funds to pay you for any such reactions or injuries, or for the related medical care. However, by signing this form, you do not give up any of your legal rights.~~

Who is sponsoring this research?
This research is funded by the United States Environmental Protection Agency. Several of the investigators including the Principal Investigator are federal employees. The researchers do not, however, have a direct financial interest in the final results of the study.

What if you have questions about this research?
You have the right to ask, and have answered, any questions you may have about this research. If you have questions, you should contact the researchers listed on the first page of this form.

What if you have questions about your rights as a research subject?
All research on human volunteers is reviewed by a committee that works to protect your rights and welfare. If you have questions or concerns about your rights as a research subject you may contact, anonymously if you wish, the Institutional Review Board at 919-966-3113 or by e-mail to IRB_ subjects@unc.edu. You may also contact the Director of the EPA NHEERL Human Research Protocol Office at 919-966-6217.

Title of study: Cardiopulmonary Responses to Exposure to Ozone and Diesel Exhaust with Moderate Exercise in Healthy Adults

Principle investigator: Tina Stevens, PhD

Subject's Agreement:

I have read the information provided above. I have asked all the questions I have at this time. I voluntarily agree to participate. I agree to my specimen(s) being stored with the identifying code(s).

Signature of Research Subject _____ Date _____

Printed Name of Research Subject _____

Signature of Research Team Member Obtaining Consent _____ Date _____

Printed Name of Research Team Member Obtaining Consent _____

Attachment #1 The Sheldon Cohen Self-Perceived Stress Questionnaire (from www.mindgarden.com)

Perceived Stress Scale

The questions in this scale ask you about your feelings and thoughts **during the last month**. In each case, you will be asked to indicate by circling *how often* you felt or thought a certain way.

Name _____ Date _____

Age _____ Gender (*Circle*): M F Other _____

0 = Never 1 = Almost Never 2 = Sometimes 3 = Fairly Often 4 = Very Often

1. In the last month, how often have you been upset because of something that happened unexpectedly?	0	1	2	3	4
2. In the last month, how often have you felt that you were unable to control the important things in your life?	0	1	2	3	4
3. In the last month, how often have you felt nervous and "stressed"?	0	1	2	3	4
4. In the last month, how often have you felt confident about your ability to handle your personal problems?	0	1	2	3	4
5. In the last month, how often have you felt that things were going your way?	0	1	2	3	4
6. In the last month, how often have you found that you could not cope with all the things that you had to do?	0	1	2	3	4
7. In the last month, how often have you been able to control irritations in your life?	0	1	2	3	4
8. In the last month, how often have you felt that you were on top of things?	0	1	2	3	4
9. In the last month, how often have you been angered because of things that were outside of your control?	0	1	2	3	4
10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?	0	1	2	3	4

Protocol title: "Cardiopulmonary Responses to Exposure to Ozone and Diesel Exhaust with Moderate Exercise in Healthy Adults"; T. Stevens PI

July 27, 2009 version

Attachment# 2 Newspaper Advertisement from Westat Inc, the recruitment contractor for US EPA Studies

The US Environmental Protection Agency is seeking

Adult Volunteers

For Research Study

Now recruiting healthy non-smoking adults ages 18 to 55 for a study about ozone, diesel exhaust & exercise. Study requires screening plus 13 visits over about 10 weeks and pays up to $3,558.

919-966-0604 or **1-888-279-9353**
www.epastudies.org

The Human Studies Facility is located on the UNC-CH campus

Attachment# 3 Web Site Announcement of this specific Study (IRB# 09-1344) at the US EPA Studies Webpage (www.epastudies.org)

DEPOZ Study, IRB Study #09-1344
Web Site Announcement
www.epastudies.org

DEPOZ

What is the purpose of the research study?

The purpose of this research is to find out how the air pollution that causes the haze seen in some polluted cities affects the heart, blood vessels and lungs of healthy adults.

Can I take part in the study?
You may be able to be in the study if you

- Are between 18 and 55 and
- Do not smoke and
- Do not have any heart or lung problems

What will I be asked to do?

- Have a free physical exam
- Have blood drawn
- Take part in several different breathing tests, including spirometry (explanation link provided)
- Have your heart rate (explanation link provided) and blood pressure monitored
- Use an exercise bike during testing
- Come in for a training visit, and then come in 3 days in a row generally every other week for 4 times.
- On the first day of each 3-day study session you will have tests and
  - Breathe clean air, or
  - Breathe air polluted with a carefully controlled amount of diesel exhaust, or
  - Breathe air polluted with carefully controlled amount of ozone, or
  - Breathe a combination of diesel exhaust and ozone,
- On the second day of each 3-day study session you will have tests and breathe air with ozone only
- On the third day of each 3-day study session you will have more tests

The polluted air that you breathe will be a lot like air you might breathe in a city like Los Angeles, New York, or Mexico City on a smoggy day

How long will it take?

- After screening there will be 13 visits, including 1 training visit and 4 sets of 3-day exposure visits, each set separated by at least 13 days
- In total, the study will take about 79 hours over about 10 weeks.

What will I get for volunteering?

- If you complete all visits and procedures, we will pay you $3,738.

How can I sign up or get more information?
Call or send an email (link provided). Our office hours are Monday-Friday from 8 am to 5 pm EST. After hours please leave a message on voice mail, and we will return your call promptly.

- (919 966-0604 (local)
- 1-888-279-9353 (toll free)
- **recruitment@epa.gov**

Attachment# 4 Email Advertisement from Westat Inc, the recruitment contractor for US EPA Studies, of this study (IRB# 09-1344) to current participants in EPA studies

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DEPOZ Study E-mail to Current Volunteers

(these are people who are already participating in other EPA studies)

IRB #09-1344

E-mail Subject Line: EPA Research Study about Ozone, Diesel Exhaust and Exercise.

Dear _____,

You have been pre-qualified for a study called "DEPOZ" which will begin [date to be decided]. This research study is for healthy non-smokers between 18 and 55. The purpose of this study is to find out how air pollution – the kind that often causes the haze seen on smoggy days in polluted cities – affects the heart, blood vessels and lungs of healthy young adults. This study involves up to 13 visits after screening over about 10 weeks. It requires a commitment of about 79 hours, including four 2 ½ consecutive day sessions generally every other week. If all visits and procedures are completed this study pays $3,738. If you are interested in learning more about the study and/or in scheduling a repeat physical exam (if needed) please call us at 919-966-0604 (or 888-279-9353). Please also visit **www.epastudies.org** for more information.

We look forward to hearing from you!
[Recruiter's name]

Attachment# 5 Email Advertisement from Westat Inc, the recruitment contractor for US EPA Studies, of this study (IRB# 09-1344) to potential participants (ie, not participating currently in EPA studies)

DEPOZ Study E-mail Announcement

(intended for targeted lists, such as that provided by UNC to subscribers)

SUBJECT: INFORMATIONAL: Research Study about Ozone, Diesel Exhaust and Exercise.

This research study is for healthy non-smokers between 18 and 55. The purpose of this study is to find out how air pollution – the kind that often causes the haze seen on smoggy days in polluted cities – affects the heart, blood vessels and lungs of healthy young adults. This study involves up to 13 visits after screening over about 10 weeks. It requires a commitment of about 79 hours, including four 2 ½ consecutive day sessions generally every other week. If all visits and procedures are completed this study pays $3,738. Please visit **www.epastudies.org** for more information or call the Westat EPA Recruiting Office at 919-966-0604.

Approved [date], by the Office of Human Research Ethics Biomedical Institutional Review Board. IRB # 09-1344: Cardiopulmonary responses to exposure to ozone and diesel exhaust with moderate exercise in healthy adults.

This email is sponsored by: U.S. Environmental Protection Agency Human Studies Division, located on the UNC-Chapel Hill campus.

Attachment# 6 Recruitment Script describing this specific study (IRB# 09-1344) from Westat Inc, the recruitment contractor for US EPA Studies, to potential participants

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Study Name: DEPOZ
IRB Study # 09-1344

Title
Cardiopulmonary responses to exposure to ozone and diesel exhaust with moderate exercise in healthy adults.

Purpose
The purpose of this research study is to find out how the air pollution that causes the haze seen in some polluted cities (like Los Angeles, New York, and Mexico City) affects the heart, blood vessels and lungs of healthy young adults. This study is for people ages 18 to 55 who are able to exercise.

Procedures and Payment

The study will require two screening visits to the EPA Human Studies Facility (one to complete medical history paperwork, and the other for a physical exam), followed by a 3-hour training session and four 3-day study sessions. Study sessions are generally about two weeks apart, so this study requires 13 visits after screening over about 10 weeks. On the first day of each segment you will be exposed for 2 hours to either clean air, or air polluted with a carefully controlled amount of diesel exhaust or ozone, or both. Then the next day you will come back for another 2-hour exposure just to ozone. Each exposure day will last 8 hours. The third day of each segment will last about 3 hours.

During exposure sessions you will be asked to give blood, urine and breath samples, ride an exercise bike at 15-minute intervals during exposures, and perform several different breathing tests. You will also wear heart and blood pressure monitors during the study sessions and over night. Additionally, you will be asked to collect urine samples over night after the first exposure of each session. The total amount of time is about 79 hours over about 10 weeks. Since each set of exposures is separated generally by 2 weeks, you will spend 2½ days at the clinic every other week, 4 times. Does this seem like something that your schedule can handle?

If you complete the training visit and all four 2½ day sessions, you will be paid $3,738.00.

Study Schedule

Screening, 2 visits, as needed: 3 hours
Training visit, *days & times to be decided*: 3 hours
Segment 1, Day 1, 8 AM, *days to be decided*: 8 hours
Segment 1, Day 2, 8 AM, day after Day 1, 8 hours
Segment 1, Day 3, 8 AM, day after Day 2, 3 hours

Study Restrictions
In addition to meeting all study eligibility criteria (*in the IRB application*), volunteers must be willing to adhere to the following restrictions as well:

- No over the counter pain medications such as aspirin, Advil, Aleve, or other non-steroidal anti-inflammatory medications including those used for allergies for 48 hours prior to the exposure and post-exposure visits

- Medications not specifically mentioned here may be reviewed by the investigators prior to your inclusion in the study
- No Vitamins C or E, or supplements containing C or E, for at least 2 weeks prior to and throughout the study.
- Avoid smoke and fumes for 24 hours before all visits
- Avoid drinking alcohol 24 hours before all visits
- Avoid strenuous exercise for 24 hours prior to and after all visits
- Avoid the use of ozone-based home air purifiers during study participation.
- Eat a light breakfast on the exposure day
- Do not consume caffeine for 2 hours prior to the exposure on days 1 & 2 and post-exposure visits

Attachment# 7 Reminder sheet from Westat Inc, the recruitment contractor for US EPA Studies, of this study (IRB# 09-1344) to accepted participants

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TO:

RE: **Your appointment at the EPA Human Studies Facility**

STUDY: **DEPOZ STUDY, IRB # 09-1344**

DATE:

TIME:

PARKING is available on Mason Farm Rd directly in front of the EPA Human Studies building. Please park in Visitor Spaces only. Enter the building, give your name to the Guard, and request a Visitor Permit.

If the EPA lot is full you may also park in [provide current parking availability information]. Use Patient/Visitor spaces only. If you are a UNC Student or are UNC staff or faculty and must use the Dogwood Deck or ACC Lot you MUST print this appointment slip and display it on the dashboard in your car. If you do not display it, you will be ticketed.

May be folded here for display

Study Instructions

Illness
If you are sick or have been sick or injured in the last 4 weeks, please call Recruitment at 966-0604 or 888-279-9353. This includes sore throats, coughs, colds, and cold sores.

Active Allergies or Hay Fever
If you have had seasonal allergy symptoms in the past week, please call Recruitment to reschedule.

Medications
- No over the counter pain medications such as aspirin, Advil, Aleve, or other non-steroidal anti-inflammatory medications, including those taken for allergies, for 48 hours prior to the exposure and post-exposure visits. Tylenol is permitted.

Diet and Exercise
- No Vitamins C or E, or supplements containing C or E, for at least 2 weeks prior to and throughout the study.
- No drinking alcohol 24 hours before all visits
- No strenuous exercise for 24 hours prior to and after all visits
- No caffeine for 2 hours before to the exposure on days 1 & 2 and post-exposure visits.
- Eat a light breakfast on exposure days.

Other
- No smoke and fumes for 24 hours before all visits
- No ozone-based home air purifiers throughout the study
- Wear comfortable clothes and shoes suitable for exercise and bring a change of clothes

- Shower only in the morning before exposures, following the medical staff's instructions for removing and reattaching monitors.

If you are unable to keep your appointment, please call Recruitment. Please be on time!

Thank You! Westat EPA Support Services

Attachment# 8 Reminder sheet for the breathing test

Reminders for the breathing test

- Click on the file for the correct time point. We will remind you of which one you need.
- Click the button that says "close".
- Click on the 2nd button on the menu bar, the red on that looks like a breathing test.
- Press the space bar.
- (The very first time a box comes up, press the "OK" button).
- A red bar across the bottom will appear.
- Wait till the red bar turns black.
- Make sure you have your noseclip on.
- Breathe normal (tidal volume) for two breaths
- Take a deep breath, and press the space bar while you are taking that breath.
- Blow as hard and fast as you can till you are "empty".
- Another box will come up with numbers. Please tell us what the value is for "FEV1".
- Click "yes" to accept this test.
- Repeat the test.
- When completely finished, click the disk icon (save) at the top, between the middle and the left.
- This closes the box, and brings you back to the main menu.
- Click on the button at the top with the 2 people on it.
- Select the file for the time point you need and repeat the sequence. We will tell you when.
- If you have any questions, please be sure to ask!

THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL

OFFICE OF HUMAN RESEARCH ETHICS
Medical School Building 52
Mason Farm Road
CB #7097
Chapel Hill, NC 27599-7097
(919) 966-3113
Web site: ohre.unc.edu
https://my.research.unc.edu for IRB status
Federalwide Assurance (FWA) #4801

To: Tina Stevens
Epa
CB:7315, MD58A USEPA , 104 Mason Farm Rd , Chapel Hill , NC , 27599

From: Biomedical IRB

Approval Date: 6/01/2011
Expiration Date of Approval: 12/05/2011

RE: Notice of IRB Approval by Expedited Review (under 45 CFR 46.110)
Submission Type: Modification
Expedited Category: Minor Change to Previously Approved Research
Study #: 09-1344
Study Title: Cardiopulmonary Responses to Exposure to Ozone and Diesel Exhaust With Moderate Exercise in Healthy Adults
Sponsors: US Environmental Protection Agency - Contracts

This submission has been approved by the above IRB for the period indicated. It has been determined that the risk involved in this modification is no more than minimal. Unless otherwise noted, regulatory and other findings made previously for this study continue to be applicable.

Submission Description:
This amendment received 5/31/11 addresses administrative changes to project personnel.

Investigator's Responsibilities:
IF YOU SUBMITTED ON PAPER, enclosed are stamped copies of approved consent documents and other recruitment materials (when applicable). You must copy the stamped consent forms for use with subjects unless you have approval to do otherwise.
This study was reviewed in accordance with federal regulations governing human subjects research, including those found at 45 CFR 46 (Common Rule), 45 CFR 164 (HIPAA), 21 CFR 50 & 56 (FDA), and 40 CFR 26 (EPA), where applicable.

CC: Michael Madden, Environmental Protection Agency; Michael Schmitt; David Diaz-Sanchez; Howard Kehrl, (EPA), Non-IRB Review Contact

THIS CONSENT DOCUMENT SHOULD BE USED ONLY BETWEEN 6/01/11 AND 12/05/11 APPROVED BY INSTITUTIONAL REVIEW BOARD, UNC-CHAPEL HILL

University of North Carolina at Chapel Hill
Consent for Storing Biological Specimens With Identifying Information

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IRB Study # 09-1344
Consent Form Version Date: 11/16/10

Title of Study: Cardiopulmonary Responses to Exposure to Ozone and Diesel Exhaust with Moderate Exercise in Healthy Adults

Principal Investigator: Tina Stevens, PhD

UNC-Chapel Hill Department: N/A
UNC-Chapel Hill Phone number: (919)843-8031, **Fax:** 919-966-6367
Email Address: stevens.tina@epa.gov

Co-Investigators: Michael Madden, PhD; David Diaz-Sanchez, PhD; Wayne Cascio, MD
stevens.tina@epa.gov; Diaz-Sanchez.David@.epa.gov; cascio.wayne@epa.gov;

Funding Source and/or Sponsor: US Environmental Protection Agency Intramural Federal Research

Study Contact telephone number: (919) 966-6257 (Michael Madden)
Study Contact email: madden.michael@epa.gov

What are some general things you should know about research?
Research is designed to gain scientific information that may help other people in the future. You may not receive any direct benefit from participating. There also may be risks.

You may refuse to take part in research.

Details are discussed below. It is important that you understand this information so that you can make an informed choice. You will be given a copy of this consent form. You should ask the researchers named above, or staff members who may assist them, any questions you have about this study at any time.

What is the purpose of this specimen repository or "biobank?"
Research with blood, tissue, cells or body fluids (specimens) can help researchers understand how the human body works. Research can also answer other questions by using specimens. Researchers may develop new tests to find diseases, or new ways to treat diseases. In the future,

research may help to develop new products, such as drugs. Specimens are commonly used for genetic research. Sometimes researchers collect and store many specimens together and use them for different kinds of research, or share them with other scientists; this is called a specimen repository or "biobank."

All specimens for this study will be labeled with your study subject number that does not include personal identification information and will be stored in a repository where only project members will have access to the specimens. There is a need to store specimens in such a repository because this will be an ongoing study where specimens from subjects will be collected over an extended period of time. Storing of specimens allows for all specimens to be processed at the same time.

It also makes it possible to keep any remaining specimens in our biobank indefinitely and allows our scientists the opportunity to further study these specimens with as yet unknown questions and techniques. Research studies and questions in which the specimens may be used have not yet been determined. These studies may involve genetic research. Genetic research is about finding the specific location of genes, learning how genes work, and investigating relationships between a certain gene and the environment or people's habits and diets, and different diseases.

How will the specimens be collected?

Your specimens will be collected during the research study listed on the first page of this consent. No additional specimens will be collected from you.

What will happen to the specimens?

Study specimens will be stored in a secure room with restricted access at the U.S. Environmental Protection Agency Human Studies Facility located in Chapel Hill, North Carolina. The specimen will be prepared, labeled with the study subject identification number, and stored indefinitely in a freezer for future testing under *IRB# 07-1768, Repository for Storage of Human Specimens*. Names of subjects associated with ID numbers will be archived and locked; only medical and scientific personnel directly associated with this study will have access to this information. No personal identifying information will be attached to the biologic fluid specimen. Portions of the specimen may be shared with researchers at other scientific institutions, however, only coded specimens will be sent and the investigator will employ a data use agreement. Under no circumstances will any identifying information be sent along with specimens. The decision to destroy the specimens may be made by the investigator or by you if you notify the investigator in writing that you no longer want the specimens stored.

What are the possible benefits to you?

Benefits to you are unlikely. Research is designed to benefit society by gaining new knowledge. You will not benefit personally from having your specimens stored in this biobank.

What are the possible risks or discomforts involved with the use of your specimens?

Risk of breach of confidentiality is minimal. You will be assigned a study number which will be used for data – not your name. The study number is all that will be entered into computer databases. All paper files which may contain your name or screening number are secure in locked file cabinets in the EPA building which has limited access 24 hours/day. A numeric coding system will be used to ensure that you cannot be directly identified from the specimens alone. If we collect genetic information from the stored specimens, there is also a potential risk for some of your relatives and other members of your ethnic group, since they share some of your genetic makeup.

Will there be any cost to you for storage of the specimens?

There will be no cost to you for the storage and use of the specimens for research purposes.

Will you receive anything for the use of your specimens?

You will not receive any additional compensation for having your specimens stored in this biobank.

Who owns the specimens?

Any blood, body fluids, cell or tissue specimens obtained for the purpose of this study become the exclusive property of The U.S. Environmental Protection Agency and will be stored under *IRB# 07-1768, Repository for Storage of Human Specimens*. The researchers may retain, preserve or dispose of these specimens and may use these specimens for research that may result in commercial applications. There are no plans to compensate you for any future commercial use of these specimens.

How will your privacy be protected?

You will be assigned a study identification number. Names of subjects associated with ID numbers will be archived and locked; only medical and scientific personnel associated with this study will have access to this information. No personal identifying information will be attached and/or recorded in the data log sheets, biologic specimens, or electronic data sets. No subjects will be identified in any report or publication about this study. Although every effort will be made to keep research records private, there may be times when federal or state law requires the disclosure of such records, including personal information. This is very unlikely, but if disclosure is ever required, the U.S. Environmental Protection Agency and UNC-Chapel Hill will take steps allowable by law to protect the privacy of personal information. In some cases, your information in this research study could be reviewed by representatives of the University, research sponsors, or government agencies for purposes such as quality control or safety.

Study specimens will be stored in a secure room with restricted access. The sample will be prepared and stored indefinitely in a freezer for future testing. Portions of the specimens may be shared with researchers at other scientific institutions, however, only coded specimens will be sent. Under no circumstances will any identifying information be sent along with specimens to outside investigators. All medical records generated during this study will be kept in the medical records office at the EPA Human Studies Facility. The Medical Station is locked when not

attended by study staff, and the EPA Human Studies Facility has limited access to authorized individuals only, 24 hours/day for 7 days/week.

If genetic information is obtained from your stored specimens, A Federal law called the Genetic Information Nondiscrimination Act (GINA) generally makes it illegal for health insurance companies, group health plans, and most employers to discriminate against you based on your genetic information. GINA does not protect you against genetic discrimination by companies that sell life insurance, disability insurance, or long-term care insurance. GINA also does not protect you against discrimination based on an already-diagnosed genetic condition or disease.

Will researchers seek approval from you to do future studies involving the specimens?
By signing this consent form, you are giving your permission for researchers to use your specimens as described above. Current and future research is overseen by a committee called the Institutional Review Board (IRB). The role of the IRB is to protect the rights and welfare of research participants. In some cases, the IRB may require that you be re-contacted and asked for your consent to use your specimens in a specific research study. You have the right, at that future time, not to participate in any research study for which your consent is sought. Refusal to participate will not affect your medical care or result in loss of benefits to which you are entitled.

Will you receive results from research involving your specimens?
Most research with your specimens is not expected to yield new information that would be meaningful to share with you personally. There are no plans to re-contact you or other subjects with information about research results.

Can you withdraw the specimens from the research repository?
If you decide that you no longer wish for the specimens to be stored, you should contact the researchers on the front page of this form. It is best to make your request in writing.

Any analysis in progress at the time of your request or already performed prior to your request being received by the researcher will continue to be used as part of the research study. Once the researchers have been notified, your remaining specimens would be destroyed. If you do not make such a request, the specimens may be stored forever. The researchers may choose to destroy the specimens at any time.

What will happen if you are injured by this research?
All forms of human health research involve some risk of injury or illness. Despite our high level of precaution, you may develop an injury or illness due to participating in this study. If you develop an injury or illness determined by an appointed US EPA physician to be due to your participation in this research, the US EPA will reimburse your medical expenses to treat the injury or illness up to $5000. If you believe your injury or illness was due to a lack of reasonable care or other negligent action, you have the right to pursue legal remedy. The Federal Tort Claims Act, 28 U.S.C. 2671 et. Seq., provides for money damages against the United States when personal injury or property loss results from the negligent or wrongful act or omission of any employee of the EPA while acting within the scope of his or her employment. Signing this

consent form does not waive any of your legal rights or release the investigator, the sponsor, the institution, or its agents from liability for negligence.

If a research related injury or illness occurs, you should contact the Director of the EPA NHEERL Human Research Protocol Office at (919) 966-6217.

Who is sponsoring this research?

This research is funded by the United States Environmental Protection Agency. Several of the investigators including the Principal Investigator are federal employees. The researchers do not, however, have a direct financial interest in the final results of the study.

What if you have questions about this research?

You have the right to ask, and have answered, any questions you may have about this research. If you have questions, you should contact the researchers listed on the first page of this form.

What if you have questions about your rights as a research subject?

All research on human volunteers is reviewed by a committee that works to protect your rights and welfare. If you have questions or concerns about your rights as a research subject you may contact, anonymously if you wish, the Institutional Review Board at 919-966-3113 or by e-mail to IRB_ subjects@unc.edu. You may also contact the Director of the EPA NHEERL Human Research Protocol Office at 919-966-6217.

Title of study: Cardiopulmonary Responses to Exposure to Ozone and Diesel Exhaust with Moderate Exercise in Healthy Adults

Principle investigator: Tina Stevens, PhD

Subject's Agreement:

I have read the information provided above. I have asked all the questions I have at this time. I voluntarily agree to participate. I agree to my specimen(s) being stored with the identifying code(s).

_____ _____
Signature of Research Subject Date

_____
Printed Name of Research Subject

_____ _____
Signature of Research Team Member Obtaining Consent Date

_____
Printed Name of Research Team Member Obtaining Consent

University of North Carolina-Chapel Hill
Consent to Participate in a Research Study
Adult Subjects
Biomedical Form—

THIS CONSENT DOCUMENT SHOULD BE USED ONLY
BETWEEN 6/01/11 AND 12/05/11
APPROVED BY
INSTITUTIONAL REVIEW BOARD, UNC-CHAPEL HILL

IRB Study # 09-1344 GCRC #: N/A
Consent Form Version Date: November 16, 2010

Title of Study: Cardiopulmonary Responses to Exposure to Ozone and Diesel Exhaust with Moderate Exercise in Healthy Adults
Principal Investigator: Tina Stevens, PhD
UNC-Chapel Hill Department: US Environmental Protection Agency
UNC-Chapel Hill Phone number: (919) 843-8031
Email Address: stevens.tina@epa.gov
Co-Investigators: Michael Madden, PhD; David Diaz-Sanchez, PhD; Wayne Cascio, MD
UNC-Chapel Hill Phone number: (919)966-6257, (919) 966-0676, (919) 966-9583
Email Address: madden.michael@epa.gov; diaz-sanchez.david@.epa.gov; cascio.wayne@epa.gov;
Faculty Advisor: N/A

Funding Source: US Environmental Protection Agency Intramural Federal Research

Study Contact telephone number: (919) 966-6257 (Michael Madden)
Study Contact email: madden.michael@epa.gov

What are some general things you should know about research studies?
You are being asked to take part in a research study. To join the study is voluntary. You may refuse to join, or you may withdraw your consent to be in the study, for any reason at any time.

Research studies are designed to obtain new knowledge that may help other people in the future. You may not receive any direct benefit from being in the research study. There also may be risks to being in research studies.

Your participation is voluntary. Deciding not to be in the study or leaving the study before it is completed will not affect your relationship with the researcher, your health care provider, or the University of North Carolina-Chapel Hill. If you are a patient with an illness, you do not have to be in the research study in order to receive health care.

Details about this study are discussed below. It is important that you understand this information so that you can make an informed choice about being in this research study. You will be given a copy of this consent form. You should ask the researchers named above, or staff members who may assist them, any questions you have about this study at any time.

What is the purpose of this study?

We breathe a complex mixture of air pollution, and ozone and diesel exhaust are generally the major and important components. Controlled exposures of volunteers to either pollutant have resulted in biological effects such as lung physiological changes. However it is not known if co-exposure to both pollutants, similar to inhaling polluted air, can induce effects than either pollutant alone. Additionally it is also uncertain if exposure to diesel exhaust alone, or diesel exhaust mixed with ozone, can alter the body's responses to breathing ozone the following day. This study proposes to examine whether exposure to both ozone and diesel exhaust can cause more of an effect than either pollutant alone. This study will also determine if breathing diesel exhaust can change a response upon exposure to ozone the day after. The purpose of this study is to measure cardiopulmonary responses in healthy young adults before, during, and after exposure to combinations of ozone (O3) and diesel exhaust for 2 hours with moderate exercise and to primarily investigate whether diesel exhaust modulates the O3-induced effects on the lung and cardiovascular systems.

This study will examine whether co-exposures to ozone and diesel exhaust, at doses in the upper range of those encountered in urbanized settings, can induce additive or synergistic effects, and whether a previous DE exposure alters a response upon subsequent exposure to ozone.

The data obtained from this study will contribute to the overall assessment of air pollution effects in the U.S. and thereby may influence future health policy. The ambient permissible concentrations of both ozone and diesel exhaust are currently regulated individually by the US EPA, but the Agency is moving towards regulating pollutant mixtures. Results from this study may increase the understanding of how gaseous and particulate air pollutants (which causes the haze seen in some polluted cities) may adversely affect the functioning of the heart, blood vessels, and lungs. This understanding may be especially important for patients with diseases of the heart and lungs.

Are there any reasons you should not be in this study?

You should not participate in this study if…

- You have a history of chest pain, irregular heart beats, a heart attack or coronary bypass surgery.
- You have a heart pacemaker.
- You have untreated high blood pressure (> 150 systolic, > 90 diastolic).
- You have a history of an EKG finding called QT/QT_C prolongation [a marked baseline prolongation of QT/QTc interval (e.g., repeated demonstration of a QTc interval > 450 milliseconds)]
- You have a history of lung disease and/or active allergy including: hay fever, dust allergies, rhinitis, asthma, chronic bronchitis, chronic obstructive pulmonary disease, tuberculosis, coughing up blood, recurrent pneumonia, chronic or allergic rhinitis or acute or chronic sinusitis.
- You cannot perform moderate exercise
- You cannot remain in a small exposure chamber for about 2 hours
- You are currently taking β-blockers (such as atenolol, metoprolol, propanolol, and acebutolol).
- You have a history of bleeding or coagulation disorders or are taking blood thinner medication.
- You are currently smoking or have a smoking history within 1 year of the study (defined as more than one pack of cigarettes in the past year) or have a greater than/equal to a 5 pack year smoking history.
- You are less than 18 years old or greater than 55 years old

- You have diabetes.
- You have cancer.
- You are currently taking estrogen replacement therapy.
- You are pregnant, attempting to become pregnant or breastfeeding.
- You have an allergy to latex.

Additionally, you should **NOT** participate if you are unable to comply with the following requirements:

- No over-the-counter pain medications such as aspirin, Advil, Aleve or other non-steroidal anti-inflammatory medications ("NSAIDS") for 48 hr prior to the exposure and post-exposure visits. Acetaminophen, eg, Tylenol, is permitted.
- Avoid smoke and fumes for 24 hours before all visits.
- Avoid drinking alcohol 24 hours before all visits.
- Avoid strenuous exercise for 24 hours prior to and after all visits.
- Eat a light breakfast on the exposure days.
- Not consume caffeine for 1-2 hours prior to the exposures on days 1 & 2 and post-exposure visits.
- Stop taking vitamin C or E or medications which may impact the results of the exposures at least 2 weeks prior to the study and for the duration of the study. Medications not specifically mentioned here may be reviewed by the investigators prior to your inclusion in this study.
- Avoid the use of ozone-based home air purifiers during study participation

How many people will take part in this study?

If you decide to be in this study, you will be one of approximately 15 people who will complete this research study.

How long will your participation in this study last?

You will have up to 13 visits to the research facility over approximately about 10 weeks if you are eligible for the study (see attached study design flow chart).

Your participation in this study will include one training session (today) for about 3 hours, 4 exposure regimens, each of which will consist of 2 consecutive exposure days and 1 follow-up visit approximately 18 hrs after the last exposure. Each exposure day will last approximately 8 hours and the follow-up visit will be approximately 3 hrs long. The 4 exposure regimens will occur at least 13 days apart.

Storage of some of your blood samples in this study may be indefinite.

What will happen if you take part in the study?

During the course of this study, the following will occur:

Training:

You should have already undergone a general physical examination to ensure that you are a candidate for this study. If you are a female participating in this study, you should have been asked about your menstrual history and will be given a pregnancy test.

Today's visit is expected to last about 3 hours. Today you will familiarize yourself with some of the techniques you will perform for the study. These include instructions on the use of the stationary bicycle to be used during the study, how to perform spirometry, on a portable spirometer and dry seal digital spirometer, how to give a saliva and an exhaled breath sample, , and you will be shown the heart rate variability (HRV) and blood pressure (BP) monitors.

After satisfactorily completing the training session, you will be scheduled for your first exposure through a company contracting with the US EPA (currently Westat).

You will be exposed to mixtures of air pollutants in 4 different regimens. Each regimen will last about 2 ½ days. During the regimens, a number of physiological and biochemical measurements will be made. **With your permission, during one of your blood draws DNA from your blood cells will also be genotyped for specific genes related to adverse health effects associated with air pollution exposure. Unwillingness to have samples genotyped will NOT exclude you from participating in this study. If you do not wish for your blood to be used for genotyping, but do wish to participate in the study, sign the section at the end of this consent form titled *Subject's Agreement to Participate in the Research Study WITHOUT Genoptyping Consent.* With your permission, we may also store some of your blood we obtain during the study for yet-to-be-determined tests in the future.**
You will have the opportunity to complete all 4 regimens separated by at least 2 weeks. The first day of each regimen you will be exposed to either clean air, diesel exhaust at about 300 micrograms of particles/meter^3, ozone at about 0.3 parts per million (ppm), or diesel exhaust mixed with ozone. The second day of the regimen, you will be exposed to approximately 0.3 ppm ozone. The third day of each regimen, you will not be exposed to any air pollutants, but will have follow up measurements made.

You may terminate your participation from this study at any time. You will be monitored for symptoms that you may develop during the exposure and over the following 24 hour period. The symptoms may include chest pain, difficulty breathing, light-headness, pale skin color, and significant irregular heart beats. In addition, analyses of blood samples taken after exposure will be monitored for abnormalities, including signs of cell damage, changes in clotting factors, as well as increases in inflammation. The study physicians will stop the study if symptoms and/or changes detected in the blood samples that are considered clinically significant.

Below is a description of what will be required from you and a summary of the measurements to be made on you on each day of each exposure regimen:

Day 1:

We will call you a few days before the exposure session to remind you of your scheduled visit. We will also remind you to refrain from alcohol, NSAID medications, excessive amounts of caffeine, and from any activities where you could be exposed to high levels of pollutants (e.g., cigarette smoke, paint fumes) for a couple of days before your visit. Please report any pollutant

exposure to the study personnel so you can be rescheduled if necessary. You will be rescheduled if you have experienced a respiratory tract illness within the past 4 weeks or any other illness within the past week.

You will be asked to eat a light breakfast and arrive at the EPA medical station at approximately 8 am. There will be an on-time bonus of $25 for arriving by 8:05 a.m. You will need to wear comfortable clothes and shoes and bring a change of clothes.

Pre-exposure measurements:

Prior to the day 1 exposures, you will be asked to do the following:

- Answer a questionnaire on stress
- Have your vital signs checked (heart rate, respiratory rate, blood pressure, and oxygen saturation level, and for women, a pregnancy test).
- Have your baseline heart rate viability (HRV) measured by a Holter monitor. You will have several ECG leads attached to your chest. It may be necessary to clean and shave the areas of your chest where these leads will be placed. Excessive deodorant, skin lotions, and body sprays may interfere with the function of some of these leads so we will ask you not apply these to your chest area on the day you report to the HSF. The leads will be connected to 2 monitors (small recording devices about the size and weight of a portable tape player) to obtain readings of your heart rate and rhythm. One of these monitors will be removed at the end of the day and the other monitor may be kept on you for the next two days and will be removed on Day 3 of the exposure session. You will be asked to recline quietly and breathe at a constant rate for 20 minutes, after which the ECG monitor will take a 10-minute measurement of your heart rhythm. It is important that you do not fall asleep during this 30-minute period. The morning of the follow up visit (Day 3), there may be a 30 minute measurement of your heart rate and then the monitor will be removed.
- Blood pressure (BP) may be measured intermittently by a BP monitor. A blood pressure cuff and a monitor which is about the size of the Holter monitor may be fitted and will remain in place most of the time until Day 3. You will be asked to keep your arm relaxed and still when the pressure cuff is inflating.
- Have about 25 ml blood drawn (~5 teaspoons).
- Have a breathing test (spirometry). You will breathe through a filter into the machine. We will coach you, and you will be asked to take a full breath in and then blow it out as hard and fast as you can. We will ask you to do this several times. This procedure will be repeated on a portable devise as well.
- Be asked to provide a urine sample; if you are female it will be tested to see if you are pregnant.
- We will collect your breath and saliva.
- You will be asked to collect your urine for the next 24 hrs
- Have a second breathing test on a portable spirometry instrument, but in a similar manner as the first.

During the Day 1 exposure you will:

- Enter an exposure chamber.

- Be exposed to clean air or air pollutants for 2 hours. You will be asked to perform intermittent moderate exercise in an exposure chamber.
- At certain times during the exposure, you may be asked to breathe into a mouthpiece so that your rate of breathing can be measured. In addition, you will be asked to breathe into a portable spirometer so that your lung function can be measured. Exposure may be terminated if you show a larger than expected decrement in lung function. A staff member will be seated outside the chamber to observe you at all times and a physician will be available during the entire exposure session. During the exposure, your heart rhythm and rate, blood pressure, and the amount of oxygen in your blood will be monitored. If it appears you are having heart rhythm or breathing problems, or you develop a severe headache, nausea or vomiting the exposure will be terminated immediately.

Immediately following the Day 1 exposure you will:

- Have your vital signs checked.
- Perform spirometry. You will breathe through a filter into the machine. We will coach you, and you will be asked to take a full breath in and then blow it out as hard and fast as you can. We will ask you to do this several times about 1 assessment each hour
- We will collect your breath and saliva
- You will recline quietly for 20 minutes, after which the ECG monitor will take a 10-minute measurement of your heart rhythm.
- Have blood drawn (about 25 ml; ~5 teaspoons).
- Provide a urine sample.

Later in the day, you will:

- Have spirometry assessed for up to 4 hr post exposure
- Be assessed for adverse responses and discharged by the nursing staff. You will spend about 8 hours at the EPA facility.
- You will be given a cooler containing 1 L plastic bottles and verbal instructions for how to collect and record the time of the urine samples.

Importantly, because you will be asked to wear the portable ECG monitor attached to your chest and a blood pressure monitor cuff on your arm for the following two nights, we will give you instructions on how to care for and remove the monitors when necessary.

Day 2:

You will return to the HSF the next morning at 8:00 a.m. and you will perform testing similar to the first day.

Pre-exposure measurements and procedures will be performed as on Day 1, with the exception of the stress questionnaire. You will then enter the exposure chamber.

During the exposure on Day 2 you will be exposed to ozone at a concentration of approximately 0.3 ppm for 2 hours with intermittent moderate exercise in an exposure chamber. Again, your heart rhythm and rate, blood pressure, the amount of oxygen in your blood, your breathing rate, and lung function will be monitored while you are inside the chamber.

- **Similar measurements and procedures will be performed with you during and following the Day 2 exposure as on Day 1.** However, you will only be asked to collect spot urine samples at the EPA facility. You will be assessed for adverse responses and you will be discharged by the nursing staff. You will spend about 8 hours at the EPA facility.

Day 3:

Follow up Visit:
Similar procedures and measurements will be made as the pre-exposure measurements of the two previous days. The Holter monitor attached to you will be removed. You will be assessed for adverse responses and you will be discharged by the nursing staff. You will spend about 3 hours at the EPA facility.

If there are remaining samples after our analysis, we would like to continue to store your samples for as yet undesignated studies. This allows us to make the best use of the samples we collect from you. You will be given a separate consent form for this storage, and you do not have to allow your samples to be stored in order to participate in this study.

What are the possible benefits from being in this study?
You will not benefit directly from being in this research study, though by participating in screening for this study you will have received a medical examination that included blood work, respiratory test, and ECG monitoring of heart at no charge. However, this is not a substitute for a routine doctor visit. The medical staff will explain to you any remarkable findings regarding your overall health status. In addition, if we observe changes in your health status as a consequence of exposure to air pollutants, you may elect to use this information to avoid exposure on high pollution days.

This research is designed to benefit society in general by gaining new knowledge. Given that every member of American society is currently exposed to these pollutants, this study has the potential to contribute to devising effective strategies aimed at protecting millions from the untoward effects of these pollutants.

What are the possible risks or discomforts involved with being in this study?
This study might involve the following risks and/or discomforts to you:

If you have any tendency to become uncomfortable in small closed spaces, it is possible that you may become uncomfortable during this study. You will be taken to the exposure chamber when you are first evaluated for suitability for the study to allow you an opportunity to see where you will sit and what the chamber looks like.

Diesel exhaust exposure: Exposure to air pollution particles can cause cough, shortness of breath, chest discomfort, eye irritation, and headache. These symptoms typically last no more than a few hours, but could last longer if you are especially sensitive. Eye wear protection goggles are available during the exposures to reduce possible eye irritation. There is a chance that exposure to particles can increase the likelihood that you will be more likely to come down with a respiratory infection within several days of the exposure. Diesel exhaust, even when diluted in this study, may have an unpleasant odor. Exposure to the air pollution particle concentrations used in this study for short periods of time has not been found to cause permanent health effects. However, some studies suggest that older people, particularly those with underlying cardiovascular diseases, are at increased risk for getting sick and even dying during episodes of high air pollution. While we can not exclude the possibility that you may have an adverse reaction to breathing these exhausts, you will only be exposed to them for 2 hours. You could be potentially inhale a similar amount if you visited a large city such Los Angeles, New York, or Mexico City on a smoggy day.

You will be monitored continuously during the exposure session through a window in the chamber or by closed-circuit television, and can communicate with a staff member via an intercom. Your heart rate and rhythm will also be constantly monitored for any adverse changes brought about by the exposure. A licensed physician is always on the premises (i.e., within the building facility) during exposures, and is available to respond in an emergency.

Ozone exposure: Potential risks may include mild decrements in lung function spirometric volume, irritation to the nose, eyes, throat and airways, pain on deep inspiration and cough. These symptoms typically disappear 2 to 4 hours after exposure, but may last longer for particularly sensitive people. Ozone may induce an inflammatory reaction that may last for about 24 hours after exposure and may increase your chance of catching a cold.

Diesel exhaust and ozone exposure combined: Because this exposure scenario has not been conducted at our facilities or elsewhere before, we do not yet know whether or not this exposure will include the same risks as diesel exhaust and ozone exposures alone. It is possible that the combination of diesel exhaust and ozone exposures will increase the effects of each pollutant individually, and it is also possible that it will not. We are doing this study in order to find out the answer.

Heart rhythm monitoring: There is little risk associated with monitoring your heart by ECG or blood oxygen by pulse oximetry. However, preparing your skin for placement of ECG electrodes and removing the electrodes the next day may cause some irritation or skin discoloration, itching, or burning in some people. If this occurs during your visit, you should tell the nursing staff. If irritation occurs while you are home, you should remove the electrodes, wash gently with mild soap and water, and tell the study coordinator or nursing staff in the morning.

Blood pressure monitoring: Similar to the regular blood pressure measurement, the risk associated with blood pressure monitor is considered minimal.

Venous blood sampling: The risks associated with taking blood samples are considered minimal. A well-trained member of the staff will draw the blood. Drawing blood could cause some bruising or minor pain, which usually resolves quickly. Occasionally fainting or light-headedness occurs, and injury is minimized by having you seated. Also, a rare complication is skin infection or an infection of the vein in which the blood has been drawn. The risk of getting infection is minimized by the use of sterile technique. If you do have signs of infection at the site (redness, warmth, painful skin, and swelling) after completion of the procedure, you will need to contact the EPA medical station.

Exhaled breath collection: Minimal risk is associated with these procedures. Sensitive individuals may become light-headed. You will be seated in a chair during collections and technicians are always available during this procedure in case you become light-headed.

Breathing tests (spirometry): You may cough or become dizzy during these tests. You will be seated in a chair, and if these symptoms occur, they are usually only temporary. You will be exposed to a low dose of acetylene for a brief period of time (single breath in and breath out), thus the risk will be quite low.

In addition, there may be uncommon or previously unrecognized risks that might occur. If you do notice any unusual symptoms occurring during the study you should call the EPA medical station or the on-call physician to report them. We will give the number of the physician on-call before you leave the building.

Genotyping: If given permission to collect genetic information, a federal law called the Genetic Information Nondiscrimination Act (GINA) generally makes it illegal for health insurance companies, group health plans and most employers to discriminate against you based on your genetic information. GINA does not protect you against genetic discrimination by companies that sell life insurance, disability insurance or long term care insurance. GINA dose not protect you against discrimination based on an already diagnosed genetic condition or disease.

What if we learn about new findings or information during the study?

You will be given any new information gained during the course of the study that might affect your willingness to continue your participation.

How will your privacy be protected?

You will be given a study code number. All electronic documents will only have that number. The paper records that the coordinators and medical doctors use may have your name. Your information can be linked to your personal information by the study number, however only study personnel have access to your personal information. Paper records that use your name are kept in a locked file cabinet in the EPA Medical Station of the Human Studies Facility. The Medical Station is locked when not attended by study staff, and the EPA Human Studies Facility has

limited access to authorized individuals only, 24 hours/day for 7 days/week. Blood samples will be stored at the EPA Human Studies Facility.

Research studies may be done at many places at the same time. Your personal identifying information will never be sent to outside researchers.

No subjects will be identified in any report or publication about this study. Although every effort will be made to keep research records private, there may be times when federal or state law requires the disclosure of such records, including personal information. This is very unlikely, but if disclosure is ever required, UNC-Chapel Hill will take steps allowable by law to protect the privacy of personal information. In some cases, your information in this research study could be reviewed by representatives of the University, research sponsors, or government agencies for purposes such as quality control or safety.

What will happen if you are injured by this research?

All forms of human health research involve some risk of injury or illness. Despite our high level of precaution, you may develop an injury or illness due to participating in this study. If you develop an injury or illness determined by an appointed US EPA physician to be due to your participation in this research, the US EPA will reimburse your medical expenses to treat the injury or illness up to $5000. If you believe your injury or illness was due to a lack of reasonable care or other negligent action, you have the right to pursue legal remedy. The Federal Tort Claims Act, 28 U.S.C. 2671 et. Seq., provides for money damages against the United States when personal injury or property loss results from the negligent or wrongful act or omission of any employee of the EPA while acting within the scope of his or her employment. Signing this consent form does not waive any of your legal rights or release the investigator, the sponsor, the institution, or its agents from liability for negligence.

If a research related injury or illness occurs, you should contact the Director of the EPA NHEERL Human Research Protocol Office at (919) 966-6217.

What if you want to stop before your part in the study is complete?

You can withdraw from this study at any time, without penalty. The investigators also have the right to stop your participation at any time. This could be because you have had an unexpected reaction, or have failed to follow instructions, or because the entire study has been stopped.

Will you receive anything for being in this study?

You will be paid approximately $12 per hour for your participation in this study and the total compensation for completion of this study will be approximately $3,738.00

We will give you parking coupons to cover the cost of parking. If you live beyond Chapel Hill you will be reimbursed for mileage at the US Government mileage rate in effect at the time. Money received by participants in research studies is normally treated as ordinary income by taxing authorities and we will report payments made to you to the Internal Revenue Service as required by law. Payments totaling more than $600 in a year from a single or multiple EPA studies will be reported to the IRS. This summary is to emphasize the importance of all the visits, and to signify the importance of your time and commitment to the research study. Below is a detailed list of compensation for the entire study.

Subject Compensation for Procedures during Diesel and Ozone Exposure Study

Training Day (assume 3 hr @$12/hr)	$36
First Exposure:	
Day 1	
Hourly payment (assume 8 hr @$12/hr)	$96
On-time bonus (8 a.m.)	$25
Stress questionnaire	$2.50
Blood Draw (twice)	$30
24 hr Urine Collection	$60
Exhaled breath and saliva collection (twice)	$10
24 hr Holter Monitoring	$100
24 hr Blood Pressure Monitoring	$50
Lung function (6x)	$60
Lunch	$5
Day 2	
Hourly payment (assume 8 hr @$12/hr)	$96
On-time bonus (8 a.m.)	$25
Blood Draw (twice)	$30
Urine Sample (3x)	$15
Exhaled breath and saliva collection (twice)	$10
24 hr Holter Monitoring	$100
24 hr Blood Pressure Monitoring	$50
Lung function (6x)	$60
Lunch	$5
Day 3	
Hourly payment (assume 3 hr @$12/hr)	$36
Blood Draw	$15
Exhaled breath and saliva collection	$5
Urine Sample	$5
Lung function	$10
[Total payment First Exposure]	$900.50
Second Exposure	$900.50
Third Exposure	$900.50

Fourth Exposure	$900.50
Completion Bonus (for completing all 4 exposure sessions)	$100
APPROXIMATE TOTAL (including training day)	$3,738.00

Additional blood draws ($10 each)
Additional hours ($12 per hour)

You should understand that your participation is voluntary. You may terminate your participation in the study at any time without penalty. If you voluntarily elect to withdraw from the study at any time or you fail to maintain compliance with eligibility requirements, you will be paid for that portion of the study that has been completed. Subjects who are dismissed by the investigators after enrollment in the study but prior to completion for involuntary reasons, will be compensated for his/her participation up to that point and will receive compensation at the hourly rate of $12 per hour for the scheduled 3 day study session for a total of $228.

In the event a scheduled study activity must be cancelled by the investigators with less than 72 hours prior notice, the subject will be paid at the standard hourly rate for the time scheduled and canceled, and will be paid 50% of procedure fees up to a total maximum of $100 for canceled procedures. You will be paid in full for any procedures that may have been started during the current visit. Cancellations could occur due to adverse weather conditions, equipment failure, or other unforeseen events. When feasible, you will be rescheduled.

Will it cost you anything to be in this study?

There will be no cost to you for participating in the study. However, if you are deemed not eligible to participate in the study for medical reasons, we may suggest that you seek follow-up care from your own health care provider for abnormalities discovered during the screening history, physical examination, or the study. **Such care is entirely at your own expense. EPA will not provide reimbursement for any follow-up care.**

All study procedures will be paid for by the study. We will give you parking coupons to cover the cost of parking. If you live beyond Chapel Hill you will be reimbursed for mileage at the US Government mileage rate in effect at the time.

This study will take approximately 10 weeks to complete. The study duration is based on 4 exposure regimes separated by at least 2 weeks. The total amount of time at this facility will be ~79 hr.

What if you are a UNC student?

You may choose not to be in the study or to stop being in the study before it is over at any time. This will not affect your class standing or grades at UNC-Chapel Hill. You will not be offered or receive any special consideration if you take part in this research.

What if you are a UNC employee?
Taking part in this research is not a part of your University duties, and refusing will not affect your job. You will not be offered or receive any special job-related consideration if you take part in this research.

Who is sponsoring this study?
This research is funded by The U.S. Environmental Protection Agency. This means that the research team is being paid by the sponsor for doing the study. The researchers do not, however, have a direct financial interest with the sponsor or in the final results of the study.

What if you have questions about this study?
You have the right to ask, and have answered, any questions you may have about this research. If you have further questions regarding this study, you should call one of the listed investigators:
Michael Madden, PhD 919-966-6257 Tina Stevens, PhD 919-843-8031

If you feel a research-related injury has occurred, please contact the HSF medical station or one of the investigators listed above. In addition, you should contact the Human Studies Division Human Research Officer and Director of the National Health Effects and Environmental Research Laboratory Human Research Protocol Office at 919-966-6217.

What if you have questions about your rights as a research subject?
All research on human subjects is reviewed by a committee that works to protect your rights and welfare. If you have questions or concerns about your rights as a research subject you may contact, anonymously, if you wish, the Institutional Review Board at 919-966-3113 or by email to IRB_ subjects@unc.edu and/or the EPA Director of the National Health and Environmental Effects Human Research Laboratory Protocol Office at 919-966-6217.

- -

IRB Study #_09-1344___ **Title of Study:** Cardiopulmonary Responses to Exposure to Ozone and Diesel Exhaust with Moderate Exercise in Healthy Adults

Principal Investigator: Tina Stevens, PhD

Subject's Agreement to Participate in the Research Study WITHOUT Genotyping Consent

I have read the information provided above. I have asked all questions I have at this time. I voluntarily AGREE to participate in this study and I REFUSE to have my cells genotyped for any genes decided by the study investigators.

_____ _____
Signature of Research Subject Date

_____
Printed Name of Research Subject

_____ _____
Signature of Person Obtaining Consent Date

_____
Printed Name of Person Obtaining Consent

.....

Subject's Agreement to Participate in the Research Study Genotyping Consent

I have read the information provided above. I have asked all questions I have at this time. I voluntarily AGREE to participate in this study and I voluntarily AGREE to have my cells genotyped for any genes decided by the study investigators to be related to adverse health effects associated with pollution exposure.

_____ _____
Signature of Research Subject Date

_____
Printed Name of Research Subject

_____ _____
Signature of Person Obtaining Consent Date

_____
Printed Name of Person Obtaining Consent

First Review of IRB Submission
Modification

Training Not Met (Ana Rappold, Margaret Herbst, David Diaz-Sanchez, Martha Sue Carraway, Mary Bassett)

Receipt Date : 5/31/2011 **Expiration Date :** 12/05/2011 **Previous Review Type:** **Renewal Full Board**

IRB: Biomedical **PI:** Tina Stevens **IRB ID :** 09-1344 **IRB Admin :**

Title: Cardiopulmonary Responses to Exposure to Ozone and Diesel Exhaust With Moderate Exercise in Healthy Adults

☐ Not-HSR ☐ Exempt (Category:) ☒ Not Full IRB (Category:) ☐ Full IRB

Agenda Date Reviewer 1: Reviewer 2:

Entered by: Sonya H Bateman

Findings

Based on the information provided, the IRB has determined that HIPAA does not apply to this study.

Study Description:

Purpose: The purpose of this study is to measure cardiopulmonary responses in healthy young adults before, during, and after exposure to combinations of ozone (03) and diesel exhaust (DE) for 2 hours with moderate exercise and to primarily investigate whether DE modulates the 03-induced effects on the lung and cardiovascular systems. Participants: Fifteen (15 healthy) young men and women in the age of 18-55 years Procedures (methods): Each subject will be exposed in environmentally controlled exposure chambers to 4 exposure regimens. Each regimen will require a 2 hr exposure with intermittent, moderate exercise on 2 consecutive days. Day 1 exposure will consist of a combined exposure to DE and 03, 03 only (i.e., no DE), or DE only, or clean air (CA) only. For all 4 regiments, subjects will return the next day (Day 2) to be exposed to 03 alone and again on Day 3 for a follow up visit. Each regimen will be separated by at least 2 weeks. Techniques measuring lung and cardiac physiology will be performed pre, during, and post exposure. Blood, urine, and breath samples will also be obtained and analyzed for immune and inflammatory markers, possible genotyping, clotting factors, susceptibility factors, and exposure markers.

Submission Description:

PROCESSING STEPS (OFFICE USE ONLY):

☐ Reviewer Checklist completed
☐ Minor Stipulation letter:
- ☐ Draft letter prepared
- ☐ Approved by chair as attached (Initials/Date:)
- ☐ Approved by chair, see edits (Initials/Date:)
- ☐ Email copy sent
- ☐ Hard copy sent

☐ Approval letter: 6/1/11
- ☐ Draft letter prepared
- ☐ Approved by chair as attached (Initials/Date: 6/1/11)
- ☐ Approved by chair, see edits (Initials/Date:)
- ☐ Email copy sent
- ☐ Hard copy sent

Consent forms attached: 2
Other attachments: 0

FINAL ACTIONS:

☐ Approved
☐ Approved with Minor Stipulations
☐ NHSR
☐ Return to sender
☐ Closure

OFFICE OF HUMAN RESEARCH ETHICS
Institutional Review Board
MODIFICATION OF APPROVED
HUMAN SUBJECTS RESEARCH
Version May 22, 2009

RECEIVED
MAY 31 2011
UNC-CH IRB

Include the items indicated, where applicable:

- *Check* the relevant items below and include one copy of all checked items 1-5 in the order listed.
- Also include one additional collated set of copies (sorted in the order listed) for items 1 and 2.

→ **Applications will be returned if these instructions are not followed.**

Check	Item	Total No. of Copies
□	1. A concise summary of the requested modification using this form. List and describe each proposed change to aid in IRB review. Add pages as necessary. Provide a concise summary of changes when submitting an updated Investigator Brochure or Master Protocol.	2
□	2. New or revised consent forms, questionnaires, surveys, recruitment materials, advertisements, etc. One copy should have changes highlighted by underlining, and the other clean copy will be used for stamping.	1 highlighted 1 clean
□	3. If you have made substantive changes to the study design or procedures, submit a revised full IRB application with changes highlighted by underlining. If you are making changes only to the first page, just submit that page.	2
□	4. The sponsor's document describing the amendment, if any.	1
□	5. If adding personnel, include name, location (UNC or specific outside location), role, and email address for each person who should receive electronic copies of IRB correspondence to PI. For those study personnel *not* in the online UNC-CH ethics training database (http://cfx3.research.unc.edu/training_comp/) include documentation of required training in human research ethics.	1

1 List and describe each proposed change:

Removed Howard Kehrl as a Co-Investigator to "other project personnel" on the protocol, consent form, and storage consent form. In addition, Wayne Cascio will be removed from "other project personnel" and added as a Co-Investigator.

2. Is this modification being submitted in response to an unanticipated problem/adverse event or new findings? ___yes _x__no
If yes, explain, including whether these events or findings are relevant to participants' willingness to continue.

3. Do any of the proposed changes increase risk? ___yes _x__no If yes, explain.

IRB study #: 09-1344 **Date:** June 1, 2011

Title of Study: Cardiopulmonary Responses to Exposure to Ozone and Diesel Exhaust with Moderate Exercise in Healthy Adults

Principal Investigator: Tina Stevens, PhD **Faculty advisor:** (if applicable)

For industry sponsored research (if applicable):
Sponsor's master protocol version #: Version date:

Investigator Brochure version #:

Any other details you need documented on IRB approval:

Version date:

Martin W. Case for Tina Stevens

Signature of Principal Investigator or designee

5/31/2011

Date

Signature of Faculty Advisor (if applicable)

Date

OFFICE OF HUMAN RESEARCH ETHICS
Institutional Review Board

RECEIVED
MAY 31 2011
UNC-CH IRB

APPLICATION FOR IRB APPROVAL OF
HUMAN SUBJECTS RESEARCH
Version9 September 29th

Part A.1. Contact Information, Agreements, and Signatures

Date: December 10, 2010

Title of Study: Cardiopulmonary Responses to Exposure to Ozone and Diesel Exhaust with Moderate Exercise in Healthy Adults

Name and degrees of Principal Investigator: Tina Stevens, Ph.D.
Department: US EPA Mailing address/CB #: 104 Mason Farm Rd.
Chapel Hill, NC
27599-7315
Phone #: (919) 843-8031 Fax #: (919) 966-6367 Email Address: stevens.tina@epa.gov

Name and degrees of Co-Investigator: Michael Madden, Ph.D, David Diaz-Sanchez, Ph.D., Wayne Cascio~~Howard Kehrl~~, MD

For trainee-led projects: __ undergraduate __ graduate __ postdoc __ resident __ other
Name of faculty advisors: N/A

Department: Mailing address/CB #:

Phone #: Fax #: Email Address:

Department: Mailing address/CB #:

Phone #: Fax #: Email Address:

Center, institute, or department in which research is based if other than department(s) listed above:

Name of Project Manager or Study Coordinator (if any):
Department: Martin Case Mailing address/CB #: 104 Mason Farm Rd.
Chapel Hill, NC
27599-7315

Phone #: (919) 966-0647 Email Address: case.martin@epa.gov

List **all other project personnel** including co-investigators, and anyone else who has contact with subjects or identifiable data from subjects. **Include email address for each person who should receive electronic copies of IRB correspondence to PI:**
Co-PI: David Diaz-Sanchez, PhD (diaz-sanchez.david@epa.gov); Michael Madden, PhD (madden.michael@epa.gov); Wayne Cascio~~Howard Kehrl~~, MD (cascio.wayne~~kehrl.howard~~@epa.gov)
Robert Devlin, Ph.D; Maryann Bassett, RN; Martha Sue Carraway, MD; Martin Case, BS; Andrew Ghio MD; Tracey Montilla, RN; Ana Rappold, PhD; Joachim Pleil, Ph.D; Michael Schmitt, MS; and Heidi Hiers, RN; ~~Wayne Cascio, MD;~~ Martha Almond, RN; Carol Robinette, RN; Margaret Herbst, RN; Lynne Newlin-Clapp, RN; Howard Kehrl, MD.

Name of funding source or sponsor (*please do not abbreviate*): Environmental Protection Agency
__ not funded x_ Federal __ State __ industry __ foundation __ UNC-CH
__ other (specify):
Sponsor or award number: N/A

RAMSeS number (from Office of Sponsored Research):
For industry sponsored research (if applicable):
Sponsor's master protocol version #: Date:
Investigator Brochure version: Date:
Any details you need documented on IRB approval:

Checklist of Items to Include with Your Submission

Include the following items with your submission, where applicable.

- Check the relevant items below and include one copy of all checked items 1-11 in the order listed.
- Also include two additional collated sets of copies (sorted in the order listed) for items 1-6.

Applications must "stand alone" and should provide all information requested, i.e., complete answers must be contained in the application. While you may reference other documents with supporting information, do not respond solely by stating "see attached."

Applications will be returned if these instructions are not followed.

Check	Item	Total No. of Copies
□	1. This application. One copy must have original PI signatures.	3
□	2. Consent and assent forms (include DHHS-approved sample, when one exists), fact or information sheets, phone and verbal consent scripts.	3
□	3. HIPAA authorization addendum to consent form.	3
□	4. All recruitment materials including final copies of printed advertisements, audio/video taped advertisements, scripts, flyers, letters, and emails.	3
□	5. Questionnaires, focus group guides, scripts used to guide phone or in-person interviews, etc.	3
□	6. Documentation of reviews from any other committees (e.g., Clinical and Translational Research Center (CTRC), Oncology Protocol Review Committee, or local review committees in Academic Affairs).	3
□	7. Protocol, grant application or proposal supporting this submission, if any (e.g., extramural grant application to NIH or foundation, industry protocol, student proposal). This must be submitted if an external funding source or sponsor is checked on the previous page.	1
□	8. Addendum for Multi-Site Studies where UNC-CH is the Lead Coordinating Center.	1
□	9. Data use agreements (may be required for use of existing data from third parties).	1
□	10. Only for those study personnel *not* in the online UNC-CH human research ethics training database (http://cfx3.research.unc.edu/training_comp/): Documentation of required training in human research ethics.	1
□	11. For drug studies, Investigator Brochure if one exists. If none, include package insert for previously approved uses..	1

Principal Investigator: I will personally conduct or supervise this research study. I will ensure that this study is performed in compliance with all applicable laws, regulations and University policies regarding human subjects' research. I will obtain IRB approval before making any changes or additions to the project. I will notify the IRB of any other changes in the information provided in this application. I will provide progress reports to the IRB at least annually, or as requested. I will report promptly to the IRB all unanticipated problems or serious adverse events involving risk to human subjects. I will follow the IRB approved consent process for all subjects. I will ensure that all collaborators, students and employees assisting in this research study are informed about these obligations. All information given in this form is accurate and complete.

Matt W. Case for Tina Stevens 5/31/2011

Tina Stevens, Signature of Principal Investigator Date

Faculty Advisor if PI is a Student or Trainee Investigator: I accept ultimate responsibility for ensuring that this study complies with all the obligations listed above for the PI.

David Diaz-Sanchez, Signature of Faculty Co-Advisor Date

Michael Madden, Signature of Faculty Co-Advisor Date

Part A.2. Summary Checklist *Are the following involved?*	Yes	No
A.2.1. Existing data, research records, patient records, and/or human biological specimens?	__	__x
A.2.2. Surveys, questionnaires, interviews, or focus groups with subjects?	_x_	__
A.2.3. Videotaping, audiotaping, filming of subjects, or analysis of existing tapes?	__	_x_
A.2.4. Do you have specific plans to enroll subjects from these vulnerable or select populations:		
a. UNC-CH students or UNC-CH employees?	_x_	__
b. Non-English-speaking?	__	_x_
c. Decisionally impaired?	__	_x_
d. Patients?	__	__x
e. Prisoners, others involuntarily detained or incarcerated, or parolees?	__	_x_
f. Pregnant women?	__	_x_
g. Minors (less than 18 years)? ***If yes***, give age range: to years	__	_x_
A.2.5. a. Are sites outside UNC-CH engaged in the research?	__	_x_
b. Is UNC-CH the sponsor or lead coordinating center for a multi-site study?	__	_x_
If yes, include the ***Addendum for Multi-site Studies***.		
If yes, will any of these sites be outside the United States?	__	__
If yes, is there a local ethics review committee agency with jurisdiction? (provide contact information)	__	__
A.2.6. Will this study use a data and safety monitoring board or committee?	__	x__
If yes: UNC-CH NC TraCS DSMB? (must apply separately)	__	__
Lineberger Cancer Center DSMC?	__	__
Other? Specify:	__	__
A.2.7. a. Are you collecting sensitive information such as sexual behavior, HIV status, recreational drug use, illegal behaviors, child/physical abuse, immigration status, etc?	__	__
b. Do you plan to obtain a federal Certificate of Confidentiality for this study?	__	x__
c. Is this research classified (e.g., requires security clearance)?	__	x__
A.2.8. a. Investigational drugs? (provide **IND #**)	__	_x_
b. Approved drugs for "non-FDA-approved" conditions?	__	x__
All studies testing substances in humans must provide a letter of acknowledgement from the UNC Health Care Investigational Drug Service (IDS).		
A.2.9. Placebo(s)?	__	x__
A.2.10. Investigational devices, instruments, machines, software? (provide **IDE #**)	__	_x_
A.2.11. Fetal tissue?	__	__x
A.2.12. Genetic studies on subjects' specimens?	_x_	__
A.2.13. Storage of subjects' specimens for future research? *If yes, see instructions for* ***Consent for Stored Samples***.	_x_	__
A.2.14. Diagnostic or therapeutic ionizing radiation, or radioactive isotopes, which subjects would not receive otherwise? *If yes, approval by the* ***UNC-CH Radiation Safety*** ***Committee*** *is required.*	__	x__
A.2.15. Recombinant DNA or gene transfer to human subjects? *If yes, approval by the* ***UNC-CH Institutional Biosafety*** ***Committee*** *is required.*	__	_x_
A.2.16. Does this study involve UNC-CH cancer patients? *If yes, submit this application directly to the* ***Oncology Protocol Review Committee***.	__	x__
A.2.17. Will subjects be studied in the Clinical and Translational Research Center (CTRC) or is the CTRC involved in any other way with this study? If yes, obtain the ***CTRC Addendum*** *and submit completed application (IRB application and Addendum) directly to the CTRC. The CTRC includes facilities located on the 3rd floor of the Main Hospital (formerly GCRC) and Ground floor Burnett-Womack (formerly CCCT).*	__	_x_
A.2.18. Will gadolinium be administered as a contrast agent?	..__	..x__
A.2.19. Will subjects' Social Security Number (SSN) be collected for:		
a. processing payments greater than $200 per year, to support IRS reporting (see also B.6)?	x__	__
b. processing payments of any amount through UNC-CH Accounts Payable?	_	x__
c. use as a unique identifier for study tracking purposes for national registry or database?	__	_x_

Part A.3. Conflict of Interest Questions and Certification

The following questions apply to **all investigators and study staff** engaged in the design, conduct, or reporting results of this project **and/or their immediate family members.** For these purposes, "family" includes the individual's spouse and dependent children. "Spouse" includes a person with whom one lives together in the same residence and with whom one shares responsibility for each other's welfare and shares financial obligations.

A.3.1. Currently or during the term of this research study, does any member of the research team or his/her family member have or expect to have:		
(a) A personal financial interest in or personal financial relationship (including gifts of cash or in-kind) with the sponsor of this study?	__ yes	__x no
(b) A personal financial interest in or personal financial relationship (including gifts of cash or in-kind) with an entity that owns or has the right to commercialize a product, process or technology studied in this project?	__ yes	_x_ no
(c) A personal financial interest in or personal financial relationship (including gifts of cash or in-kind) with an entity engaged in the performance of this project as a subcontractor, sub-recipient or vendor?	__ yes	_x_ no
(d) A board membership of any kind or an executive position (paid or unpaid) with the sponsor of this study or with an entity that owns or has the right to commercialize a product, process or technology studied in this project?	__ yes	_x_ no
A.3.2. Has the University or has a University-related foundation received a cash or in-kind gift from the sponsor of this study for the use or benefit of any member of the research team?	__ yes	__x no
A.3.3. Has the University or has a University-related foundation received a cash or in-kind gift for the use or benefit of any member of the research team from an entity that owns or has the right to commercialize a product, process or technology studied in this project?	__ yes	_x_ no

If the answer to ANY of the questions above is *yes*, the affected research team member(s) must complete and submit the form, which is accessible online at http://coi.unc.edu. List name(s) of all research team members for whom any answer to the questions above is *yes*:

_____

Certification by Principal Investigator: By submitting this IRB application, I (the PI) certify that the information provided above is true and accurate regarding my own circumstances, that I have inquired of every UNC-Chapel Hill employee or trainee who will be engaged in the design, conduct or reporting of results of this project as to the questions set out above, and that I have instructed any such person who has answered "yes" to any of these questions to complete and submit for approval a Conflict of Interest Evaluation Form. I understand that as Principal Investigator I am obligated to ensure that any potential conflicts of interest that exist in relation to my study are reported as required by University policy.

Matt W. Case for Tina Stevens — 5/31/2011

Tina Stevens — Date

Faculty Advisor if PI is a Student or Trainee Investigator: I accept ultimate responsibility for ensuring that the PI complies with the University's conflict of interest policies and procedures.

_____ — _____

Signature of Faculty Advisor — Date

Part A.4. Questions Common to All Studies

For all questions, if the study involves only secondary data analysis, focus on your proposed design, methods and procedures, and not those of the original study that produced the data you plan to use.

A.4.1. **Brief Summary**. Provide a *brief* non-technical description of the study, which will be used in IRB documentation as a description of the study. Typical summaries are 50-100 words. *Please reply to each item below, retaining the subheading labels already in place, so that reviewers can readily identify the content.*

Purpose: The purpose of this study is to measure cardiopulmonary responses in healthy young adults before, during, and after exposure to combinations of ozone (O3) and diesel exhaust (DE) for 2 hours with moderate exercise and to primarily investigate whether DE modulates the O3-induced effects on the lung and cardiovascular systems.

Participants: Fifteen (15) healthy young men and women in the age range of 18 – 55 years

Procedures (methods): Each subject will be exposed in environmentally controlled exposure chambers to 4 exposure regimens. Each regimen will require a 2 hr exposure with intermittent, moderate exercise on 2 consecutive days. Day 1 exposure will consist of a combined exposure to DE and O3, O3 only (i.e., no DE), or DE only, or clean air (CA) only. For all 4 regimens, subjects will return the next day (Day 2) to be exposed to O3 alone and again on Day 3 for a follow up visit. Each regimen will be separated by at least 13 days. Techniques measuring lung and cardiac physiology will be performed pre, during, and post exposure. Blood, urine, and breath samples will also be obtained and analyzed for immune and inflammatory markers, clotting factors, susceptibility factors, and exposure markers.

A.4.2. **Purpose and Rationale**. Provide a summary of the background information, state the research question(s), and tell why the study is needed. If a complete rationale and literature review are in an accompanying grant application or other type of proposal, only provide a brief summary here. If there is no proposal, provide a more extensive rationale and literature review, including references.

Numerous epidemiological studies have demonstrated an association between acute and chronic exposure to air pollution and various adverse cardiopulmonary effects including mortality, respiratory tract infections, exacerbation of asthma symptoms, chronic bronchitis, ischemic heart disease, and stroke [1] and other health effects. Understanding the components responsible for these effects is difficult because ambient air pollution is a complex mixture of gases and particulate matter (PM). In this complex mixture of ambient air pollution, ozone (O3) and diesel exhaust (DE) are generally major and important components. Controlled exposures of volunteers to either pollutant have resulted in biological effects such as lung physiological changes. However it is not known if co-exposure to both pollutants, similar to polluted ambient air, can induce additive or synergistic effects. Additionally it is also uncertain if exposure to DE, or DE with O3, can alter a subsequent exposure to O3. This study proposes to examine whether co-exposures to O3 and DE, at doses in the upper range of those encountered in urbanized settings, can induce additive or synergistic effects, and whether a previous DE exposure alters a response upon subsequent exposure to O3. The data obtained from this study will contribute to the overall assessment of air pollution effects in the U.S. and thereby may influence future health policy.

One of the best studied gas phase pollutants is ozone (O3). Effects of O3 exposure in a controlled exposure setting have been well documented particularly for decrements of lung function [2-12] and an influx of neutrophils and other markers of inflammation [13-17] at concentrations as low as 0.08 ppm in a dose-response manner. Repeated exposure of healthy adolescents to about 0.5 ppm O3 for 2 hrs on 5 consecutive days has shown a decrement in lung function after the first exposure, an even greater

decrement after a second day exposure, but then increasing attenuated lung function decrements for the next 3 exposure days [18-21]. Hence the greatest lung function decrement is after 2 days exposure, with an adaptation occurring after the first two exposures. The adaptation is associated with attenuation of some soluble biochemical mediators collected by lung lavage (eg, PGE2), but not others (eg, IL-8), after 5 consecutive days of exposure [22].

A wide variation in lung function and lung cellular response to O3 exposure has been observed among individuals with no clear understanding in the susceptibility factors involved. NSAID usage has been shown to attenuate O3-induced lung function decrements [23]. Recent reports have linked certain genetic polymorphisms to possible sensitivities to O3. For example, exercising individuals had greater lung function decrements as a group when they possessed a glutathione-S-transferase M1 (GSTM1) null genotype. Field studies over 3 years have shown increased respiratory breathing problems in children living in Mexico City who were GSTM1 null [24, 25], but no increased respiratory problems were associated with those children who were GSTP1 null.

PM exposure has been associated primarily with premature mortality [26, 27], but also with morbidity such as increased hospitalizations for cardiopulmonary problems including lung infection, asthma symptoms, and heart attacks [28-30]. Controlled ambient PM exposure studies of humans have been used to examine biological responses as surrogates for understanding the health effects and mechanisms involved in the responses. These controlled exposures have utilized inhalation of ambient PM that was concentrated to achieve increased mass concentrations (average 120 ± 14 $\mu g/m^3$ for PM2.5, with a maximum of 207 $\mu g/m^3$) at our EPA facility in Chapel Hill [31]. The controlled exposure studies have demonstrated no changes in lung physiological measurements. However, a dose-dependent increase in total number of cells, neutrophils, and monocytes was observed in the lavage fluid. Cardiac measurements showed no changes (standard deviation of normal to normal beat intervals (SDNN), percentage of normal to normal beat interval differences > 50 ms (PNN50), the high frequency domain (HF), the low frequency domain (LF), or the ratio of HF/LF) either immediately following PM2.5 exposure and 24 hrs after exposure. Animal studies have suggested that long-term exposure to low concentration of PM altered vasomotor tone, induces vascular inflammation, and potentiates atherosclerosis [32].

Diesel exhaust is a component of air pollution in urban settings, and contributes both PM and gaseous phase compounds to the atmosphere. Diesel exhaust fumes contain primarily fine ($\leq$ 2.5 μm) and ultrafine ($\leq$ 0.1 μm) carbonaceous particulates generated by incomplete combustion of fuel. The composition of the DE PM and the gases can vary depending on the type and age of engine, quality of fuel and additives, emission controls, load characteristics, and after treatment. Few controlled human exposures to diesel exhaust have been performed. Healthy human volunteers exposed to 300 $\mu g/m^3$ diesel exhaust for one hour with intermittent exercise resulted in marked systemic and redox-sensitive pulmonary inflammatory responses [33, 34], and vascular dysfunction and impaired endogenous fibrinolysis that links diesel exhaust inhalation to the pathogenesis of atherothrombosis and acute myocardial infarction [35, 36]. Despite a decade of intensive studies, much about the PM health effects problem, especially the cardiovascular effect, is still not well understood.

There are few studies looking at lung responses with combined O3 and DE in a controlled exposure setting. One study using healthy, young adults showed that a sequential exposure to 300 $\mu g/m^3$ DE for 1 hr followed 5 hr later by exposure to 0.2 ppm O3 induced more lung inflammation (eg. neutrophils collected by induced sputum) than DE alone with no O3 exposure [37]. The same research group, using similar exposure regimen exposure levels and timing, showed that diesel exhaust increased O3-induced lung inflammation (i.e., neutrophils collected by bronchoscopy) relative to O3 exposure alone [38]. Few studies with controlled O3 exposures have examined changes induced in extrapulmonary responses, including cardiac physiology and blood clotting and inflammatory factors. One study showed an increased diastolic blood pressure in healthy adults exposed to concentrated ambient particular matter

(CAPs; ~147 μg/m^3) and O3 (~0.12 ppm) simultaneously compared to clean air responses [39]. However, no separate exposure to O3 alone, or CAPs alone, were performed.

The purpose of this study is, first, to examine whether DE can alter lung and cardiovascular responses to O3 exposure when given a day before or during O3 exposure; second, to investigate if co-exposure of DE and O3 on day 1 augments the lung function decrements following a subsequent O3 exposure (day 2); third, to investigate if two consecutive days of O3 affect individual cardiovascular responses such as changes in heart rate variability (HRV) and blood pressure (BP), to ozone in young healthy adults. We will measure spirometric lung function in association with 2-hour exposures to O3. Results will be analyzed for effects of each or combinations of the above on changes in lung function. We hypothesize that an exposure to DE with O3 (day 1) or DE exposure (day 1) given prior to O3 exposure (day2) will not induce a significant decrement in lung function in healthy young adults as a group relative to O3 alone. We further hypothesize that an O3 exposure (on day 2) after the DE and O3 co-exposure (day 1) will cause significant cardiopulmonary responses in healthy young adults. Finally, we hypothesize that two consecutive days of O3 exposure will affect cardiovascular responses.

A.4.3. **Subjects.** *You should describe the subject population even if your study does not involve direct interaction (e.g., existing records).* Specify number, gender, ethnicity, race, and age. Specify whether subjects are healthy volunteers or patients. If patients, specify any relevant disease or condition and indicate how potential subjects will be identified. Researchers are reminded that additional approvals may be needed from relevant "gatekeepers" to access subjects (e.g., school principals, facility directors, hospital or healthcare system administrators).

A group of 15 healthy adults (men and women) between the ages of 18 and 55 years will participate and complete the study. However, because of potential dropouts and early terminations we will recruit as many as needed to have 15 individuals complete all 4 exposure regimens. Enrollment in this study will not be restricted to any specific races and ethnicities. All subjects will be non-smokers for at least a year, with no active cardiac or respiratory disease, or active medical problems of any kind. Pregnant women, those trying to become pregnant, and those breast-feeding, will not be accepted. All potential subjects will undergo screening procedures (previously approved 95-EPA-66 Phase I and II), including a medical history form, physical examination and routine chemical and hematologic screens. All subjects are required to be moderately active so that they could sustain a prolonged period of moderate exercise. All subjects will be recruited without regard to their genetic profiles; however, they will be genotyped and classified for presence or absence of polymorphisms of select genes.

A.4.4. **Inclusion/exclusion criteria.** List required characteristics of potential subjects, and those that preclude enrollment or involvement of subjects or their data. Justify exclusion of any group, especially by criteria based on gender, ethnicity, race, or age. If pregnant women are excluded, or if women who become pregnant are withdrawn, specific justification must be provided.

Inclusion Criteria:

1. Healthy men and women between 18 and 55 years of age
2. Physical conditioning allowing intermittent, moderate exercise for 2 hours
3. Normal lung function:
    a. FVC > 75 % of that predicted for gender, ethnicity, age and height.
    b. FEV_1 > 75 % of that predicted for gender, ethnicity, age and height.
    c. FEV_1/FVC ratio > 75 % of predicted values.
4. Oxygen saturation > 96 %.

Exclusion Criteria:

1. A history of acute and chronic cardiovascular disease, chronic respiratory disease, diabetes, rheumatologic diseases, immunodeficiency state, and acute respiratory illness within 4 weeks.
2. Subjects who are asthmatic or have a history of asthma.
3. Allergic to chemical vapors or gases.
4. Any allergic symptoms during the time of participation in the study
5. Female subjects who are currently pregnant, attempting to become pregnant, or breastfeeding
6. Subjects unwilling or unable to stop taking vitamin C or E or medications which may impact the results of the ozone challenge (such as, systemic steroids and beta blockers) at least 2 weeks prior to the study and for the duration of the study. Medications not specifically mentioned here may be reviewed by the investigators prior to a subject's inclusion in the study.
7. Current and past smokers within 1 year.
8. Uncontrolled hypertension (> 150 systolic, > 90 diastolic).
9. Subjects who do not understand or speak English
10. Subjects unable to perform the moderately active exercise required for the study.
11. Subjects with a history of skin allergies to adhesives used in securing heart rate monitor electrodes.
12. Unspecified diseases or conditions, which in the judgment of the investigator might influence the responses to the exposures, will be a basis for exclusion.
13. Subjects unwilling to stop taking over-the-counter pain medications such as aspirin, Advil, Aleve or other non-steroidal anti-inflammatory medications ("NSAIDS") for 48 hr prior to the exposures and post-exposure visits.
14. Subjects with a marked baseline prolongation of QT/QTc interval (e.g., repeated demonstration of a QTc interval >450 milliseconds (ms))

A.4.5. **Full description of the study design, methods and procedures.** Describe the research study. Discuss the study design; study procedures; sequential description of what subjects will be asked to do; assignment of subjects to various arms of the study if applicable; doses; frequency and route of administration of medication and other medical treatment if applicable; how data are to be collected (questionnaire, interview, focus group or specific procedure such as physical examination, venipuncture, etc.). Include information on who will collect data, who will conduct procedures or measurements. Indicate the number and duration of contacts with each subject; outcome measurements; and follow-up procedures. If the study involves medical treatment, distinguish standard care procedures from those that are research. If the study is a clinical trial involving patients as subjects and use of placebo control is involved, provide justification for the use of placebo controls.

This is a randomized crossover single blind study with 4 arms separated by at least 13 days. In this study we will measure cardiopulmonary responses to O3 (approximately mean concentration of 0.3 ppm over the 2 hr exposure period) and diesel exhaust (DE; ~300 $\mu g/m^3$) combined exposure and singularly, and clean air control in healthy adults undergoing moderate intermittent exercise (minute ventilation = ~ 25 liters/min/m^2 BSA). [See figure 1].

Each subject will be exposed randomly to all 4 exposure regimes separated by at least 13 days. For all regimes, the subject will be exposed to the pollutant or clean air for 2 hrs with moderate exercise during the exposures. Moderate exercise will involve riding a stationary bike in the chamber for 15 min intervals beginning after the first 15 min of exposure and resting for 15 min after each time for a total of 1 hr of moderate exercise per chamber exposure. Ventilation rate measurements will be taken at ~ 6 min into each exercise session to ensure ventilation rates are within the appropriate parameters [target ~25 L/min/ m2 BSA, which in most subjects is ~ 50 L/min.]. For the DE and O3 co-exposure, there is a potential for the O3 to interact with the DE, but the O3 concentration will be maintained at a final mean concentration of about 0.3 ppm.

All exposures will be carried out at the EPA Human Studies Facility on the UNC campus. Subjects will be monitored continuously by the EPA personnel. A duty physician will be available. The subjects will

be able to end their exposure and exit the chamber at any time if they choose to end their participation in the study. Total exposure times will be 2 hours. The exposure atmosphere will be at approximately 40 ± 10% RH and approximately 22 ± 2 °C. Clean air will be passed through an air purification system to ensure no presence of pollutant gases (O_3, NO, NO_2, SO_2, CO) in the air. Ozone and DE concentrations will be monitored continuously. The DE will be generated from a diesel engine used to power an air compressor that is located outside the Human Studies Facility, and subsequently introduced into the exposure chamber after different dilutions with clean HEPA and charcoal filtered and humidified air to give a chamber concentration of approximately 300 $\mu g/m^3$. The monitoring analyzer registers a concentration in real time. Exposures will be terminated at values $\geq$ 400 $\mu g/m^3$ during runs in which the exposure targets 300 $\mu g/m^3$ DE. This safety limit will prevent an inhalational exposure greater than 1,080 µg, which assumes that the subject, only resting for 1 hr, exercising for 1 hr, will inhale 2.7 m^3 during the 120 min exposure. It is expected that 75 to 95% of the diesel exhaust PM from this type of engine will be approximately 0.05-0.2 µm. Preliminary testing has shown the mean particle size to be approximately 0.15 ± 0.05 µm. Levels of carbon monoxide (CO), and oxides of nitrogen (NOx; mainly NO, and some NO_2), will be kept under 10 ppm CO, 15 ppm NO, and 3.5 ppm NO_2 or the exposure will be terminated. [The OSHA 8 hr time-weighted average for these substances are: CO=50 ppm; NO=25 ppm; NO_2=5 ppm; Diesel fuel used for the study will be purchased as a commercial ultra low sulfur fuel. This certified fuel represents diesel fuel composition that is typically available at gas stations for most regions of the country except for California. Subjects will enter the exposure chamber. Particle mass will be measured in real time and validated further by weighing filters after the 2 hr exposure is finished. Particle size distribution will be determined at regular intervals. Filter samples will also be analyzed for chemical composition of particles. Minute ventilation will be measured during the exercise periods of exposure.

Lung Function Test:

Primary endpoints for evaluating health effects are changes in lung functions, mainly FEV_1, FVC and FEV_1/FVC before, immediately after, and approximately every hour for up to 4 hrs post exposure.

Measurements and Collections:

Blood pressure, telemetry, and oxygen saturation will be monitored during the exposure period. Other primary endpoints for evaluating health effects, in addition to lung function, are heart rate variability (HRV) and markers of inflammation including total and differential cell counts as well as pro-inflammatory cytokines and immune system mediators and clotting factors from collected blood. Secondary endpoints from additional blood, breath, saliva, and urine samples will serve as indicators of the exposure based on the levels of metals (eg, Zn) and organics (eg, PAHs) and other components that may be derived from DE deposition. From the collected blood samples, additional parameters and indices may be obtained as analysis tools become available. Genetic analysis may also be performed on collected blood samples for susceptibility factors. A questionnaire measuring perceived stress by the subject at the beginning of an exposure regimen will be performed. Some of the supplemental spirometric measurements and secondary endpoints may not be obtained if they are deemed unnecessary.

In order to participate in this study, subjects will be asked to:

- Avoid smoke and fumes for 24 hours before all visits.
- Avoid drinking alcohol 24 hours before all visits.
- Avoid strenuous exercise for 24 hours prior to and after all visits.
- Avoid the use of ozone-based home air purifiers during study participation.
- On the exposure days, eat a light breakfast.
- Refrain from all over the counter anti-inflammatory agents including those for allergies for a period of 48 hrs prior to exposure.

Figure 1

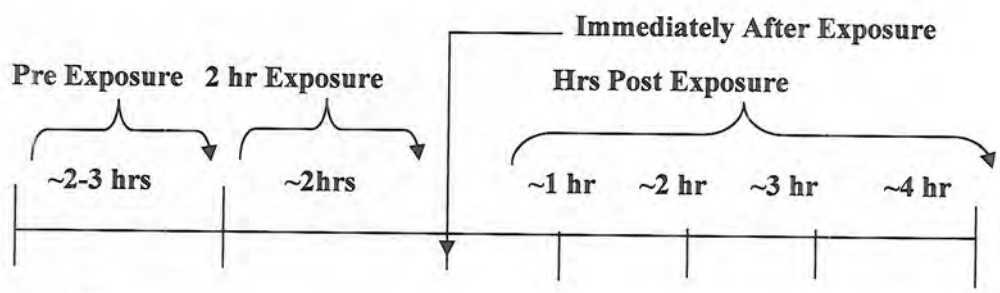
Experimental design:

	Day 1 2 hr exposure	Day 2 2hr exposure	Day 3
Exposure Regime 1	DE + O3	O3	follow up (no exposure)
Exposure Regime 2	O3	O3	follow up (no exposure)
Exposure Regime 3	DE	O3	follow up (no exposure)
Exposure Regime 4	Clean Air	O3	follow up (no exposure)

==========**Figure 2**

Endpoints:

Day 1



Measurements & Collections	*			*				
Lung Function	*	*	* * *	*	*	*	*	*

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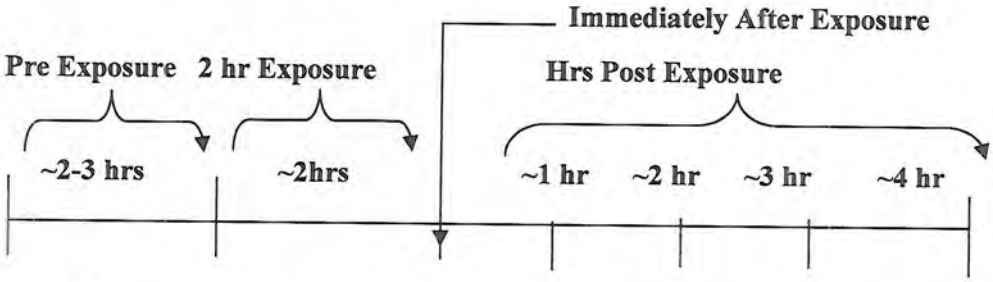
Day 2



Measurements & Collections	*			*				
Lung Function	*	*	* * *	*	*	*	*	*

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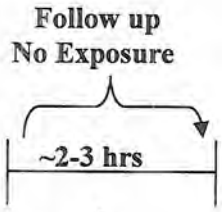
Day 3



Measurements & Collections	*
Lung Function	*

Protocol: Written consent will be obtained. The subjects will be trained (on D0) in techniques for obtaining lung function measurements. Subjects also will exercise on a bicycle, and appropriate settings (the speed and grade of incline) required to produce a desired value of minute ventilation will be determined. On the first day of exposure, subjects will be assessed for vital signs (blood pressure, pulse, temperature and respiratory rate) at the check-in. Subjects may perform pre-exposure baseline lung functions in clean air, have resting heart rate variability (HRV) assessed, and urine, blood, saliva, and exhaled breath collected for later analyses of soluble mediators such as clotting factors, inflammatory proteins, and lipids and blood cell types and numbers. These samples may also serve to determine biomarkers of exposure, such as the concentration of PAHs. A questionnaire measuring perceived stress by the subject at the beginning of an exposure regimen will be filled out; this is included as Attachment #1. [Information about grading the questionnaire (Sheldon Cohen Perceived Stress Scale) is described at www.mindgarden.com].The subject then will enter the chamber already set for the appropriate conditions (DE & O3, DE alone, O3 alone, or clean air), and after 15 min begin exercising on a stationary bicycle. Each exposure session will consist of 4 periods of 15 rest/15 min exercise at a level of approximately 25 liters/min/m^2 body surface area (BSA) in minute ventilation. Lung function measurements, including FEV1, will be obtained for safety precautions using a portable spirometer in the chamber during the exposure period. Measurements of lung function will also be obtained immediately after, and every hour for up to 4 hr post exposure using the dry seal digital spirometer. Resting HRV may be recorded, and blood, urine, saliva, and breath collected immediately post exposure. Following the day 1 exposure, the subject may remain at the Medical Station for follow up measurements of lung function for approximately 2-4 hr. The subjects will go home with a heart rate monitor and blood pressure cuff. On Day 2, the subject will report to the medical station in the morning. The same measurements (resting HRV, lung function; symptoms; venipuncture performed) as Day 1 may be done pre- and post- exposure to O3. Subjects will return on Day 3 for follow up measurements but with no exposures.

Experimental procedures:
Medical history will be collected, including current medications and any recent illness.

Vital signs will be measured to include height, weight, heart rate, respiratory rate, blood pressure, oxygen saturation, and temperature. In addition a pregnancy test will be given to all women before each exposure regime.

Spirometry will be performed for safety measures on a portable spirometer during exposures in the chamber and as a primary endpoint on a dry seal digital spirometer to record forced expiratory maneuver, forced vital capacity (FVC), forced expired volume in the first second (FEV_1), and FEV_1/FVC.

Exhaled Breath Collection: The participant will be asked to breathe into a cooled tube for up to 15 minutes. Collected breath condensate may be analyzed for markers of airway inflammation and immune system alterations and exposure markers. Additionally a small Tedlar bag of uncooled, exhaled breath

will be collected (up to 5 min) to examine gas phase exposure and inflammation/immune system constituents.

For exercise measurements the subjects breathe for up to 3 min through a pneumotachograph while performing exercise and ventilation parameters including the minute ventilation, tidal volume and breathing frequency will be obtained. Heart rate will be monitored throughout exposure using a telemetry monitor.

Cardiac measurements: Heart Rate Variability monitoring (ambulatory ECG) monitoring: On the day 1 and day 2 of each of the exposure regimes we will mount a Holter monitor to the participants. The skin may be shaved (men only) and prepped. ECG electrodes are attached and connected to the beeper-sized Holter monitor, which participants wear around their waist. After mounting the monitor onto participants, they will be asked to relax for 20 minutes in a reclined position after which a 10-minute resting HRV measurement will be obtained. Participants are released while wearing the Holter monitor and return to the HSF the next morning (day 2 of the study segment) to obtain the Holter monitor information and change the batteries, if necessary. The monitor will be worn for day 2 and removed on day 3. We will analyze time and frequency as well as re-polarization parameters. Participants will be given instructions for the removal of the monitor in case it becomes necessary.

Blood pressure (BP) measurements: BP will be monitored during the study. A BP cuff may be worn to measure BP intermittently. A pressure cuff and a monitor which is about the size of the Holter monitor will be placed and will remain in place until the subjects leave for the day. The subjects will be instructed to keep arm relaxed and still when the pressure cuff is inflated. The subjects may wear the cuff for day 1 and 2 of the study session and have it removed on day 3. Participants will be given instructions for the removal of the monitor in case it becomes necessary.

Venipuncture: Up to approximately 500 ml of blood will be collected for the 8 exposure days over a minimum of 8 weeks. This translates to approximately 50 ml of blood for each exposure day and 25 ml on the follow up day. A portion of the sample will be used for genotyping to examine sensitivity in selected blood types. Blood will be analyzed for, but not limited to, clotting/coagulation and inflammation factors and biomarkers of immune response.
A portion of the peripheral blood sample will be used for genetic testing, to identify potential polymorphisms that may make subjects more susceptible to air pollutants. In addition, samples may be stored for as yet undesignated research. Unwillingness to have samples used for genotyping or stored will NOT exclude a subject from the panel study. Consent for genotyping will be included with the general consent form.

Saliva: subjects will be asked to spit into a cup or tube for comparison of inflammation/immune system constituents and exposure markers with exhaled breath. Up to about 5 ml will be collected.

Urine: Participants will collect their urine on days 1, 2, and 3 for each arm of the study. Day 1 will be a 24 hr collection. Urine collection on days 2 and 3 will be limited to subject's stay in the facility. It is estimated that there will be on average seven urine voids collected per person for a 24 hr sampling period [40]. Each urine void will be collected in a separate 1 L polypropylene container (*not pooled*) for this study. In addition, each urine void will be analyzed separately for exposure reconstruction purposes.

For collection of a 24 hr urine sample, each participant will start collecting their individual urine samples on day 1 at the medical station (~8:00 a.m.) and collect through the first morning void the next day (i.e. day 2). The participants will collect each urine void in a separate 1 L polypropylene container and record the time the sample was collected and the time of their last urine void. Then, they will place the container in a provided thermoelectric cooler. The participant will return the cooler containing the 24 hr urine collection samples in the morning at the HSF on day 2, for each arm of the study. On day 2, a urine

sample before and immediately after exposure will be collected. On day 3, one urine sample will be collected. For each person, it is estimated that about 40 samples (~10 urine samples per exposure session X 4 exposure sessions) will be collected from them during the study.

Urine will be examined for markers of exposure (e.g. PAHs) and effect (e.g. IL8 as a marker of inflammation), plus normalization factors (e.g. creatinine).

Likely Personnel assignment	
Subject recruitment and payment	Westat Corporation (Protocol #950518)
Chamber setup and maintenance	TRC Environmental Corporation
Subject surveillance during exposure	Martin Case, BS, Mike Madden, PhD, Tina Stevens, PhD, Howard Kehrl, MD, David Diaz-Sanchez PhD, Medical Station personnel
Lung function testing	Martin Case, BS, Mike Madden PhD, Tina Stevens, PhD Howard Kehrl, MD, Martha Almond, RN, Carol Robinette, RN, Margaret Herbst, RN, Lynne Newlin-Clapp, RN
Blood sampling	Human Studies Facility Medical Station personnel
Subject screening tests	Human Studies Facility Medical Station personnel
Genomic assay	Michael Schmitt, MS

A.4.6. **Benefits to subjects and/or society.** Describe any potential for direct benefit to individual subjects, as well as the benefit to society based on scientific knowledge to be gained; these should be clearly distinguished. Consider the nature, magnitude, and likelihood of any direct benefit to subjects. If there is no direct benefit to the individual subject, say so here and in the consent form (if there is a consent form). Do not list monetary payment or other compensation as a benefit.

The results of this study will contribute to the overall assessment of air pollution effects in the U.S. and thereby influence health policy. The subjects will not benefit personally from being in this research study other than by undergoing a free limited physical examination and screening.

A.4.7. **Full description of risks and measures to minimize risks.** Include risk of psychosocial harm (e.g., emotional distress, embarrassment, breach of confidentiality), economic harm (e.g., loss of employment or insurability, loss of professional standing or reputation, loss of standing within the community) and legal jeopardy (e.g., disclosure of illegal activity or negligence), as well as known side effects of study medication, if applicable, and risk of pain and physical injury. Describe what will be done to minimize these risks. Describe procedures for follow-up, when necessary, such as when subjects are found to be in need of medical or psychological referral. If there is no direct interaction with subjects, and risk is limited to breach of confidentiality (e.g., for existing data), state this.

This study might involve the following risks and/or discomforts:

1. Blood sampling will be performed by well-trained personnel, and entails only a risk of mild discomfort with the infrequent possibility of lightheadedness, fainting, infection or developing a bruise. Subjects are closely monitored for any signs of faintness, and only allowed to leave the facility after a 15-min waiting period.

2. Breathing tests (spirometry): There pulmonary function tests are standard clinical tests that are commonly performed in hospitals and entail little or no risk to the subjects. However, cough or dizziness may occur during these tests. If these symptoms occur, they are usually temporary. Subjects will remain seated in a chair until symptoms disappear. There is an extremely small chance that the subject could have a bronchospasm or faint upon performing a forced breath expiratory maneuver for spirometry.
3. Exhaled breath condensate and exhaled breath gas: Minimal risk is associated with these procedures. The subject is seated in a chair during these collections and the technician is always available during this procedure in case the participant becomes light-headed due to hyperventilation.
4. Moderate exercise on a stationary bicycle entails the potential, although minimal, risk of occasional muscle soreness, cramps or general fatigue. These discomforts are temporary and not harmful. Heart rate and rhythm will be monitored continuously. Heart rate will be kept below age related maximum (i.e., 220 bpm – age in years). Exercise will be terminated at any time upon the request of the subject or if the investigator/medical staff observes problems while monitoring the ECG readout.
5. Ozone exposure: Potential risks may include mild decrements in lung function spirometric volume, irritation to the nose, eyes, throat and airways, pain on deep inspiration and cough. These symptoms typically disappear 2 to 4 hours after exposure, but may last longer for particularly sensitive people. Ozone may induce an inflammatory reaction that may last for about 24-48 hours after exposure and may increase the chance of catching a cold.
6. ECG and heart rate variability are standard non-invasive techniques commonly used for heart rate and rhythm analysis and entail little or no risk to the subject. There is the possibility that preparation of the skin for electrode placement and removal may cause skin irritation, itching, or soreness in some subjects.
7. Blood pressure and heart rate measurement: Similar to the regular blood pressure measurement, the risk associated with blood pressure monitor is considered minimal.
8. Diesel exhaust (DE) exposure: The amount of DE (target of 300 $\mu g/m^3$) used in this study would be equivalent to concentrations of DE particulate matter that would be encountered at busy intersections in large urban areas and in occupational exposures. Occupational levels for some truck drivers are generally about 100-300 $\mu g/m^3$ and average ~900 $\mu g/m^3$ for some mines where diesel powered machinery are used. A recent study demonstrated diesel exhaust particulate matter concentrations during drive-by incidents averaged about 125 and199 μg/m3 at the height of an adult pedestrian and a child in a stroller, respectively. Using a 2006 diesel engine, (generally recognized as emitting less PM mass than most older models currently on the road), it was demonstrated that an average DEP concentration up to 364 ug/m^3 (over ~9 sec) could be generated at near roadside monitoring stations at head level during drive by simulations with a peak concentration of 860 ug/m^3. [41].
   Controlled, acute DE exposure studies in Sweden, using about 300 $\mu g/m^3$ of DEP, have shown lung inflammatory effects not unlike effects observed with numerous ozone exposure studies performed here at the EPA facility on the UNC campus during the past 20 yr. DE particles contain some probable carcinogenic polycyclic aromatic hydrocarbons and other components, which in high enough concentrations and/or with repeated exposures may induce tumors. Diesel exhaust also contains aldehydes, some of which are possibly carcinogenic in high enough dose and with long enough exposure. However, the exposure time and concentrations to be used in this protocol are minimal relative to the durations required to induce lung cancer. Overall, there are no known long-term health risks in healthy individuals acutely exposed to DE at the PM concentrations given in this study. Short-term health effects include slight alterations in

blood clotting, oxygen diffusion capacity and changes in heart rate variability. These symptoms typically disappear within 24 hrs of exposure. During exposure, subjects will be monitored by direct observation or via closed-circuit television. Subjects will have EKG leads attached during the exposure to monitor cardiac function during exercise. Subjects will be aware that they can terminate their exposure for any reason and still receive compensation for their participation up to that point. The investigators or duty physician will end the exposure if the subject is found to be suffering from any significant adverse effect. No major adverse effects were observed in a completed diesel exhaust study of healthy adults (ages 18-40; entitled "Physiological, Cellular, and Biochemical Effects of Diesel Exhaust in Healthy Young Adults"; Mike Madden, PI; UNC IRB # # 99-0842) where the PM concentration averaged 106 ug/m3. No major adverse health effects were observed in a completed study that exposed subjects (18-35 yr old, healthy volunteers) to concentrated Chapel Hill air particles here at the EPA facility (Physiological and Biochemical Changes Associated with Exposure to Air Pollution Particles; Andrew Ghio, MD, PI; UNC IRB# 95-EPA-310). The maximum PM concentration reached 311 $\mu g/m^3$ during the exposure. The data from this exposure study suggest that normal healthy subjects tolerate inhalation of concentrated ambient PM fairly well, and support the idea that exposures to lower PM concentrations, including DEP, will be fairly safe in terms of cardiopulmonary responses. For safety reasons, pulse oximetry will be performed during the exposures and the subject withdrawn from the chamber if the O_2 saturation value is $\leq 92\%$. Additionally subjects will have carboxyhemoglobin values determined within 1 hr after an exposure and kept at the Medical Station if levels are >20% (where performance of everyday cognitive tasks may be jeopardized) until levels become <20%; but because the CO levels are expected to be 2-4 ppm [based on preliminary chamber characterizations], levels are expected to be < 5%.

A duty physician is always onsite to respond to an emergency. Fully equipped resuscitation equipment is available for use in the event of a cardiac or pulmonary emergency. Physicians at the University of North Carolina (UNC) Hospitals Emergency Room are also available to assist in treatment of an emergency.

Heart rate and rhythm, and pulse oximetry will be monitored continuously. Subjects will also be monitored for significant respiratory distress or dyspnea, chest pain, significant cardiac arrhythmias, pallor, and ataxia. Subjects will be aware that they can terminate their exposure for any reason and still receive compensation for the entire exposure session. The investigator or duty physician will end the exposure if the subject is found to be suffering from any adverse effect.

9. Effects of combined ozone and diesel exhaust exposure: Because this exposure scenario has not been conducted at our facilities or elsewhere before, we do not yet know whether or not this exposure will include the same risks as diesel exhaust and ozone exposures alone. It is possible that the combination of diesel exhaust and ozone exposures will increase the effects of each pollutant individually, and it is also possible that it will not. We are doing this study in order to find out the answer.
10. Confidentiality: Risk of breach of confidentiality is minimal. All subjects will be assigned a study number which will be used for data recording – not the subject's name. The study number is all that will be entered into computer databases. All paper files

that may contain the subject's name or screening number are secure in a locked cabinet in a locked room at the US EPA facility. Any abnormal medical findings (CBC, ECG, spirometry) will be discussed with the volunteer and the volunteer will be counseled to seek treatment from his/her personal physician. Samples will be stored at the U.S. EPA HSF. A numeric coding system will be used to ensure that subjects cannot be directly identified from the samples alone.

In addition, there may be uncommon or previously unknown risks that might occur. During all testing, subjects will be monitored continuously by the EPA personnel. A duty physician will be available in response to an emergency. A group of physicians employed by EPA and UNC Center for Environmental Medicine, Asthma & Lung Biology have primary responsibility for medical coverage of studies conducted in the EPA Human Exposure Facility. This facility is also equipped with an emergency "crash cart" with standard emergency medications, IV fluids and a defibrillator in the unlikely event of a medical emergency for any challenge or exposure study.

A.4.8. **Data monitoring and analysis.** Tell how the qualitative and/or quantitative data will be analyzed. Explain how the sample size is sufficient to achieve the study aims. This might include a formal power calculation or explanation of why a small sample is sufficient (e.g., qualitative research, pilot studies). Describe the provisions for monitoring the data to ensure the safety of participants. These plans could range from the investigator monitoring subject data for any safety concerns to a sponsor-based DSMB, depending on the study.

The research objective of this study is to determine if healthy volunteers safely exposed to low levels of O3 and DE alone or in combination, will show changes in cardiopulmonary endpoints including modest decrements in lung function. The study will follow a randomized, repeated measures design with each subject exposed to 4 different exposure regimens (see Figures 1 and 2 above). The data analysis will be focused on changes in lung function measurements, primarily FVC and FEV_1, between pre and post 2hr exposure for each exposure, but also blood endpoints include inflammatory factors (eg IL-6), blood clotting factors (eg fibrinogen), and susceptibility factors (eg specific genotypes such as glutathione-S-transferase M1 (GSTM1) null).

In evaluating exposure effects of O3 and DE, alone or in combination, upon lung function, the difference between the pre-exposure and post-exposure FEV1 will be calculated and the pre-post differences for the air and the exposures will be compared utilizing repeated measures ANOVA parametric test. Clinically significant change is determined to be a 10% decrease in FEV1 measured prior to and immediately after the exposure compared to the pre exposure value. For a conservative sample size calculation, we used one sided test for a single sample under the assumption of normal distribution with Type I error of 5% and Type II error of 20%. Therefore, a ρ value of 0.05 or less will be considered significant and the proposed sample size will provide adequate (80%) power for detecting a 10% decrease in ΔFEV1.

Sample size calculation was based on the Forced Expiratory Volume in 1 Second (FEV1) in response to the O3 exposure. Data for the power calculation were obtained from results of FEV_1 [42] for a constant acute exposure to 0.3 ppm O_3 versus clean air (CA). In 22 subjects, the pre exposure FEV_1 was 4.608 ± 0.514 (mean ± SEM) in CA exposure and 4.656 ± 0.592 in O_3. The post exposure FEV_1 was 4.64 ± 0.476 in CA exposure and 3.856± 0.687 in O_3. We used 0.687 as an estimate of standard deviation after the ozone exposure and estimated 10% decrease in pre-exposure FEV1 levels to be 0.46 ml. Based on these data and the test for the mean of a normal distribution with a one-sided alternative the required

sample size is 14 subjects. We will recruit 15 subjects for this study to ensure the statistical power that can analyze small differences expected from low concentration exposures.

Although EPA does not have an official Data Safety Monitoring Board, we do have measures in place to insure the safety of our subjects. Adverse events will be reported to Bob Truckner, the EPA/NHEERL human research protection officer of the IRB.

Precautions taken to minimize risk to the subject include:

1. subject monitoring via direct observation or CCTV during exposure
2. Cardiac function will be assessed throughout the exposures. Evidence in 2 individuals of a QTc interval >450 milliseconds (ms) will prompt a pause in the study. The length of the QT period was chosen as the primary endpoint to examine as a marker of cardiac toxicity in part based on this marker's use in Phase 1 Clinical Trials where possible cardiac toxicity was monitored via ECG. In addition, QTc interval increases greater than 60 ms from baseline will also prompt a pause in the study.
3. Pulse oximetry will be performed during the exposures and the subject withdrawn from the chamber if the oxygen saturation value is $\leq 92\%$.
4. Subjects will be aware of their right to terminate their participation in the study without prejudice.
5. Lung function will be monitored in the chamber during exposures using a portable spirometer. If FEV1 decreases by 40% from baseline, as measured by the portable spirometer, the subject will be removed from the chamber and the exposure will be terminated.
6. Any exposure will be stopped upon evidence of any adverse effects suffered by the subject during the exposure
7. Full resuscitation equipment will be available at all times during exposures and used if needed
8. In the event of an emergency, after initial medical assessment, patients will be transported to the UNC Hospitals Emergency Room for continued treatment
9. A formal pause to the study will be performed by the medical station staff after 4 subjects complete the 4 exposure regimes to assess whether highly adverse effects occurred with respect to lung and cardiac physiology responses. If no highly adverse effects are observed, the study will continue.