

Environmental and Occupational Health Working Group Report: Analysis of Existing Strengths,
Critical Gaps, and Opportunities for Collaboration
May 2014

Analysis

Strengths.

In the 1980's the New Jersey state government was under tremendous pressure to take strong political action to address the increasing concern of how the environment affected the health of its citizens. This led to the state providing resources to Rutgers and UMD to a recruit a strong cadre of faculty in environmental health sciences and in 1986 the formation of the Environmental and Occupational Health Sciences Institute (EOHSI). Due to the strong and creative leadership of EOHSI, its talented faculty who were developing major individual research programs also consciously choose to work together to create a truly interdisciplinary research center.

Faculty

Rutgers strength begins with the faculty. They are recognized as experts as evidenced by their invitations to participate on committees that recommend or set policy on or priorities for environmental and occupational health for the state of NJ, nationally and globally. These include testimony before the US Congress, chairing or serving on committees for the National Academy of Sciences, Institute of Medicine, National Institutes of Health, US Environmental Protection Agency (EPA), NJ Department of Environmental Protection (NJDEP) and NJ Department of Health (NJDOH) etc., as well as serving on Governmental Science Advisory Boards (NIEHS, USEPA, NJDEP, NJDOH). The faculty have been leaders and speakers at Gordon Conferences, Chair of the Threshold Level Value Committee for the American Conference of Industrial Hygienists, Board of Science Committee for the National Toxicology Program etc.

The research conducted by Rutgers faculty from across multiple departments examines a broad range of environmental and occupational exposures, their health outcomes and policy implications. Between 2008 and 2013 Rutgers faculty members have published more than 1,200 articles in the area of Environmental and Occupational Health, with many being joint publications indicative of the inter-disciplinary and collaborative nature of research that currently exist. Publications have been in high impact journals across a variety of fields including: Science, Nature, JAMA, Neurology, Risk Analysis, Environmental Science and Technology, Environmental Health Perspectives and the American Journal of Public Health, to name a few. Faculty have also published more than 10 books and contributed numerous book chapters over the past five years.

When compared to our peer institutes we are ranked as one of the best based on the number of publications and on searches in PubMed using the key words, environmental health and occupational health. Searches were restricted to the last five years by institution, with Rutgers and various combinations of UMDNJ, New Jersey Medical School, and RWJMS used to identify publications. It is likely that this restriction resulted in under-counting of publications, but this would apply equally across the comparison Universities.

Table Prioritizing Publications Compared to Peer Universities, 2008-2013

School	Occupational Health* (Rank/Pubs)	Environmental Health (Rank/Pubs)
Rutgers University (plus UMDNJ)	2/747 - #1 in Big 10	3/1010 - #2 Big 10
University of Michigan	3/693	2/1528
University of Wisconsin	8/269	7/459
University of Iowa	4/559	5/682

University of Maryland	6/398	9/320
University of Illinois	5/551	4/685
Michigan State University	9/211	8/416
University of California-Los Angeles	7/356	6/631
University of Washington	1/1355	1/2224

**Note: The difference in the numbers of articles quoted in the text of >1200 and the sum of the two categories for Rutgers above (>1750) is the former are individual articles of faculty that are members of the NIEHS Center while the later includes all faculty at Rutgers that are cited by PubMed with these search terms and an individual paper could be both Environmental and Occupational Health so would be listed in both categories but only once for the >1200 count.*

In the area of Environmental policy, the Edward J. Bloustein School of Planning and Public Policy (EJB) stands out as a non-RBHS partner that has successfully collaborated with the environmental health group. For context, the EJB planning program was ranked number 3 out of 104 in the U.S. in the last evaluation (MIT & Cornell were ranked higher.)

Besides widely disseminating our research in scientific articles and books, faculty have received research funding related to Environmental and Occupational Health from federal, state, non-profit and industrial sources. Since 2008 more than \$22 million in research grants have been received from NIEHS and an additional \$98 million received from other NIH Institutes on projects related to environmental and occupational health issues. Other federal agencies, such as the CDC, Department of Energy, EPA, Federal Aviation Administration, Housing and Urban Development, National Institute of Occupational Safety and Health (NIOSH), Federal Emergency Management Agency, Department of Homeland Security, and the National Science Foundation have funded in excess of \$37 million to research related to environmental and occupational health and policy. Funding has also been received from the state of New Jersey, Foundations, and industrial sources.

In addition to these quantitative data, qualitative information further underscores the strength of the faculty. Faculty members from Rutgers-UMD have won 4 of the 33 annual lifetime achievement awards from the Society for Risk Analysis since 1980. Similarly, four of our faculty have received the lifetime achievement awards given by the International Society of Exposure Science, which was formed in 1989. Several faculty have been editors or assistant editors for scientific journals, such as Risk Analysis, the American Journal of Public Health, Environmental Health Perspectives, Journal of Exposure Science and Environmental Epidemiology, Toxicology and Applied Pharmacology, Journal Air Waste Management Association, Developmental Dynamics, Matrix Biology, Environmental Science and Technology, Aerosol Science and Technology, etc. and are frequently asked to serve as reviewers for articles and grant applications.

Centers: Rutgers is home to the longest continuously funded of the current 20 National Institute of Environmental Health Sciences (NIEHS) Centers of Excellence – the Center for Environmental Exposures and Diseases (CEED), which has fostered collaborative research to understand, detect, prevent and solve environmental health problems for the past 26 years. Rutgers also hosts the NIH Center of Excellence for Countermeasures Against Chemical Threats, a U.S. EPA Center for Exposure and Risk Modeling (CERM), and a NJDEP Ozone Research Center. The Bloustein School has had a National Transportation Security Center of Excellence Center for Transportation Safety, Security and Risk supported by the US DHS, and a National Center for Brownfield Research funded by the EPA. A new International Center for Environmental Research (ICER) has also been recently formed by EOHSI in collaboration with Universities and Governmental agencies in China, Italy, Mexico, South Korea, and Thailand. This just led to a grant to establish "Center For China Environmental Health (CCEH)" at EOHSI to develop and expand programs in research, education, and training in Chinese environmental health by collaborating with partners in China.

Education: Two nationally recognized graduate programs are housed in EOHSI. The Joint Graduate Program in Toxicology, established in 1980 is in its 27th continuous year of a T32 NIEHS training grant, documenting the recognized excellence of the program. The Joint Graduate Program in Exposure Science was accredited in 1992 and was the first program in the nation to grant a doctoral degree Exposure Science. It received the first T32 NIEHS training grant ever awarded in Exposure Science in 2011. Two of the Toxicology faculty have received Toxicology Educator of the Year and two the Women in Toxicology Mentoring Awards at the Society of Toxicology (SOT). At this past SOT meeting 15 Rutgers students received awards for their presentations demonstrating the recognition of our faculty and students.

Faculty from multiple departments teach graduate students about environmental and occupational health. Some programs are housed in EOHSI and others are resident in their home departments across the campus. A core goal of the environmental health education at Rutgers is to develop scientists trained to be conversant across the entire field to understand how to integrate results from epidemiological and toxicological studies with exposure science leading to new understandings of risk analysis and risk management. These graduate students take courses literally from one end to the other of the Rutgers, New Brunswick Campus. Three educational programs are partially housed in EOHSI: the Joint Graduate Program in Toxicology and the Joint Graduate Program in Exposure Science which have NIEHS T32 training grants and a National Institute of Occupational Safety and Health (NIOSH) funded Occupational and Environmental Medicine Residency program. Having diverse graduate programs in a single building provides a unique opportunity for students to be broadly educated about Environmental and Occupational Health. This is enhanced by their watching their mentors interact daily with scientists across different disciplines. For example, the biweekly seminar held at EOHSI is well attended by students and faculty across different programs.

In addition, several Rutgers units have also developed a certificate program in transportation management: vulnerability, risk and security. This program includes courses from seven different Rutgers units and is managed by the Bloustein School. Graduate programs (MS and Ph.D.) also exist in Environmental Sciences, Food Sciences and a recently approved Master's Degree in Bioenvironmental Engineering within the School of Environmental and Biological Sciences (SEBS), in Environmental and Occupational Health and in Epidemiology (MPH, Ph.D. and DrPh) at the School of Public Health (SPH), and Pharmacy, Medicinal Chemistry and Toxicology (M.S., Ph.D. and MD/Ph.D.) at the Ernest Mario School of Pharmacy (EMSOP). Education extends below university-based education. EOHSI and SPH have been translating environmental health research into age-appropriate K-12th grade curricular materials. EOHSI/SPH's curricular materials have been used in school districts in 27 states, Washington DC, Guam and Puerto Rico. Finally, RBHS now has 2 residency training programs for physicians focusing on occupational and preventive medicine. The one at RWJMS specializes in occupational and environmental medicine and the one at NJMS in preventive medicine and public health.

Influence on Public Policy and the Interdisciplinary Model: An important strength of the Rutgers environmental health group is the ability and desire to link science and public policy. The following bullets list some of the major issues that we have played key roles:

- Collection and evaluation of exposures at the World Trade Center
- Creation of the model for the U.S. toxic release inventory data base
- Environmental justice guidelines for the US EPA
- Evaluation of Tocks Island Dam proposal
- Toms River leukemia cluster

- MTBE water and air pollution
- Risk analysis of removal of asbestos from all public university buildings in New Jersey
- Jersey City chromium contamination
- Evaluation of nuclear power plant proposals in the Delaware River and the Atlantic Ocean
- Evaluation of contamination and health impacts after Tropical storms Floyd, Irene and Sandy

The ability to impact policy is the direct consequence of the deliberate choice of the EOHSI leadership and senior EOHSI members to work together outside of their disciplinary comfort zones. It is fair to say that the formation of EOHSI provided Rutgers a focal point for environmental research that can impact policy. In short, this group representing various schools has contributed through:

- Translation of basic research to clinic and to policy formation
- Education that encourages interactions among faculty and students from various disciplines
- A forum that encourages scientists to work with state and national government

EOHSI has created an environment that fostered true inter-disciplinary research and collegiality among faculty that was unique when EOHSI was first created and is still more encompassing of disciplines than programs subsequently developed at other Universities and governmental laboratories. As EOHSI matured, its leadership had the vision to form the School of Public Health, was instrumental in the development of the Rutgers Cancer Institute of New Jersey and continues to assist other institutes and departments in recruitment of faculty and development of initiative related to Environmental and Occupation Health. EOHSI members includes faculty from 7 departments from Robert Wood Johnson Medical School (RWJMS), 4 departments from EMSOP, 2 departments from Division of Life Sciences (DLS), 3 departments from SEBS, 2 departments from School of Engineering (SOE), 3 divisions from SPH, and faculty from EJB. This multi-disciplinary capability has made this Rutgers' group recognized in the U.S. and globally.

This interdisciplinary model that made EOHSI and Rutgers a leader in this field can be expanded and improved with the appropriate vision and resources. The merging of Rutgers and UMD presents new opportunities to reinforce this interdisciplinary effort across a broader range of scientific, engineering and policy disciplines. What is required is the leadership and the University's political and financial support, as described below.

Gaps

Even though Rutgers has great strengths, gaps need to be filled to be able to sustain and build upon our history as being preeminent in this field. We summarize and illustrate seven limitations of which the first three are the most important ones. These are directly tied to our recommendations.

1. New Leadership for EOHSI: The flagship environmental health institution, EOHSI, has not been able to recruit and hire a full-time director because of the uncertainties in the merger process, although we have tried. The lack of a strong leader combined and lack of support for inter-school research has undermined our capacity to compete for inter-disciplinary environmental health projects. (see recommendation #1)
2. Plan to Replace Senior Faculty Who Will Retire: Senior faculty leaders in environmental health and associated areas are approaching retirement. They will need to be replaced by younger faculty who would benefit by being mentored by their more senior colleagues. The transition needs to be carefully orchestrated and it is essential that university-wide needs be considered when appointments are made that are in the purview of schools and departments in order to both address school/departments needs and overall university ones. (see recommendation #2)

3. Decreasing Collaboration: Beginning 25 years ago there was a deliberate attempt among the environmental health faculty across the campus and those in other disciplines to collaborate in order to develop projects that would bring in large and lead to better policy. These collaborations have decreased during the last decade. The gap needs to be filled (see recommendation number #2)
4. Faculty and staff gaps in expertise: Better designs for development and recruitment of long-term cohorts in New Jersey that can be the basis of environmental epidemiologic studies are needed. Recruitment of a faculty with expertise in environmental epidemiology is needed to fill this gap. This would also allow enhanced use of the RU-CINJ SEER and State Cancer Registries. (See recommendations # 2, 3 and 4).
5. Seed Grants to Develop Data: When EOHSI was formed the State of New Jersey and the federal government provided seed grants to support new initiatives and support for the study of emerging issues, such as hazardous waste site exposures. A version today would be environmental disasters and efforts to make vulnerable areas less vulnerable and more resilient. Seed grants are available from foundations and government, but they take time to acquire, which means a loss in competitive advantage to obtain data leading to much larger grants. (See recommendations 2, 4)
6. Tuition Matches: In regard to education, the current requirement for full tuition to be charged to grants discourages faculty from supporting graduate students since the cost of post-doctoral fellows are lower. This differs from the policy of most other schools in our Peer Group and in the Big 10 (see recommendation 4).
7. Translational: While there have successes in translation of our science from the laboratory or field to clinical setting, additional efforts are needed to implement research findings in the area of environmental health in the clinical setting and in the larger public arena (see recommendation 2, 3).

Collaboration

EOHSI adopted collaboration during the planning stages and implemented it by housing faculty from multiple disciplines in its building as well as creating divisions in toxicology, exposure, clinical health and occupational medicine, environmental epidemiology and biostatistics, environmental health policy, and public education. The opportunities to re-engage some of the collaborative efforts that have diminished with the RSPH, SOE, SEBS, and EJB are not only possible but they are imperative. Several examples will illustrate this point. The last Rutgers grant funding from the Superfund Basis Research Program (SBRP) was more than 15 years ago. This dearth in SBRP funding at Rutgers represents not only a lost opportunity to contribute to the eventual clean-up of these sites, but also a tremendous loss in potential grant funding. This area of research needs to engage faculty in toxicology, exposure science, engineering, as well as planning and policy. The same need for greater collaboration is true for addressing major natural hazard events, such as Hurricanes Irene and Sandy, and the areas of sustainability. EOHSI can bring important elements to the table, and can play a pivotal role in bringing different members of the faculty from different schools, such as RBHS, RSPH, SOE, SEBS, and EJB together to form a team to address Superfund health issues. There is also a need to link human health problems arising from environmental contaminants with other disciplines including genetics, epigenetics, metabolomics and toxicology. This will create an in-depth understanding of the mechanistic basis of diseases of environmental etiology. Researchers at EOHSI bring expertise in some of these areas to the problem and working together with clinicians at RWJMS have the resources to investigate environmental health questions by creating broad interdisciplinary teams.

More collaborations with clinicians is appropriate for us. This can be facilitated by improving interaction with university clinicians for both education and research. Education materials should

be developed highlighting specific environmental contaminants (e.g., plasticizers, perchlorates, pesticides—emphasizing those that are investigated locally), and how to minimize exposure in general and during periods of increased risk (e.g., pregnancy). Using the platform and prestige of the EOHSI, clinicians could reach out to specialty-specific physicians (e.g., obstetricians), educating them and potentially groups of their patients in office or clinic settings. As this serves the secondary purpose of promoting university clinical services, physicians in various specialties may want to take advantage of the outreach opportunity. Such a program would require its own resources, infrastructure and leadership to develop materials, identify physician groups to participate and to target, and to administer logistics. This would be done in collaboration with the clinical departments and the Hospital, with a physician liaison in each specialty.

One way to foster this, in part, is through a pilot grant program. These have been done on a limited scale through EOHSI and the NIEHS Center with some very positive outcomes. However, the bar has been raised. Very few clinicians have the time or resources to design and implement meaningful patient-based studies, opting instead for small retrospective studies or case reports. Perhaps a more expansive RBHS internal pilot grant program could be developed more like a Clinical Research Center (CRC). In this model, clinicians would then join with a basic scientist to compete on the basis of concept and availability of a study population. Meritorious projects would be supported by a dedicated infrastructure, including committed co-investigators to advise on study design and analysis to ensure momentum. The CRC model would then also support qualified clinical trial personnel as needed to navigate the IRB process, patient recruitment, data management, etc. Very few active clinicians have the expertise, clerical support, or time to successfully build a good study from scratch, even when it is funded.

In addressing global environmental health we need to strengthen the association with SPH. It is important to evaluate research findings and policy recommendation on environmental health with other public health concerns. These will vary with the needs and resources of the community being considered. The planned international research and education on environmental and occupational health is complementary to activities being undertaken within The Center for Global Public Health at SPH. As our activities move forward the issues and remedies identified in the environmental arena can contribute to a better understand and provide concrete services to improve and promote overall global public health.

A final metric of recognizing that Rutgers is a premier institute in Environmental and Occupational Health is the recruitment of high quality graduate students. Success of these recruitment efforts is demonstrated by the students obtaining their own funding, publishing their findings, earning their degrees in a timely fashion, and then observing their success in finding positions after graduation.

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