**Project Name:** Carbon footprint impact of reduction in unnecessary prostate biopsies

**Organization Names:** Yale-New Haven Hospital (YNHH) and Yale School of Medicine, Departments of Urology and Anesthesiology

**Preceptor Names and Contact Information:**
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**Description of the Organization:**
YNHH is a 1,541 bed, private, nonprofit teaching hospital that ranks among the premier medical centers in the nation. It is the largest acute care provider in southern Connecticut and one of the Northeast's major referral centers, servicing 1.1 million patient visits and performing 50,000 surgeries annually. The primary York Street Campus is located in New Haven.

**Project Description:**
The objective of this project is to quantify the magnitude of greenhouse gas emissions associated with prostate biopsies performed in the diagnosis, evaluation and management of prostate cancer, and to estimate the effect of reduction in unnecessary biopsies.

The US healthcare sector is responsible for nearly 10% of the nation's greenhouse gas emissions. If the US healthcare sector were a country itself, it would rank 13th in the world for greenhouse gas emissions. One-third of US healthcare has been deemed wasteful and unnecessary, and thus reducing waste is an important way to reduce the carbon footprint of US healthcare without compromising quality of care.

Prostate needle biopsy is a mainstay of the diagnosis and management of prostate cancer. Approximately one million prostate biopsies are performed each year in the United States, mostly in the setting of clinical suspicion for prostate cancer encountered during screening of males with prostate-specific antigen (PSA), or in the active surveillance (AS) of patients with low-grade prostate cancers. Conventional prostate biopsies are guided by ultrasound. However, the field is moving toward MRI-fusing biopsies in which MRI imaging and ultrasound are fused, resulting in greater biopsy precision.

Efforts to reduce the number of prostate biopsies performed globally are informed by the direct harms associated with the procedure, including discomfort, bleeding, and infection (observed in 1-4% of patients), risks of over-diagnosis of indolent disease, and considerations of cost. In addition, by virtue of its scale and reliance on disposable equipment, the environmental impact of the procedure remains poorly defined.

A growing appreciation for the biologic and clinical heterogeneity of prostate cancer has indicated that a significant proportion of incidentally discovered cancers possess indolent clinical characteristics, and informs efforts to temper early-detection efforts in patients unlikely to harbor aggressive disease. Moreover, prior estimates suggest that prostate biopsy is still over-performed outside of guideline recommendations, particularly in older patients or those with limited life expectancy due to competing comorbidities. Indeed, prior analyses from the National Health Interview Survey (NHIS), a face-to-face, computer assisted, cross sectional survey performed in the United States, have demonstrated that approximately one third of men over the
age of 75 are screened for prostate cancer, outside of explicit guidelines advising against screening in this demographic.

Quantification of greenhouse gas emissions resulting from prostate biopsies could invigorate compliance with current guidelines, motivated by new information on pollution emissions of wasteful practices. Further, pollution prevention recommendations may be adopted by the Choosing Wisely Campaign, which seeks to promote evidence-based guidelines to reduce waste and conserve resources. Results of this project could further motivate health care providers to lead by example in mitigating the climate crisis, as is advocated by the Lancet Commission on Health and Climate Change and the World Health Organization.

This project will have three aims:

**Aim 1**: Examine longitudinal trends in the utilization of prostate biopsies among Medicare beneficiaries, via Yale Cancer Outcomes, Public Policy, and Effectiveness Research (COPPER) SEER-Medicare database, as well as a review of the literature.

- **Aim 1a**: Query COPPER database to determine trends in the number and proportion of patients undergoing biopsy in patients >75 years or those with <10 year life expectancy
- **Aim 1b**: Query COPPER database to determine trends in the incidence of serious bleeding or infectious complications related to prostate biopsy in patients >75 years or those with <10 year life expectancy
- **Aim 1c**: Conduct a thorough literature review of prostate biopsy trends in the US

In these analyses, students will attempt to distinguish between biopsies associated with screening and biopsies associated with AS. Heterogeneity according to geographic region, age, and race will be explored.

**Aim 2**: To estimate the carbon dioxide emissions associated with prostate biopsies, in consultation with environmental engineers, use of online carbon calculators, and through literature review.

- **Aim 2a**: Compile an inventory of material and energy inputs from supply lists by surgeons and pathologists, and include radiology equipment
- **Aim 2b**: Consult with environmental engineers (either using a life cycle assessment [LCA]-process-based approach or via economic input-output [EIOLCA] modeling [Carnegie Mellon University web tool]) to estimate procedure carbon footprint
- **Aim 2c**: Perform literature review and use the EPA miles-CO$_2$ conversion tool to estimate carbon footprint reduction from averted miles driven for clinic visits

**Aim 3**: Using results from Aims 1 and 2, to estimate the carbon footprint impact, cost savings, and averted serious bleeding or infectious complications associated with measures to reduce unnecessary prostate biopsies in the US population

- **Aim 3a**: To estimate the carbon footprint reduction associated with screening guideline-concordant biopsy practices compared with current practices
- **Aim 3b**: To estimate the carbon footprint reduction associated with reductions in serial prostate biopsies conducted for the purpose of AS
- **Aim 3c**: To estimate the cost savings and reduction in serious bleeding or infectious complications associated with reducing unnecessary prostate biopsies

**Expected Work-Product and Deliverables:**

1. Report written in manuscript form, including abstract, introduction, methods, results and discussion
2. Optional collaboration with preceptors for academic publication