QUARTERLY HIGHLIGHTS

- In the Science Programs section, two new projects related to TCE have begun. One is directed by James S. Norris, Ph.D., and its title is "Real-Time Measurement of Oxidative Free Radical Generation and Quantification of DNA Damage in the Same Cells." Dr. Norris and other experienced researchers seek to determine whether TCE or its metabolites induce free radical generation in the peroxisomes of established and primary human liver cells as primary cultures.

- "Scleroderma-TCE Project," is directed by Richard M. Silver, M.D. As the title suggests, Dr. Silver is conducting a case-control study to ascertain the real relationship between scleroderma and environmental exposure to TCE. Because Dr. Silver has over 400 case studies of scleroderma at MUSC, he expects to be able to take advantage of the University's ongoing efforts in finding answers to questions regarding human health.

- Harold May, Ph.D., is leading the project "Anaerobic Dechlorination of Polychlorinated Biphenyls (PCBs) and the Biodegradation of Ether-Containing Gasoline Additives and Ether Solvents" has made significant progress regarding future remediation efforts. Anaerobic dechlorination of PCBs in essence detoxifies a contaminated site. Ortho dechlorination is very rare and has only been reported twice. In both of the reported cases, the activity was very slow in development (6-12 months) and was not sustained. Dr. May's enrichment showed activity in five weeks and has been sustainable. Again, attack of the ortho positioned chlorines is rare, and hence, the characterization and development of this type of dechlorination could be of use in future remediation efforts.

- Since September, the Graduate Education in Risk Assessment project has received 985 requests for information and 545 requests for applications. These academic programs began less than two years ago.

- Dr. Frank Parker, chairman of the External Advisory Group (EAG), delivered the Group's report in early February. The document serves as a blueprint for strengthening the Program.

- The Information Systems group and other EHAP sections integrated their respective capabilities to implement and bring on-line the EHAP World Wide Web (WWW) Mosaic. EHAP's Mosaic page is available to all those on the Internet, and among other purposes, it serves as a means to educate the public about environmental health at MUSC, other universities and governmental agencies.
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10 INTRODUCTION

On June 23, 1992, the U. S. Department of Energy (DOE) signed Assistance Instrument Number DE-FG01-92EW50625 with the Medical University of South Carolina (MUSC) to support the Environmental Hazards Assessment Program (EHAP).

Dr. James B. Edwards, President of the Medical University of South Carolina recently suggested, "Good health is not the result of 'good doctorin' but the result of a healthy society in a healthy, economic, political and biological environment." In pursuit of that lofty goal he was reminded by Dr. William J. Schull, from the University of Texas Health Science Center, of Thomas Jefferson's quotation.

"I know no safe depository of the ultimate powers of society but the people themselves; and if we think them not enlightened enough to exercise their control with a wholesome discretion, the remedy is not to take it from them, but to inform their discretion."

- Thomas Jefferson

It is fitting that a grant of this magnitude turns to the people themselves, at the crossroads, to seek the answers to expand the base of environmental knowledge. Moreover, it is appropriate that an educational institution such as MUSC utilize this information to help people from all walks of life understand better what truly does affect human health, what does not, and why.

Note

In the case of text enclosed by a dotted border, such as this example, this represents an effort funded by other sources in support of the total EHAP mission. Moreover, this border means no grant funds were expended in creating the project.

Grant Objectives

The objectives of the EHAP program stated in the proposal to DOE are to:

1. Develop a holistic, national basis for risk assessment, risk management, and risk communication that recognizes the direct impact of environmental hazards on the health and well-being of all;
2. Develop a pool of talented scientists and experts in cleanup activities, especially in human health aspects; and

3. Identify needs and develop programs addressing the critical shortage of well-educated, highly-skilled technical and scientific personnel to address the health oriented aspects of environmental restoration and waste management.

This report describes activities and reports on progress for the third quarter (January-March) of the third year of the grant. It reports progress against these grant objectives and the Program Implementation Plan published at the end of the first year of the grant. Questions, comments, or requests for further information concerning the activities under this grant can be forwarded to Jack Davis in the EHAP office of the Medical University of South Carolina at (803) 727-6450.

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.
2.0 PROGRAM OVERVIEW

2.1 Program Elements

As the program has evolved, more projects have been funded and many existing projects have become more complex. Thus, to accomplish better the objectives over the years and retain a solid focus on the total mission, we have reorganized the grant effort from three to five major elements: 1) Public and Professional Outreach; 2) Clinical Programs; 3) Science Programs; 4) Information Systems; and 5) Program Management.

The relationship of these elements among each other is shown in Figure 2.0. Each element has a specific programmatic function briefly described in the following paragraphs and described in more detail in the following sections. In addition to the function, each element has the responsibility to involve people from outside MUSC faculty, staff, and students.

Figure 2.0. The Major Program Elements and Their Relationships.
During the third year and under the category of Public and Professional Outreach, we continue our successful Crossroads of Humanity Series. In this Series we bring the pool of experts and results developed in our workshops and round table forums to bear on real problems. Hence, we have moved from the hypothetical to the actual, with the basis focused on human health. Additionally, mid- and upper-level managers are being trained in risk assessment to ensure those decision makers in the environmental cleanup business are better informed.

The focus on human health continues in the Clinical Programs section wherein research on the management of hazardous waste is being undertaken and synthesized from a range of sources. Results of this research and other studies of risk assessment are woven into the diagnostic backgrounds of established general practitioners; this continuing education program increases the risk assessment capacity of many physicians.

Science Programs provide a foundation to enable health care providers and researchers to deeply explore environmental health issues. The Science element continues work on numerous research projects that are initially providing some of the hard facts needed to assess certain environmental health risks. Medical and graduate students learn about environmental health issues through research, lectures, and case studies. Faculty engage in environmental health issues through research and teaching.

To ensure we accomplish the grant objectives in an effective and efficient manner, the Program Management element provides reporting, budgeting, and accounting as well as monitoring and program direction to those actively involved in EHAP initiatives. The Program Management group is primarily responsible for developing ties with other universities and research laboratories to ensure we are working cooperatively with other researchers engaged in closely related issues and projects.

Interwoven throughout EHAP, the Information Systems section provides and maintains the computer and network structure for information handling. Moreover, Information Systems continues to work to refine the data fusion techniques necessary to provide the user with advanced, user-friendly information search and retrieval capabilities.
2.2 **Program Expenditures**

The following presents an overview of the Third Quarter of Year 3 grant expenditures:

<table>
<thead>
<tr>
<th>EHAP 3rd Quarter Year 3 Expenditure Summary</th>
<th>3rd Qtr</th>
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<tbody>
<tr>
<td>(Dollars in thousands)</td>
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<tr>
<td><strong>Public and Professional Outreach</strong></td>
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<tr>
<td>Crossroads of Humanity Series</td>
<td>$416</td>
<td>$760</td>
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<tr>
<td>Publications/Information</td>
<td>532</td>
<td>1,239</td>
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<tr>
<td>Research and Evaluation</td>
<td>112</td>
<td>335</td>
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<tr>
<td>Professional Training</td>
<td>381</td>
<td>630</td>
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<tr>
<td><strong>Science Programs</strong></td>
<td>567</td>
<td>1,237</td>
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<tr>
<td>Toxicology</td>
<td>19</td>
<td>90</td>
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<tr>
<td>Risk Assessment</td>
<td></td>
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<tr>
<td>Education</td>
<td></td>
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<tr>
<td><strong>Clinical Programs</strong></td>
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<td>Health Services Research</td>
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<td>Family Medicine</td>
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<td><strong>Information Systems</strong></td>
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<tr>
<td><strong>Indirect Costs</strong></td>
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<tr>
<td><strong>Equipment</strong></td>
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<tr>
<td><strong>Total</strong></td>
<td>$2,030</td>
<td>$4,293</td>
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</table>

Total expenditures, encumbrances, and commitments through the Third Quarter total $5,237,258, which represents 72% of the award for Year 3.
3.0 PROGRAM MANAGEMENT

The MUSC administration established the Environmental Hazards Assessment Program Office to ensure the management of grant efforts to meet the program goals and objectives. The Program Office responsibilities include: development and implementation of the program plan for the DOE grant, development and implementation of major support systems necessary for managing and reporting on all EHAP program efforts, developing partnerships for the execution of programs with other universities and research institutions, and the development of joint venture funding of environmental programs.

The Program Office reports to the Office of the President. To support this office, MUSC has made non-federal funds available to the Director.

Principal Investigator: James B. Edwards, D.M.D.
Executive Assistant to Principal Investigator: Steven L. Jones, B.S., M.S.W.
Deputy Principal Investigator and Director: Lawrence C. Mohr, Jr., M.D.
Director of Development: R. Martin Jones, Ph.D.
Assistant to Director for Operations: Jack C. Davis, M.S.
Assistant to Director for University Programs: W. Allen Smith, DR., P.H.
Assistant to Director for External Programs: Robert Draughn, D.Sc.
Assistant to Director for Finance: Susan G. Legare, B.S., C.P.A.
Director for Crossroads: Glenn A. Fleming, Ed.D.
Director for Research, Science and Education: Rosalie K. Crouch, Ph.D.
Administrative Assistant: Jill Canaday
Administrative Specialist: Mimi Gainey
Administrative Specialist: Anita G. Noisette
Business Manager: Gail C. Brubaker
Assistant to Director for University Programs: Marion H. Watson

Milestones and Products for Third Quarter, Year 3

1. Dr. Frank Parker, the chairman of the External Advisory Group (EAG), delivered the Group’s report in early February. Planning for the summer meeting of the EAG was initiated.
   - Copy of report
2. Contact was made with staff of the Brookhaven National Laboratory regarding collaboration in the area of teaching of risk assessment and risk communication.

3. EHAP's Continuation Proposal for Year 4 was written and sent to DOE.

4. In the Science Programs section, two new projects related to TCE have begun. One is directed by James S. Norris, Ph.D., and its title is "Real-Time Measurement of Oxidative Free Radical Generation and Quantification of DNA Damage in the Same Cells." Dr. Norris and other experienced researchers seek to determine whether TCE or its metabolites induce free radical generation in the peroxisomes of established and primary human liver cells as primary cultures.

5. Another project is directed by Richard M. Silver, M.D., and it is entitled "Scleroderma-TCE Project." As the title suggests, Dr. Silver is conducting a case-control study to ascertain the real relationship between scleroderma and environmental exposure to TCE. Because Dr. Silver has over 400 case studies of scleroderma at MUSC, he expects to be able to take advantage of the University's ongoing efforts in finding answers to questions regarding human health.

6. In collaboration with Coleman Research Corporation (CRC) and the Atomic Energy Authority Technology Consultancy Services (AEA) of the United Kingdom, we continued to prepare the "Risk Assessment/Risk Management International Symposium Study." This project is designed to examine environmental risk assessment and risk management practices in the United States and in UK/Europe/International, comparing and contrasting approaches and involving a wide range of stakeholders through reports, workshops, an International Forum and Steering Committee evaluations.

7. Completed first draft of a program review of EHAP, projecting the activities of each project throughout the life of the grant.

8. Held strategic planning sessions to seek options and to find answers dealing with what EHAP will do when the original grant funding expires.

9. Dr. Hoel and Dr. Jollow hosted the TCE Data Analysis Project peer review, which was held March 23-24, in Charleston. A report was presented by Chem Risk and discussed by the panel of distinguished scientists.
10. The preparation of a manuscript on our study of attitudes and activities toward environmental issues in general dentistry residency training programs neared completion. A draft manuscript was prepared and will continue to be reviewed and revised through the next quarter. This work is a collaborative effort of faculty of the MUSC College of Dental Medicine (W. Burton, M. Barry, and R. Draughn) and the professional staff of EHAP (C. Musham).

Milestones and Products Projected for Fourth Quarter, Year 3

1. R. Martin Jones, Ph.D. has been the director of EHAP since its beginning. Dr. Jones has been selected chairman of MUSC's Department of Environmental Health Sciences in the College of Health Professions. As of April 1, Lawrence C. Mohr, Jr., M.D. will be the new director of EHAP. Dr. Mohr has a long and distinguished career in medicine and in the military. Dr. Mohr's presence as director will enhance the Program's ability to involve health-care providers. Dr. Mohr will maintain an active clinical practice, bringing day-to-day physician experience to the Program. Dr. Jones will remain active in EHAP as the director of development as well as remaining an active contributor on grant efforts in education, research and outreach.

2. Will continue strategic planning sessions to seek options and to find answers dealing with what EHAP will do when the original grant funding expires.

3. Will complete a report and publishable manuscript on the survey of dental educators regarding environmental issues in dental training, which will be submitted to the Journal of Dental Education.

   • Copy of report and manuscript

4. Will travel to INEL to pursue definition of collaborative efforts in the environmental area.

5. Will continue work to define the potential for collaboration between MUSC/EHAP and Metrica Corporation.

6. Work will continue to define interactions between MUSC and Brookhaven National Laboratory in the area of teaching of risk assessment.
4.0 PUBLIC AND PROFESSIONAL OUTREACH

4.1 Crossroads

Executive Summary

During the third quarter of year three, Public and Professional Outreach built upon the work and planning of preceding quarters in a manner consistent with achievement of EHAP's long-term objective: development of a holistic, national basis for risk assessment, risk management and risk communication, focused on human health.

In the areas of Research and Evaluation, the Crossroads staff continued a public-participation project in the rural-agrarian community of Blackville, SC. The Blackville Project is designed to measure citizens' perceptions of environmental risks to human health in their community, then supplement citizens' knowledge via coordinated, multi-media outreach efforts. We will apply lessons learned from the Blackville Project in partnerships with other communities.

For example, Crossroads staff is actively pursuing a partnership with entities in an urban-industrial community--the "Neck" area of the Charleston peninsula--for the purpose of studying and positively affecting the environmental health of that community.

Crossroads staff continued publication and information efforts in support of MUSC/EHAP. These include: the quarterly EHAP newsletter; ongoing redesign of the Crossroads Series database; publication support of MUSC's graduate-level programs in Risk Assessment and Environmental Studies; publication and logistical support of Research and Evaluation efforts in Blackville, SC; publication support of EHAP Program Management activities; and publication and logistical support of the MUSC-EHAP External Advisory Group.

Objectives

1. To provide research in areas of risk perception and risk communication.

2. To develop Crossroads Series workshops.

3. To publish printed materials related to EHAP and the Crossroads Series.
4. To expand and redesign the database containing names, addresses and telephone numbers of individuals and organizations with expertise and/or interest in environmental issues.

5. To publish material and provide information support of Program Management, Science, Education and Information Systems initiatives.

4.1.1 Crossroads of Humanity Series

| Director:          | Glenn A. Fleming, Ed.D. |
| Events Coordinator: | Sylvia Rivers          |
| Administrative Assistant: | Percilla Coaxum |

Milestones and Products for Third Quarter, Year 3

1. Completed Phase I and implemented Phase II of Blackville Project described in above introductory overview segment of Crossroads Series quarterly report.

2. Circulated 500 videos of the November 1994 Blackville Environmental Health Issues Discussion (BEHID). Created video packages and new posters for display in high traffic areas in Blackville.
   - BEHID poster
   - BEHID video packages

3. Attended several organizational meetings, including the civic club, town council and church meetings, to present the BEHID video and to discuss the Blackville-MUSC partnership and environmental health concerns.

4. Arranged for students in grades 4-12 in the Blackville public schools to view the BEHID video. Conducted an essay contest—"How I Can Improve the Environment of the Blackville Community?"—in these grades to promote discussion and education of environmental health issues. 205 students submitted essays.

5. Arranged to sponsor the Barnwell County Chamber of Commerce April Business After Hours Reception. This event is to promote the BEHID video to community business leaders. It is also to inform those attending of speakers who will deliver environmental health presentations within the Blackville community in the next few months.
6. Developed news releases and public service announcements about the BEHID video detailing how to obtain them.
   - Copy of news releases
   - Copy of public service announcements

7. Created a Blackville Community Newsletter called "Enviromation," which discusses the MUSC-Blackville Partnership, the BEHID video and other MUSC/EHAP/Blackville events. This newsletter continually updates the citizens on the project's progress and provides them with environmental health information and education.
   - Copy of newsletter

8. Conducted biweekly visits to the Blackville area to continue developing community efforts for environmental health promotion and discussion.

9. Established a database of physicians who treat the citizens of Blackville so that EHAP could send them informational and educational materials on environmental health topics. This effort is also to establish the MUSC/EHAP's Occupational and Environmental Medicine Office (OEMO) as a resource in this community intervention project.

10. Conducted and/or attended meetings related to development of a Blackville-style initiative in an urban-industrial community.

11. Met with Dr. Robert Bullard and Mr. Delane Garner of Clark Atlanta University regarding environmental equity issues in urban-industrial communities such as the "Neck" area of the Charleston peninsula.

12. Attended introductory and question-and-answer sessions regarding federal government designation of portions of the City of Charleston, and contiguous, unincorporated areas of Charleston County as an Enterprise Community.

13. Continued related workshop and database-related activities.

14. Continued development of discipline-specific "blue ribbon" panels including physicians discussing risk assessment information, and mayors and first-response individuals. The purpose of these future panels is to address issues identified in previous Crossroads Series round table forums and workshops.
15. Assisted in planning for statewide conference on environmental justice.

16. Continued to overhaul the Crossroads database, adding experts as they were identified. This effort continues each quarter so as to provide user-friendly access to the data critical for networking. Database currently contains 3,389 entries.

Assisted Idaho National Engineering Laboratory’s Buried Waste Integrated Demonstration (INEl-BWID) in final editing of a Socratic dialogue on buried waste issues, conducted 11/19/94 in Idaho Falls, ID. Twelve panelists role-played a hypothetical scenario, which was videotaped for later television broadcast. The final version of the program will be available to interested stations, via satellite, 6/4/95.

Milestones and Products Projected for Fourth Quarter, Year 3

1. Will circulate Blackville videotape, conduct meetings of Blackville Citizens Steering Committee and implement related community-development activities as part of Phase II of Blackville Project.

2. Will judge and award prizes to the top nine essay writers for the school essay contest. Blackville Mayor Richard Lamar and MUSC representatives will present the contest awards.

3. Will supply speakers to the Blackville community at organizational meetings to present environmental health information on topics of interest.

4. Will conduct strategy and planning meetings related to MUSC taking a lead role in development of the federally sponsored Charleston Enterprise Community.

5. Will continue developing "blue ribbon" panels for future Crossroads forums and workshops.
Milestones and Products for Third Quarter, Year 3

Research Activities

1. Completed analysis of dental educator survey data. This survey assessed dental educators' perceptions regarding the need for environmental health education in graduate school.
   - Dental paper draft

2. Received favorable notice from Dr. Barry Weiss, editor of Family Medicine, on the submitted manuscript, "Environmental Health Training in Family Practice Residency: A Survey of Program Directors." Dr. Weiss recommended a few changes before publication. These changes have been made and a revised copy has been sent to him.
   - Revised manuscript

3. Developed proposal for an environmental health topics in undergraduate engineering schools study with Dr. Janet Z. Temple of MUSC's Department of Environmental Health Sciences.
   - Sample population listing

4. Finalized survey instrument and protocol for the study of stakeholder perspectives in two South Carolina communities with Dr. Abe Wandersman of the University of South Carolina's Department of Psychology.

5. Tested feasibility of using the Crossroads "Purity" Round table videotapes as educational tools. Two tape viewings and subsequent focus group discussions were conducted in two graduate-level classes (Department of Medicine and Department of Marine Biology, USC). Presently a proposal is being developed to examine educational uses of the "Purity" tape in a wide range of class levels, from junior high through graduate training.
Dissemination of Research Results


- Abstracts

Professional Networking

7. Attended monthly South Carolina Family Practice Research Consortium meetings for continued support of environmental risk perception and communication research.

- Meeting minutes

8. Dr. Catherine Musham participated in a one-day seminar on risk communication sponsored by Clemson University. As a result of this conference, the Outreach program initiated a project assessing undergraduate and graduate education relevant to risk communication activities and responsibilities.

9. Continued coordination efforts with Dr. John Eureta of the University of South Carolina in establishing a South Carolina Risk Perception and Communication computer network.

Education and Reference

10. Worked on refining a structured environmental research intern program for undergraduate students.

11. Collected and organized research literature relevant to risk perception and communication. A catalog of this literature is now available to all Outreach Division researchers as well as other EHAP personnel. The major categories of published research include: Environmental Risk Perception, Environmental Equity, Industry-based Risk Communication Efforts, Community-initiated Environmental Health Programs, and Medical Practitioners and Environmental Health. This catalog will be continually updated.
Milestones and Products Projected for Fourth Quarter, Year 3

1. Conduct attitude and opinion study of South Carolina Lowcountry residents who catch and consume mercury-contaminated fish. The purpose of this study is to measure the awareness, knowledge and attitudes of this target population as a first step in developing a public risk communication program on the dangers of mercury poisoning.

2. Design and complete the first phase of an evaluation of the effectiveness of the "In Search of Purity" videotape series for educational purposes. The first phase will consist of viewing sessions and focus groups in four grade levels in South Carolina's public school system.

3. Concentrate on publishing and presenting the various studies we have conducted in the past two years. By December 1995, it is expected that the research program will have published and/or presented an additional eight manuscripts.

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<thead>
<tr>
<th>4.1.3 Publications/Information</th>
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<tbody>
<tr>
<td>Program Information Coordinator:</td>
</tr>
<tr>
<td>Public Information Specialist (Publications):</td>
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<td>Public Information Specialist:</td>
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<tr>
<td>Public Information Specialist (Database):</td>
</tr>
<tr>
<td>Public Information Specialist (Reports):</td>
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Milestones and Products for Third Quarter, Year 3

1. Continued in-house newspaper, magazine and publication "clip file."

2. Published and mailed January newsletter.
   - EHAP News and Information

3. Planned publication of Spring EHAP newsletter.

   - EHAP Accomplishments


7. Designed publications and provided logistical support for Blackville community intervention project.

Milestones and Products Projected for Fourth Quarter, Year 3

1. Will continue design process and publication for new generation of MUSC/EHAP brochures and information sheets.

2. Will publish and distribute next newsletter in April/May.

3. Will provide publication and logistical support for future External Advisory Group meetings.

4. Will provide continued assistance in the editing, formatting, planning and creating of EHAP's WWW Mosaic.

5. Will continue to design publications and provide support for Blackville community intervention project.

4.2 Department of Environmental Health Sciences (DEHS) - Education and Training Initiative

| Chairman, DEHS:                           | R. Martin Jones, Ph.D. |
| Project Director:                        | Janet Z. Temple, Ph.D. |
| Faculty:                                 | William Hotle          |
| Faculty:                                 | Marc Hunt, CIH         |
| Faculty:                                 | Andy Rowland           |
| Administrative Specialist:              | Gerri Hollis           |
| Accounting Technician:                  | Lisa Burkhardt         |

Executive Summary

The primary objective of this project is to address worker and management training needs in a rapidly changing environment. One of the environmental industry's missions is to ensure that resources are available to assure that the current and future work force has the skills, knowledge and abilities to carry out its mission today and in the future. It is also a priority to ensure that all groups within our society participate in the successful cleanup activities of environmentally hazardous sites. Adequate training to address the risks to the public, the workers, and the environment is essential for those workers and managers who will be involved in environmental cleanup and government, business, and industry restoration issues.
The Department of Environmental Health Sciences (DEHS) is involved in the Education and Training Initiative. An Advisory Committee has been established to render guidance for this task. This committee includes representatives from EPA, OSHA, DOE, DOD, unions, educators, public interest groups and the health care community. The fifth meeting of the Advisory Committee is scheduled for May in Charleston, SC.

A needs assessment instrument has been developed to secure profiles of mid- and upper-level managers and their training needs relating to risk. The product may be modified for application to other professions.

Two Professional Development seminars are being designed and developed during Year 3. The programs will vary in length, and will include 1) "Risk Communication"-an introduction to risk communication methods and theory; and 2) "Executive Overview of Risk Analysis"-a short course to provide basic information in risk assessment, risk management and risk communication for senior managers.

In November, the first course, "Risk Communication" was pilot tested to the Advisory Committee and received beneficial comments from committee members. A second pilot was conducted in March with a final review to be held during May's Advisory Committee meeting. The second course, "Executive Overview of Risk Analysis," will be initially presented at the meeting this May.

Objectives

1. To address worker and management needs in a rapidly changing environment.

2. To ensure that resources are available to assure the current and future work force has the skills, knowledge, and abilities to carry forth its mission today and in the future.

3. To ensure that all groups within our society participate in the successful cleanup activities of environmentally hazardous sites.

Milestones and Products for Third Quarter, Year 3

Planning/Administration

1. Continued networking to examine training needs of government and industry facilities.

2. Maintained an off-site library housing environmental risk assessment, management and communication information.
Needs Assessment Instrument

3. Developed a revised needs assessment instrument to better ascertain the level of subject groups' risk awareness. Upon request, this will be distributed to various groups and may be further customized to meet their needs.

Advisory Committee

4. "Risk Communication," the third of the seminar series, was pilot-tested in March.

Program Design and Development

5. Completed course development for the first Professional Development Seminar entitled, "Concepts of Risk Analysis." This course is an introduction to the concept of risk, the risk assessment process (specifically for hazardous waste site remediation), risk management and risk communication. The course was pilot tested to the Advisory Committee February 1-2 in Charleston. Members of EHAP, MUSC, the Department of Energy and the Savannah River Site attended this seminar.

6. Continued course development for the third Professional Development Seminar entitled, "Risk Communication"-an introduction to risk communication concepts and practice. The second pilot of this course was conducted in March.

7. Presented guest lectures on risk communication and risk assessment to a special topics marine biomedical and environmental sciences class at the Grice Marine Lab on March 24.

Milestones and Products Projected for Fourth Quarter, Year 3

Planning/Administration

1. Will continue networking and holding meetings April-June.

Advisory Committee

2. The advisory committee will meet May 10-11 and will be invited to attend the initial pilot testing of the fourth Professional Development Seminar, "Executive Overview of Risk Assessment."
Program Design and Development

3. Will finalize course development for the first Professional Development Seminar entitled, "Concepts of Risk Analysis."
   
   • Products will include the agenda, student text, slides, other audio visual aids, course examination and course evaluation.


   • Products will include the agenda, student handbook, slides, other audio visual aids, course examination and course evaluation.

5. Will continue course development and modifications as directed by the advisory committee for the third Professional Development Seminar, "Risk Communication."

   • Draft documentation from the student textbook for the Environmental Risk Management course as well as a draft agenda and exam
5.1 Biomedical Research Projects

5.1.1 Immunological Mechanisms Associated with Beryllium

<table>
<thead>
<tr>
<th>Project Director:</th>
<th>Jean-Michel Goust, M.D.</th>
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<tr>
<td>Co-Investigator:</td>
<td>Philippe Arnaud, M.D., Ph.D.</td>
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<tr>
<td>Research Technician:</td>
<td>Kathy Haines</td>
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The above project was not funded for the previous quarter. It is noted above for reference because it will be included in the annual report for Year 3.

5.1.2 Assessment of Genetic Risks to Environmental Diseases

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<tr>
<th>Project Director:</th>
<th>Janardan P. Pandey, Ph.D.</th>
</tr>
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<tr>
<td>Co-Investigator:</td>
<td>Gillian M.P. Galbraith, M.D.</td>
</tr>
<tr>
<td>Laboratory Technician:</td>
<td>P. Werner</td>
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Executive Summary

The overall long-term goal of this investigation is to identify, map, and determine the mechanism of action of gene(s) responsible for susceptibility and/or resistance to environmental diseases.

The broad spectrum of environmental diseases includes those known to result from occupational or other exposure to defined environmental toxins, and those in which the role of the environmental insult is less clear. Berylliosis is an example of the first group which offers a model for study of disease susceptibility throughout the spectrum of environmental diseases. Exposure to beryllium, usually by inhalation of particulate beryllium, results in chronic, progressive, destructive lung disease in some, but not all, individuals exposed. This in itself suggests that factors exist which determine disease susceptibility. Current evidence indicates that the disease process is mediated, at least in part, by the individual's immune response to beryllium, and it is therefore reasonable to suspect that genes controlling this immune response may be involved in determination of disease susceptibility. This hypothesis is supported by data which indicate that susceptibility is associated with the possession of a particular cell surface molecule, which is produced by a gene called HLA-DPB1*0201, and which is involved in the initiation of the immune response.

Our studies to date have shown that other substances produced in the immune response may be involved in susceptibility to the disease. For example, a substance called TNF-a, which is produced by immune cells, is
suspected to be responsible for many of the pathological changes in this disease. We have shown that exposure of certain immune cells to beryllium in the laboratory results in the "switching on" of the gene which produces TNF-a. This is particularly interesting since the amount of TNF-a which is produced by an individual in response to a given stimulus appears to depend on allelic variations in the TNF-a gene. This is one hypothesis which will be examined in the studies described in this report. Most recently, we have shown that human macrophages stimulated by immune complexes switch on the TNF gene (product listed below). Also, we have recently investigated the role of HLA antigens and Ig allotypes in IgA nephropathy (product listed below).

Objective 1

To determine if the distribution of various genetic markers is significantly different in patient groups and controls.

Strategy 1

Blood samples will be obtained from various patient populations, such as chronic berylliosis (CBD), sarcoidosis (a disease of unknown etiology that strongly mimics CBD both in pathological and clinical presentation), and silicosis. For sarcoidosis, the controls will consist of ethnically matched healthy people. For CBD and silicosis, the control populations will be composed of ethnically matched subjects who were exposed to the environmental trigger for the same length of time as the patients but did not develop disease. Studies in mice and very recently in humans (Science 262:242, 1993) have clearly shown that susceptibility to CBD is MHC-restricted. For this reason, candidate genes for our initial association studies will be immunologically relevant genes including HLA-DR and tumor necrosis factor a and b (chromosome 6), T cell receptor a and Gm (chromosome 14), and Km and interleukin-1b (chromosome 2). Both serological and molecular methodologies will be employed to study the distribution of these genetic markers.

Objective 2

To examine TNFa and IL-1b gene expression in monocyte/macrophage cells.

Strategy 2

Cells under study will include those obtained from the subject groups delineated in (1) and the monocytic cell line THP-1. Cells will be exposed in culture to activation with well-characterized stimuli such as lipopolysaccharide and phorbol ester, as well as beryllium. Gene expression
will be monitored using molecular biological assays. In addition, the effect of extended MHC haplotypes (including the restriction fragment length polymorphisms—RFLPs—associated with the TNF locus), on gene expression will be investigated. Similarly, the possible effect of Km alleles on IL-1b gene expression will be studied.

It should be noted that human material for these studies has already been obtained from several sources and certain of these sample sets have been characterized with respect to one or more of the genetic markers listed above. In such cases, it is therefore unnecessary to duplicate the findings of our collaborators.

Notes on Terms

A lipopolysaccharide is a molecule or compound in which lipids and polysaccharides are linked, as in cell membranes.

Milestones and Products for Third Quarter, Year 3

   

2. Studied role of HLA, Gm, and Km genes in IgA nephropathy.
   

Milestones and Products Projected for Fourth Quarter, Year 3

1. Will conduct an examination of TNF-a gene expression in normal human monocytic cells exposed to stimuli including beryllium and lipopolysaccharide.
   
   - Manuscripts
Executive Summary

Trichloroethylene (TCE) is a commonly used industrial solvent and has become a common environmental contaminant. At many hazardous waste sites, it is the most abundant chlorinated hydrocarbon contaminant, being present in ground water and soils and sediment in some areas at levels thousands of times to millions of times higher, respectively, than EPA's regulatory maximum level for drinking water.

During this third quarter we have continued work to characterize a rabbit polyclonal antibody that was raised against trichloroethylene-protein adducts. As detailed previously, this work is concerned with establishing the specificity and sensitivity of the antibody, which will provide information that will be of critical importance when we begin to develop an immunoassay for TCE adduct detection in human blood samples.

We are continuing work to synthesize compounds for use to characterize the specificity of the antibody (i.e., what does the antibody recognize, and how much cross-reactivity exists). Previous methods utilized to synthesize a dichloroacetylated lysine derivative were not successful, and one of the major efforts during this quarter has been to use alternative synthetic routes to make the inhibitor product. We have been successful at synthesizing the less reactive thiolacetate derivative of dichloroacetyl chloride, ethyl dichlorothiolacetate. This reagent was purified by fractional distillation, and analyzed by GC-MS and proton NMR spectroscopy. This reagent was then used to make the first antibody inhibitor. Briefly, an excess of dichlorothiolacetate was reacted with L-lysine, and the product precipitated from solution upon cooling to 4°C. The dichloroacetylated lysine product was then washed in hot ethanol, and subjected to analysis by HPLC, MS, and NMR spectroscopy. The product was found to be >99% pure, and its structure was confirmed by two-dimensional NMR, which was performed in collaboration with Dr. John Oatis in MUSC's Department of Pharmacology.

The dichloroacetyl lysine inhibitor was then sent to Dr. Neil Pumford who utilized the inhibitor in competitive ELISA (enzyme-linked immunosorbent assay). This inhibitor was found to displace the antibody (effective inhibitor concentration producing 50% inhibition was approximately 50 μM), and was about 10,000-fold more effective than acetyl lysine (i.e., no chlorine atoms on the molecule).
We are now working to synthesize the remaining two inhibitors (mono- and trichloroacetyl-lysine), which should give us the means to determine what type of chemical adducts the antibody will recognize. The most efficient inhibitor, which we expect will be the dichloroacetyl lysine, will then be used to establish antibody sensitivity.

Objectives

1. To identify and structurally characterize human hemoglobin adducts derived from exposure to TCE.

2. To prepare immunogens and generate antisera to these biomarkers for development and application of immunoassays for the biomarkers.

3. To characterize protein adduct biomarkers of exposure to additional chemicals of relevance to DOE sites and develop antisera to these biomarkers.

Milestones and Products for Third Quarter, Year 3

1. Synthesized dichloroacetyl lysine and confirmed its structure and purity.

2. Utilized this inhibitor in competitive ELISA and shown that it effectively displaced antibody binding.

3. Synthesized the mono- and trichlorothiol-acetates for use in preparing the remaining inhibitors in the series.

4. Submitted an abstract on the above work which will be presented at the International Congress of Toxicology VII in July in Seattle, WA. The abstract will be presented in a poster-discussion session topic entitled, "Covalent Binding."

   • Copy of abstract

Milestones and Products Projected for Fourth Quarter, Year 3

1. Continue to prepare TCE antibody inhibitors for studies to characterize antibody specificity and sensitivity.

2. Complete the characterization of anti-TCE antibody specificity and sensitivity.
Executive Summary

Trichloroethylene (TCE) is a commonly used industrial solvent and has become a common environmental contaminant. At many hazardous waste sites, it is the most abundant chlorinated hydrocarbon contaminant, being present in ground water and soils and sediment in some areas at levels thousands of times to millions of times higher, respectively, than EPA’s regulatory maximum level for drinking water.

The main target organ for TCE toxicity is the liver. Chronic exposure to TCE has been shown to cause hepatic carcinomas in B6C3F1 mice, but not in Osborne-Mendel rats. In addition, TCE exposure has produced lymphomas in hamsters, lung tumors in ICR rats and renal tumors in Fischer 344 rats. These tumors, however, have not been consistently observed in other rodent species and strains.

TCE falls into a category of compounds known as peroxisome proliferators, for example, they induce an increase in the number of peroxisomes in a cell. Peroxisome proliferators also induce a characteristic pattern of biochemical responses in the liver. Hepatocarcinogenesis is a common property of all peroxisome proliferators tested thus far; however, this response is not usually associated with direct DNA damage by the compound. Increased production of hydrogen peroxide, which may cause indirect DNA damage, and the propensity of these compounds to induce hepatocyte replication have been argued to contribute to their ability to cause hepatic cancer in certain laboratory animal species.

TCE-induced peroxisome proliferation has been demonstrated in rats and mice and in cultures of mouse hepatocytes. We propose to examine the ability of TCE and its proposed hepatotoxic metabolites, trichloroacetic acid (TCA) and dichloroacetic acid (DCA), to induce peroxisome proliferate and DNA synthesis and/or cell replication by utilizing hepatocyte cultures from B6C3F1 mice and rats, and to compare the response in these cultured cells to that in a human liver cell line and/or cultured human hepatocytes. The results from these studies would provide information on the relative susceptibility of human, rat and mouse liver cells to the potential hepatocarcinogenic activity of TCE.

This project should provide useful information in assessing the risk TCE poses as a human health hazard, both at DOE sites and in surrounding areas where there is ground water contamination.
Objectives

1. To determine the dose/response relationship of TCE and its toxic metabolites to induce peroxisome proliferation and DNA synthesis in rat and mouse hepatocyte cultures.

2. To determine the ability of TCE and its toxic metabolites to induce peroxisome proliferation and DNA synthesis in human liver cell lines and/or human hepatocyte cultures.

Milestones and Products for Third Quarter, Year 3

1. Continued to optimize hepatocyte culture conditions for studies on TCA-induced peroxisome proliferation and induction of DNA synthesis with reference to the dose-response relationship.
   - Data on TCA-induced peroxisome proliferation in mouse hepatocytes
   - Data on TCA induction of DNA synthesis in rat hepatocytes and human hepatoma cell lines

2. Continued to compare the ability of TCA to induce peroxisome proliferation with that of clofibrate, a compound known to induce peroxisome proliferation. Comparative data for clofibrate in mouse hepatocytes is included in first product under milestone 1 above.

3. Continued to compare the induction of DNA synthesis for TCA with that of epidermal growth factor, a compound known to induce cell replication (i.e., DNA synthesis). Comparative data for epidermal growth factor in rat hepatocytes and human hepatoma cell lines is included in second product under milestone 1 above.

   - Copy of abstract
Milestones and Products Projected for Fourth Quarter, Year 3

1. Will continue to optimize hepatocyte culture conditions for studies on TCA-induced peroxisome proliferation and induction of DNA synthesis with reference to the dose-response relationship.
   - Data on TCA-induced peroxisome proliferation in rat and mouse hepatocytes and/or human hepatoma cell lines
   - Data on TCA induction of DNA synthesis in rat and mouse hepatocytes and/or human hepatoma cell lines

2. Will continue to optimize conditions for immunoblots of the peroxisomal bifunctional enzyme.
   - Copy of Western blot protocol

3. Will continue to compare the ability of TCA to induce peroxisome proliferation with that of clofibrate.
   - Comparative data for clofibrate in rat and mouse hepatocytes and human hepatoma cell lines

4. Will continue to compare the induction of DNA synthesis for TCA with that of epidermal growth factor.
   - Comparative data for epidermal growth factor in rat and mouse hepatocytes and human hepatoma cell lines

5.1.5 Disease Initiation by Environmental Toxins

Project Director: Thomas A. Dix, Ph.D.

Executive Summary

A central role for O2-derived oxidants in human disease initiation and propagation has been demonstrated. These species are generated as part of human metabolism; consequently, a multicomponent antioxidant system has evolved to keep the reactivity of these species under control in normal tissue. However, various agents that directly or indirectly generate oxidants have the potential for disease initiation by increasing these species to levels that overwhelm the defenses.

A potentially important, although under-evaluated, source of oxidant generating agents is the environment. In tests conducted outside of the
organism (in vitro), a number of chemicals found in the environment either generate oxidants directly under biomimetic conditions, or interact with O2-metabolizing enzymes to effect oxidant release. The role of environmental agents within the organism (in vivo) is less clear, however, as it is difficult to establish a cause and effect relationship between chemical exposure, oxidant generation, and disease initiation. A long-term goal of our research program is to establish this relationship, which would support further control of release of toxic agents into the environment.

This goal can be approached using the following strategy. Over the last few years, we have developed methods to generate each of the physiologically significant O2-derived oxidants specifically and have evaluated the mechanisms by which these species react with biomolecules (in particular, lipids and nucleic acids). Oxidants of interest include superoxide (O2•−), the hydroxyl (HO•), peroxyl (ROO•), alkoxy (RO•), and perhydroxyl (HOO•) radicals, hydrogen peroxide (H2O2), and hypochlorous acid (HOCl). We have established that the oxidants that react with lipids are HOO•, HO•, and ROO•, and that each reacts by a different mechanism.

Potentially, the isolation of lipid-derived products of oxidant attack would serve as a marker for generation of specific oxidants (and might imply a site and mechanism of generation); however, lipid-derived fatty acid metabolites are degraded extensively before excretion in the urine. This is not the case with oxidized nucleic acid material. Ames and colleagues have demonstrated that very small amounts of oxidized DNA bases can be noninvasively collected from the urine and analyzed; the levels of material collected correlate to the existence of tissue prooxidant states, although a direct link to specific oxidant generation has not been done. Preliminary results from our laboratory have established that HOO•, HO•, and ROO• react with DNA by different mechanisms, which implies that the base-derived products of each oxidant's attack can be developed as biomarkers for the formation and reaction of the individual oxidants in vivo.

Objective

To establish a cause and effect relationship between chemical exposure, oxidant generation, and disease initiation, which would support further control of release of toxic agents into the environment.

Milestones and Products for Third Quarter, Year 3

1. Completed product studies for the reaction of HO• with polyunsaturated lipids.
2. Completed studies to determine the mechanism by which HOO\textsuperscript{-} reacts with the deoxyribose-phosphate backbone of DNA.

Milestones and Products Projected for Fourth Quarter, Year 3

1. Will begin preparation of a manuscript describing the reaction of HO\textsuperscript{-} with polyunsaturated lipids.

2. Will complete a manuscript describing the reaction of HOO\textsuperscript{-} with the deoxyribose-phosphate backbone of DNA.

3. Will initiate product studies for the reaction of HO\textsuperscript{-} with the DNA bases.

4. Will initiate product studies for the reaction of ROO\textsuperscript{-} with the DNA bases.

5.1.6 Anaerobic Dechlorination of Polychlorinated Biphenyls (PCBs) and the Biodegradation of Ether-Containing Gasoline Additives and Ether Solvents

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<tr>
<th>Project Director:</th>
<th>Harold D. May, Ph.D.</th>
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<tr>
<td>Laboratory Technician:</td>
<td>Mary Berkaw</td>
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Executive Summary

Polychlorinated biphenyls (PCBs) have been used in a wide variety of industrial applications worldwide. Due to their stability and potential toxicity, PCBs in soils and sediments have been an environmental concern for several decades. Up until about 15 years ago, PCBs were considered to be resistant to biological degradation; however, since then, the dechlorination and biodegradation of these compounds has been documented in both the laboratory and in the environment.

However, no PCB-dechlorinating anaerobes have been isolated, and the physiology and ecology of the organisms responsible for this activity have not been determined. This makes construction of bioremediation schemes difficult. The reductive dechlorination of PCBs by anaerobes is considered an important step in the destruction of these compounds in the environment because 1) many of these environments are anaerobic; 2) more heavily chlorinated congeners are more easily attacked under anaerobic conditions; and, 3) the more heavily chlorinated congeners are considered to be more toxic. Congeners are compounds closely related to another and ones that have similar effects as another.
The research of the laboratory continues to focus in two areas. The first of these is the reductive dechlorination of polychlorinated biphenyls (PCBs) under anaerobic (no oxygen) conditions. The long-term goal of this work is the destruction of PCBs in situ (where they exist) in anaerobic soils and sediments. The project will also deliver information on reductive dechlorination in general and on the microbial communities that are operating in these environments. The second project targets the microbial destruction (aerobic or anaerobic) of ether compounds that are used as solvents, are by-products of plastics production, or are used as octane-enhancing additives to gasoline. The latter of these compounds are methyl t-butyl ether (MTBE) and ethyl t-butyl ether (ETBE), which are commonly referred to as gasoline oxygenates.

**Notes on Terms**

Anaerobic dechlorination of PCBs in essence detoxifies a contaminated site. To completely dechlorinate PCBs in anaerobic environments, several dechlorinating activities will be required. This is because there are potentially 209 forms of PCBs and no one organism is capable of attacking them. Also, the number and position of the chlorines on the biphenyl rings is another element of this problem. Attack of the ortho positioned chlorines is rare, and hence, the characterization and development of such activity (action by organisms) could be of use in future remediation efforts.

**Objectives for Anaerobic Dechlorination of PCBs**

1. To enrich, isolate, and characterize the microorganisms involved in the anaerobic dechlorination of PCBs, which is needed as a first step toward understanding the microbiology of the process of bioremediation of PCBs.

2. To achieve bioremediation of soils and sediments contaminated with PCBs.

**Objectives for Biodegradation of Ethers**

1. To isolate and characterize microorganisms that are capable of degrading the gasoline additives MTBE and ETBE.

2. To achieve bioremediation of ground waters contaminated with the aforementioned ethers.
Milestones and Products for Third Quarter, Year 3

Research

Project 1: Anaerobic Dechlorination of Polychlorinated Biphenyls

1. We now have three enrichments that are expressing three different types of anaerobic PCB dechlorination. One of these rapidly removes meta chlorines from the rings but does not attack the outer most or inner most positions, para and ortho respectively. A second enrichment line is attacking the para positions, however, entirely different culture conditions are required for the para dechlorination to be maintained. Both of these cultures have been developed from freshwater sediments. A third culture is expressing ortho dechlorination in addition to meta and para dechlorinations. Ortho dechlorination is very rare and has only been reported twice. In both of the reported cases, the activity was very slow in development (6-12 months) and was not sustained. Our enrichment, which was developed from an estuarine sediment that was not contaminated with PCBs, showed activity in five weeks and has been sustainable.

2. We also have meta and para dechlorination ongoing in marine enrichments. The anaerobic PCB dechlorination in the marine environment has not been extensively investigated and gives us another group of potentially unique and useful organisms to examine.

Project 2: Biodegradation of Ether-Containing Gasoline Additives and Ether Solvents

3. Four cultures have been isolated in pure form from enrichments growing on ETBE. One of these is known to produce t-butyl alcohol from ETBE or MTBE. Degradation analysis of the others, as well as physiological characterization, is still awaiting the completion of the laboratory renovation. Degradation of t-butyl alcohol is presently also under investigation.

Education

4. On February 14, I presented a three-hour lecture on reductive dechlorination of halogenated organics to students of the pollution microbiology course in MUSC’s Department of Microbiology and Immunology.

5. As one of the EHAP seminar series, I presented “Biodegradation of Cyclic Ethers and Ether-containing Gasoline Oxygenates” on February 23.
Milestones and Products Projected for Fourth Quarter, Year 3

1. Characterize further the ortho PCB dechlorination observed and develop enough data for presentation at a national meeting.

2. Develop molecular probe technology for detecting dechlorinating anaerobes in mixed populations.

3. Determine degradation products of ether-degrading isolates.

4. Recruit a doctoral student to work on these projects.

5.1.7 Biodegradation of Hydrophobic Contaminants (PCBs and Fossil Fuels)

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<tr>
<th>Project Director:</th>
<th>Pamela J. Morris, Ph.D.</th>
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<td>Laboratory Technician:</td>
<td>Louise Weston</td>
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Executive Summary

The long term goal of this research investigation is to better understand the biodegradation of hydrophobic contaminants (e.g., fossil fuels, polychlorinated biphenyls) in soils and sediments.

The strong sorption of polychlorinated biphenyls (PCBs) onto soils and sediments limits their availability to PCB-degrading microorganisms. This availability to the biotic community, referred to as bioavailability, is an increasingly important component in the bioremediation of hydrophobic compounds. In addition, co-contaminants, such as fossil fuels, may substantially contribute to the organic component of the soil matrix, and result in a change in the sorptive behavior of PCBs. Researchers have demonstrated that both natural organic matter and residual oil components of soil act as a partition media for organic solutes such as PCBs, with the latter being roughly ten times more effective as a sorptive phase. In addition, studies have demonstrated the inhibition of degradation in the presence of a mineral oil component.

Our studies are focusing on environmental sites that are contaminated with both PCBs and fossil fuels. We have begun to enrich for microorganisms capable of biodegrading the fossil fuel fraction from several of these sites. In addition, we are isolating and characterizing pure cultures from these enrichments and assessing their individual contributions to fossil fuel biodegradation.
Milestones and Products for Third Quarter, Year 3

1. Three Ph.D. students--Samuel Rawlin, Romish Stanislaus, and Roberto Frontera-Suau--are conducting their doctoral research in my laboratory. Romish is studying a fossil fuel-degrading enrichment culture, and has isolated six microorganisms in pure culture from this enrichment. He is studying the ability of the individual isolates to degrade crude oil. Roberto Frontera-Suau has partially characterized the isolates. In addition, Roberto has conducted antibiotic susceptibility tests on 22 antibiotics in order to develop a screening method to monitor population dynamics during crude oil biodegradation. Samuel Rawlin is conducting hydrophobicity tests on heterotrophic microorganisms isolated from a PCB-contaminated soil, by comparing their affinity for a hydrophobic phase (hexadecane). He has observed that changes in nutrient concentration, from higher to lower levels, result in certain microorganisms responding as more hydrophobic in the assay.

2. Continued to examine crude oil-degrading enrichment cultures from several sites in the Charleston area--aquarium site, Washington Street Park, Calhoun Street, and James Island--and are in the process of characterizing the microorganisms from these cultures.

3. In January Romish Stanislaus and I traveled to visit Dr. P. S. C. Rao at the University of Florida's Department of Soil and Water Science to begin collaborative studies on techniques/methods to enhance the desorption of polychlorinated biphenyls and fossil fuels from contaminated soil. Romish will be returning in the summer to learn soil column chromatography techniques.

Milestones and Products Projected for Fourth Quarter, Year 3

1. Will give an oral presentation based on the manuscript--Morris, P.J., Shelton, M.E., and Chapman, P.J. "Co-Contaminated Sites: The Biodegradation of Polychlorinated Biphenyls and Fossil Fuels" at Battelle’s In Situ and On-Site Bioreclamation, the Third International Symposium, April 24-27 in San Diego, CA.

2. Will give a poster presentation based on the manuscript--Stanislaus, R., Shelton, M.E., and Morris, P.J. "Isolation of Fossil Fuel-Degrading Microorganisms." Abstract submitted to the American Society of Microbiology for the Annual Meeting in May in Washington, D.C.
Executive Summary

Trichloroethylene (TCE) is a widely used industrial solvent that has pervasively contaminated the environment. At some hazardous waste sites, it is so concentrated that it has entered the ground water, soils and sediments to levels, thousands to millions of times higher than EPA regular maxims allow.

TCE toxicity is mainly targeted toward the liver. It has been shown in the B-6C3F1 mouse model to be a hepatic carcinogen. TCE exposure also induces lymphomas in hamsters, lung tumors in ICR rats and renal tumors in fisher 344 rats. However, there is some discrepancy between the consistency with which these tumors are observed among other rodent species and strains suggesting that there is a genetic element underlying susceptibility.

TCE is believed to function as a peroxisome proliferator. This has been demonstrated in rodent models but remains to be determined in humans. Peroxisome proliferators are typically able to act as hepatic carcinogens by mechanisms that are not well defined. For example, direct DNA damage by the compound has not been observed. However, the sensitivity of the assays used are not always sufficient to detect rare but predicted DNA damage that would be induced by this type of carcinogen via its ability to induce hydrogen peroxide in peroxisomes. Because peroxisome proliferators interact with their cognate receptors that interact with other receptors, it is also quite possible that TCE may act to alter transcription of important control elements in the cell. This latter activity, for example, induction of the oncogene might lead to chromosome instability and hepatic cancer.

In the proposed project, TCE will be evaluated for its peroxisome proliferation activity as well as for its ability to generate oxygen free radicals and corollary DNA damage. The system that we have available for doing these assays is state-of-the-art and will allow the assay to be carried out in a continuum in a single cell, providing the first direct functional information relative to oxygen free radical induction versus DNA damage. This project is groundbreaking in this respect and its future potential for analyzing mechanistic responses to environmental chemical exposure is considered highly significant.
Note on terms

An oncogene is a hypothetical viral genetic material carrying the potential of cancer.

Objective

To determine whether TCE or its metabolites induce free radical generation in the peroxisomes of established and primary human liver cells as primary cultures.

Milestones and Products for Third Quarter, Year 3

1. Initiated construction of fos-luciferase (fos-luc) reporters, sequence, and checked functionality by transient expression approaches following stimulation with phorbol esters (control) and TCE metabolites (test).

2. Initiated testing fos-luc vectors in Dr. Frawley’s photon counting apparatus under conditions (established above) where vector expression is observed.

3. Initiated establishment of conditions for photon counting that will later be analyzed for suitability in the comet assay.

4. All of the above experiments were and will be done in established cell lines. Once conditions are worked out, experiments will be repeated in primary rat hepatocyte cultures obtained from Dr. JoEllyn McMillan. milestones 1-3 will probably occupy all of Year 3.

Milestones and Products Projected for Fourth Quarter, Year 3

1. Will continue construction of fos-luciferase (fos-luc) reporters, sequence, and check functionality by transient expression approaches following stimulation with phorbol esters (control) and TCE metabolites (test).

2. Will continue testing fos-luc vectors in Dr. Frawley’s photon counting apparatus under conditions (established above) where vector expression is observed.

3. Will continue to establish conditions for photon counting that will later be analyzed for suitability in the comet assay.

4. Will continue all of the above experiments in established cell lines. Once conditions are worked out, experiments will be repeated in primary rat hepatocyte cultures obtained from Dr. JoEllyn McMillan.
Executive Summary

According to the Agency for Toxic Substances and Disease Registry (ATSDR), about 400,000 workers are exposed to TCE in the United States during an average 40-hour work week. Moreover, TCE is widely used as a solvent and is used to make other chemicals and is found in typewriter fluid, paint removers, adhesives, and spot removers. We contend that exposure to TCE increases the risk of scleroderma and the immunogenetic background of the host is an important determinant of susceptibility to TCE-associated scleroderma.

In terms of the environmental etiology of scleroderma or origin of the disease, it is thought to be as a result of exposure to the following: silica, adulterated rapeseed oil, contaminated L-tryptophan, vinyl chloride, bleomycin, epoxy resins, toluene, benzene, xylene, perchloroethylene and TCE. The genetic etiology of scleroderma or origin of the disease is thought to be as a result of a change in specific genetic markers (HLA-DR allele associations, DR1 - anticientromere antibody (ACA), DR5 - ACA and anti-Scl-70, and DQB1 domain - ACA). In terms of epidemiology, the national incidence of scleroderma is 0.85 -19.0 cases/100,000 and prevalence of 4 -125 cases/million. In a random community based survey in SC, prevalence of scleroderma was 19 -75 cases/100,000.

Whereas the Medical University of South Carolina has: 1) 400 scleroderma patients and 52% thereof are SC residents; 2) MUSC survey research center; and 3) immunogenetic markers currently determined by MUSC immunologists and consultants, particularly within EHAP, MUSC is the proper place to conduct this project. We will complete a case-control study to determine prevalence of TCE-exposed patients. Then, we will quantify the risk of scleroderma attributable to TCE, which will be followed by a further study. Specifically, we will compare TCE-exposed and non-exposed patients with respect to immunogenetic markers and scleroderma-specific antibodies.

It is important to note that this is the first case-control study to determine risk of scleroderma attributable to TCE exposure. Furthermore, this is also the first immunogenetic analysis of TCE-associated scleroderma.
Objective
To conduct a case-control study to ascertain the real relationship between scleroderma and environmental exposure to trichloroethylene (TCE).

Milestones and Products for Third Quarter, Year 3

1. We have an IRB-approved consent form and our graduate student, Paul Neitart, has been collecting data (questionnaire and blood specimens) from subjects in the Rheumatology Clinic and the Medical University Hospital. Thus far, he has collected data from approximately 30 scleroderma patients and a number of control subjects.

Milestones and Products Projected for Fourth Quarter, Year 3

1. In addition to data collection, our group will bring in a consultant from the NCI on April 13, 1995, Dr. Mustafa Dosemeci. Dr. Dosemeci's experience in industrial hygiene is extensive, and his talents and experience will be a great asset to our project.
5.2 Risk Assessment Projects

5.2.1 Low Dose-Rate Radiation Health Effects

<table>
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<tr>
<th>Project Director:</th>
<th>David G. Hoel, Ph.D.</th>
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<tr>
<td>Research Associate:</td>
<td>Zhen Zhang, Ph.D.</td>
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<tr>
<td>Research Associate:</td>
<td>Ping Li, Ph.D.</td>
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<tr>
<td>Graduate Student:</td>
<td>Tomas Radivoyevitch</td>
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Executive Summary

In the evaluation of external ionizing radiation exposure to man, all of the health risk assessments are based on acute exposures. It has been known from animal studies that often times for same total dose, the toxic effects of radiation are less if the exposure is given continually at a low dose-rate. Estimates of the reduction in risks have ranged from a factor of two to ten. Obviously, this would greatly impact the strategies for cleanup of radioactive materials and the level of permissible exposure to workers. This is particularly important because of the recent comparisons being made between A-bomb survivors and nuclear worker populations. The shape of the cancer dose-response function is also important to study in light of the discussion concerning hormesis. Hormesis is the stimulating effect of sub inhibitory concentrations of any toxic substance on any organism.

In studying exposure to workers, methods of physiologically based pharmacokinetic (PBPK) modeling and simulation are often used in dose-response evaluations of human health effects. Specifically, the project will utilize PBPK modeling and simulation to measure the effects of radiation in the body over time. Fate-transport models are used to estimate the distribution of radioactive materials in the environment including living and working places. In both cases, models are often highly nonlinear in nature and of a large number of variables and parameters. These models are usually developed with very limited information on the precision of the estimated input variables and model parameters.

Objectives

1. To determine dose-rate effectiveness factors for various cancers in rodent studies after gamma or neutron exposure.

2. To determine relative biological effectiveness of neutrons in rodent cancer studies and relate the rodent models to human epidemiological data.
3. To incorporate the analytical tools of systems science and engineering to the theoretical and methodological research of PBPK models.

Strategy

To study this question, it is necessary to bring together large amounts of animal studies that have been conducted through the years by DOE and compare chronic versus acute exposures using statistical cancer models for the analysis. One would then be able to project the effects of estimated human cancer risk at low dose-rate exposures. Connected with this analysis, it is also possible to work out risk assessments for neutron exposure for which there is little or no human data. This work would again depend upon DOE experimental information. This research is being carried out collaboratively with scientists at the Argonne National Laboratory.

To examine the low-end of the dose-response function, cell cultures will be irradiated and mutations will be measured in real time through the use of the luciferase gene.

Monte Carlo techniques and other methods such as calculation of sensitive indices are currently used for the evaluation of precision in human exposure estimation and dose-response analyses. We would like to develop a new method for the analysis of sensitivity based on global optimization search algorithms. The new method will be more suitable for nonlinear models of large number of estimated input variables and/or parameters.

Milestones and Products for Third Quarter, Year 3

1. Used multi-stage models to compare expected outcomes for acute and chronic exposures. Comparisons were made to show theoretical dose-rate effects which depended on what stage the radiation acted. The results will be incorporated into a future manuscript on dose-rate effects and used to compare with modeled animal dose-rate data.

2. Reanalyzed connective tissue tumors with improved model fits. These new models will be used to estimate the dose-rate effects and be compared with the predicted multi-stage model results. Remodeling allowed for the incorporation of a quadratic does term, which improved on the linear dose response fits that were done last quarter.

3. Obtained the following preliminary lab information: The Yeast Gall/Luciferase plasmid pJM400 from Dr. C. Nombela of Madrid, Spain. The plasmid was amplified in e.coli and used to transform the yeast strain 338 of Dr. J. Dolan at MUSC. The two transformed colonies were picked and grown in each of the three sugars, glucose, raffinose, and galactose. Luciferease activity was measured in a luminometer both
before and after a two hour luciferase induction period. One of the colonies (Colony 2) showed a 10,000 fold increase in photonic activity over the control cells in galactose and a 1,000 fold increase in activity compared to the same cells grown in raffinose and glucose. The results indicated that the plasmid was successfully integrated into the yeast and that the luciferase enzyme was highly expressed under appropriate conditions.

4. Completed draft of a journal paper for publication.

Milestones and Products Projected for Fourth Quarter, Year 3

1. Will re analyze the major cancer sites, beside connective tissue tumors, with quadratic terms and dose-rate effects calculated.

2. Will perform further research toward detecting optical activity in individual yeast cells using a single photon counting microscope.

5.2.2 Environmental Risk Perception in Defined Populations

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<tr>
<th>Project Leaders:</th>
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<tr>
<td>Daniel Lackland, Ph.D.</td>
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<tr>
<td>John Dunbar, Dr. P.H.</td>
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<td>David Hoel, Ph.D.</td>
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Executive Summary

Risk perception is an important consideration in environmental restoration and cleanup standards, as well as being a key component of risk assessment. The quantification of perceived risks, risk awareness and knowledge of health hazards is critical to the determination of public-acceptable levels of environmental contamination. The development and implementation of methodologies are necessary preludes to any comprehensive environmental hazard and risk assessment program.

This program is designed to be a major resource for decision makers involved in environmental remediation and restoration of hazardous waste sites. Furthermore, the project will provide timely feedback of community and population-based findings to concerned parties, in particular the risk assessment programs.

Objectives

1. To build and maintain a comprehensive survey research center for conducting population health, awareness, knowledge and perception assessments.
2. To develop methodology and implement the measurement of knowledge, awareness and attitudes with regards to environmental hazards risks to human health.

3. To quantify these measures and construct a perceived risk index.

4. To estimate levels of acceptable risk in the population.

Milestones and Products for Third Quarter, Year 3

1. Planned the second "Perceived Risk Survey" which will be completed in small geographic areas around the Savannah River Site including Fernald, Rocky Flats, Hanford, Oak Ridge, Pinewood, and Spartanburg. Target populations are residents of these areas. The assessment will involve the quantification of attitudes, perceptions, and knowledge and awareness regarding the health and environment risk of their proximal areas. Completed the survey that will be used.
   - Copy of survey
   - Copy of study plan

2. Decided to postpone the meeting of the Perceived Risk Advisory Committee until completion of the survey. This decision is an effort to conserve resources and to allow the Committee to review the results and make recommendations for analysis and future directions.

3. Obtained the Computer Assisted Telephone Interview (CATI) system from the University of Wisconsin. This system will greatly enhance the operations and capabilities of the population assessment efforts. The system has been installed and will be used for the next survey.

Milestones and Products Projected for Fourth Quarter, Year 3

1. Will conduct preliminary analyses from population surveys around environmental hazards sites.

2. Will maintain active communication with the Perceived Risk Advisory Committee and will provide records of this communication.
Executive Summary

Traditional approaches for the assessment of environmental exposure evaluation have employed the usual screening methodologies. In a typical assessment, investigation will select a population believed to be at risk, collect data and tissue samples, and determine cases of exposure and potential adverse health outcomes. Although this approach is useful, numerous limitations exist. First, only individuals who are selected and agree to participate are used in the investigation. Risk assessment of specific geographic areas is very difficult as surrounding areas are not identified or assessed, and geographic clusters of events are often missed with one hundred percent participation. A second limitation involves the difficulty in obtaining often missing information on confounders in a high-risk population. Use of computerized data bases, such as census demographic files, water quality, tax records, and health records is extremely laborious to quantify and is typically completed variable by variable. In summary, the traditional assessment methodology is useful for the study of a single household, only cursory investigations are possible for large regions and populations.

An alternate and progressive approach is proposed which will utilize a geographic information system (GIS) to be used in the defining of geographic study areas and the analysis of multiple data sets. The proposed system will consist of computerized data bases structured to a defined geographic area combined with analytic tools including thematic map generation, proximity analysis, buffer zone identification, and map overlay comparisons.

Objectives

1. To complete and assess comprehensive geo-coding of all addresses and areas in a specific geo-political area.

2. To merge health, demographic and environmental data sets based on location in the geographic analysis system.

3. To complete a health and risk assessment on a defined geographic area.
Milestones and Products for Third Quarter, Year 3

1. Geo-coding efforts are proceeding as planned, if not slightly ahead of schedule. Office of Research and Statistics delivered a report of activities and details of the contractual progress.
   
   • Copy of report

   
   • Copy of program

Milestones and Products Projected for Fourth Quarter, Year 3

1. Will present results from "Geo-coding of Health and Demographic Data on a Resource for Environmental Incidents Preparedness and Response" at the America Nuclear Society Topical Meeting: Emergency Preparedness and Response, April 18-21 in Savannah, GA.
   
   • Copy of manuscript
   
   • Copy of program

2. Will deliver progress report of geo-coding efforts.
   
   • Copy of report
5.3 Education

5.3.1 Graduate Education in Risk Assessment

| Project Director: | Dr. Rosalie Crouch, Dean, College of Graduate Studies |
|Assistant Director: | Dr. Eberhard Voit, Assistant Dean for Environmental Studies |

Executive Summary

The educational component is an essential part of the environmental risk assessment program. This task concerns establishing strong academic graduate programs at the master's and doctoral levels addressing the needs of governmental agencies, private industry and public concerns. These programs address the void of graduates who have the combination of some understanding of science, risk analysis and the policy process. Graduates at the doctoral level have, in addition, considerable expertise in a defined area that they select for their dissertation. In future years of the project, attention will be given to undergraduate environmental studies programs. These topics will also be introduced at the primary and secondary school levels.

Objective

To develop outstanding academic programs at the master's and doctoral levels that educate the student in the fundamentals of environmental risk, policy and science with a specialization in one of these areas.

Milestones and Products for Third Quarter, Year 3

1. Advertised risk assessment teaching positions in international journals. Received 57 applications to date.
   - Detailed list of applicants

2. Processed additional applications to MES program. Received a total of 32 applications for Fall 1995. From these 32 applications, 20 applicants have been accepted to the program with 11 still being reviewed.
   - Lists of MES applicants accepted for Fall 1995

3. Received 985 requests for information since September. 554 are from recruitment posters with 271 requesting applications. 139 are from telephone inquiry, 21 are from brochure return card, ten are from written requests, and 261 have been forwarded from the University of Charleston. Applications requested from all sources was 545. A total of
925 posters were recently mailed to mathematics departments at all United States four year colleges using labels produced by Peterson’s Guides.

- Chart of requesting students with requests from posters broken down by state and scientific background


- List of guest speakers

**Milestones and Products Projected for Fourth Quarter, Year 3**

1. Continue recruitment efforts for MES students.
2. Finalize drafts for multidisciplinary core courses.
4. Continue, and possibly complete, search for faculty in Risk Assessment.

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<th>5.3.2 Department of Health Administration and Policy</th>
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<td><strong>Project Director:</strong></td>
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<td><strong>Chairman and Professor,</strong></td>
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<td><strong>Department of Health Administration and Policy:</strong></td>
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**Executive Summary**

Continuing responsibilities were in three major areas: environmental health policy, environmental health education, and international environmental issues. This program also implements research projects involving the extent to which considerations (other than purely scientific ones) are incorporated into environmental decision-making. These may include social and economic considerations, as well as citizen participation issues. A major thrust of the Policy Studies Journal symposium, the hazardous waste study, and future planned projects will address the relations of social and economic issues and environmental policy.

Policies for the management of hazardous waste is another major focus of current research. One major milestone was achieved with the completion of the study on perceptions of hazardous waste operators and inspectors. A paper and presentation on comparative views of hazardous waste site operators and inspectors is being prepared for the National Association of Environmental Professionals’ June meeting in Washington, DC. This
product is part of an over-arching effort to increase understanding of and to improve policies for the management of hazardous waste. As a result of this project, a number of recommendations were developed for improved regulatory policy and operations of hazardous waste sites.

Milestones and Products for Third Quarter, Year 3

   - Copy of paper

2. Completed data analysis and wrote abstract and paper "Hazardous Waste Site Operators and Inspectors: Their Perceptions of the Media and Environmental Groups." Submitted to National Association of Environmental Professionals.
   - Copy of paper

3. Taught course in Environmental Health Policy at MUSC.

4. Initiated preliminary data analysis for two abstracts "Environmental Clusters and Ranking of Selected Nations" and "An Organizational Typology of Environmental Agencies and Businesses." These have been submitted for presentation at the October 1995 American Public Health Association Meeting in San Diego.
   - Copy of abstracts


Milestones and Products Projected for Fourth Quarter, Year 3

1. Will prepare and present paper at session on Risk Assessment/Public and Stakeholder Involvement at National Association of Environmental Professionals' Annual Meeting in June.
   - Copy of paper and abstract

2. Will begin initial compilation of database of international environmental indicators (e.g., hazardous waste, toxic substances, air/water pollution, greenhouse gases, deforestation).
6.0 CLINICAL PROGRAMS

6.1 Health Services Research

Project Director: W. Allen Smith, Dr., P.H.

Executive Summary

Health Services Research has been involved with EHAP and risk assessment since the grant was initiated, but before the first quarter of year three, the project's mission was carried out under Program Management. In accordance with the new emphasis placed on involving medical doctors and other medical practitioners in the environmental risk assessment and decision-making process, Health Services Research continues to be a separate project.

Through personal networking, I have been meeting with numerous MUSC faculty members to explain in detail the concept of risk assessment in medicine. As a result, many departments and individual physicians have taken an interest in the project, and many individuals have been recruited into health risk associated projects.

Additionally, I have participated in a conference that concentrated on predicting the mass tort cases of the future, and as a result and in collaboration with the Einstein Institute, the project may produce a videotape for the training of judges in environmental health issues.

Other plans include an industrial medicine clinic and a referral system, both of which would further institutionalize risk assessment in the practice of medicine. As the various elements of the project develop, more physicians, other medical practitioners, and assorted professionals will be better educated in environmental health issues.

Objectives

1. To involve more medical doctors and other medical practitioners in the environmental risk assessment and decision-making process.

2. To create a need-to-know attitude toward environmental medicine.
Milestones and Products for Third Quarter, Year 3

1. Tried on an experimental basis using the Student Health Coalition as a vehicle through which to inject OEM principles into the undergraduate medical curriculum. However, the ad hoc university committee to study the Coalition's future has found that the activity is redundant and that other activities more closely meet the medical school curriculum needs. While we shall continue to look for alternative ways to infiltrate the curriculum, it is probably true that student needs are best met at the graduate level.

2. Planned a joint faculty meeting to introduce Clemson to a variety of environmental health issues of concern to the medical community. There are benefits to be derived from bringing together the disciplines of medicine and engineering in environmental health. It is envisioned that a memorandum of understanding between MUSC and Clemson could result in the exchange of both faculty and students in medicine and engineering.

3. Work of the Family Medicine OEM curriculum committee produced a core curriculum and a number of elective educational modules. We are now looking for opportunities to export these modules and the techniques used in their development. We believe that the developmental technique and the process involved is probably more important than the actual modules regarding their effect upon the medical community's desire to learn and participate in environmental health issues.

4. Attended meetings of the Charleston Naval Base Redevelopment Authority because the Charleston Naval Shipyard could offer an opportunity for MUSC to take a leadership role in addressing the health hazards created by the departing military. Unfortunately, the closure and reuse of the base facilities has been in disarray, and our role at this time is a bit obscure.

5. Continued to plan a meeting of nationally recognized (practicing) family physicians, which may stimulate interest and encourage greater participation among the primary care medical community in the discussion and resolution of environmental risk issues. Attendees will evaluate the utility of the current risk assessment processes to the family practice physician in his/her role as a community health advocate. They will also explore things that can be done to improve this utility.
Milestones and Products Projected for Fourth Quarter, Year 3

1. Will continue to work toward hosting a meeting of nationally recognized (practicing) family physicians.

2. Will continue to look for opportunities for the Medical University to take a leadership role in addressing the health hazards created by the departing military at the Charleston Naval Base and Shipyard.

6.2 Environmental Medicine & Risk Communication: Curriculum and a Professional Support Network - Department of Family Medicine

<table>
<thead>
<tr>
<th>Director:</th>
<th>Stanley H. Schuman, M.D., Dr. P.H.</th>
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<tbody>
<tr>
<td>Associate Director:</td>
<td>William M. Simpson, Jr., M.D.</td>
</tr>
<tr>
<td>Project Administrator:</td>
<td>Samuel T. Caldwell, M.A.</td>
</tr>
<tr>
<td>Staff Dev. &amp; Training Coordinator:</td>
<td>Larry H. Spell</td>
</tr>
<tr>
<td>Staff Dev. &amp; Training Specialist:</td>
<td>Jan A. Lay, M.S.</td>
</tr>
<tr>
<td>Administrative Assistant:</td>
<td>JoAnn Retter</td>
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Executive Summary

Historically there has been little or no environmental and occupational medicine (EOM) training in the curriculum of family practitioners even though this group of physicians see more EOM patients than any other medical specialty. In addition, patients expect their family physician to be knowledgeable about environmental risks in their community. Family medicine residents and practitioners who receive training in EOM will be able to better serve their patients and community in the risk assessment process.

These needs led to the project goal of developing and implementing graduate and continuing medical education curriculum in EOM for family physicians. To achieve this goal, an Environmental Medicine Curriculum Committee (EMCC) comprised of at least one faculty member from each of the seven teaching sites of the South Carolina Statewide Family Practice Residency Program (SFPRP) was formed to advise the OEMO on curriculum development. The OEMO also developed an EOM resource to support the faculty, residents and staff of the Statewide Family Practice Residency System (SFPRS) with consultations on patients with EOM complaints. The work of the committee and EOM consultative resource is ongoing. Future activities include adapting the core and elective EOM curriculum to other disciplines and into self-study programs for the busy practitioner.

All activities during the past quarter proceeded on schedule. Sub-committees of the EMCC continued to work closely with OEMO staff in the development of the EOM elective curriculum slides and lecture notes. Project staff consulted on 48 EOM cases during the period and presented 14 EOM lectures.
In cooperation with Dr. W. Allen Smith, project staff continued to develop plans for a national meeting of leaders in family medicine.

Objectives

1. To provide continued support to the Environmental Medicine Curriculum Committee (EMCC) including EOM consultative and research services to the Statewide Family Practice Residency System.

2. To develop eight environmental medicine elective curriculum modules for family medicine residents and to update core curriculum modules.

3. To determine if the core EOM curriculum can be adapted to other disciplines.

Milestones and Products for Third Quarter, Year 3

EOM Consultative and Research Services

1. Continued ongoing monthly environmental/occupational medicine literature review for pertinent articles to be added to the project's computerized data base.

2. Staff members consulted on 48 environmental/occupational medicine cases during the period.

3. Recorded cases that are described in the attached January-March Monthly Summary Reports.

   • Copies of reports

EOM Curriculum for Family Medicine

4. The EMCC met February 2-3, to critique the first drafts of the nine EOM elective lectures. OEMO staff members revised the drafts in accordance with the committee's suggestions and returned them to the EMCC in mid-March for final review. Reviews were still being received from the committee as of March 31. The nine EOM elective modules are as follows (Modules 1-5 comprise the core EOM curriculum):

Module 6- Carpal Tunnel Syndrome: Diagnosis, Treatment and Prevention
Module 7- Acute and Chronic Occupational Low Back Pain: A Review for Family Physicians
Module 8- Noise Induced Hearing Loss in Primary Care
Module 9 - Environmental and Occupational Chemical Exposure
Module 10 - Environmental and Occupational Skin Disease
Module 11 - Environmental and Occupational Lung Exposure
Module 12 - Workplace Substance Abuse: Recognition, Detection and Treatment
Module 13 - Low Dose Risks
Module 14 - Title 42: SC Workers Compensation Law: What Should the Family Physician Know?

5. Published the monthly newsletter, *Environmental Medicine Update*, January-March. The objectives of the newsletter are to report on the activities of the EMCC and to stimulate committee members concerning recent developments in EOM.

- Copies of newsletters

6. Presented 14 EOM lectures during the period. Lectures are described in the attached January-February Monthly Summary Reports.

7. Continued the survey of alumni of the SFPRP. The objectives of this study are to determine: 1) the extent of EOM within their practice; 2) suggestions for EOM curriculum improvements in residency training; and, 3) the need for EOM continuing medical education. On March 20, the OEMO began the survey of the graduates of the Columbia and Greenwood residencies that are the last two remaining sites to be surveyed. The final report on this activity will be completed by the next quarter.

8. On March 30, Dr. William Simpson led the two-hour workshop, "Environmental and Occupational Medicine in Family Medicine: A Longitudinal Curriculum for Family Medicine Residents," at the Prevention '95: Annual National Preventive Medicine Conference held in New Orleans, LA. The first hour consisted of an overview of designing a three year curriculum for busy family medicine residents, utilizing five core modules and nine elective modules, with input from seven residency training programs. The second hour was a demonstration of one core and one elective module, utilizing slide-lecture and/or interactive self-study, computer-assisted formats.

**EOM Curriculum for other Disciplines**

9. A committee of nursing faculty from the MUSC College of Nursing was appointed to work on a project to adapt the EOM core curriculum to the nurse practitioner program.
Milestones and Products Projected for Fourth Quarter, Year 3

1. Will provide continued support to the Environmental Medicine Curriculum Committee (EMCC) including EOM consultative and research services to the Statewide Family Practice Residency System.

2. Will continue production of the nine elective EOM modules consisting of teaching slides, lecture notes, interactive PC and Macintosh program, and references.

3. Will meet with MUSC nursing faculty to plan the adaptation of the family medicine EOM core curriculum to the nurse practitioner program.

Executive Summary

This project supports the information, communication, and computational needs of the outreach, education, and research tasks encompassed by EHAP. The basic strategy involves two primary components. First, the Information Systems Design Group built the specifications and architecture for computer systems that are capable, generally, of the computation and communication necessary to achieve EHAP goals. During the first year of the program, core equipment, based on the design architecture was purchased. Installation of this equipment continued through the second year. The major focus during the second year of the grant was to generate preliminary designs of an information access system which will serve researchers, health practitioners, and other environmental professionals. To achieve this, we completed extensive surveys of needs and available information sources, and developed the first prototype systems. Two basic tenets provide focus for the information access system design. First, no new databases or other information systems are being created—the system’s function is to provide easy, user-friendly access to a broad range of data sources that already exist. Second, we will be developing data integration techniques to assist the user in identifying and retrieving as much relevant data as is possible from a wide range of sources.

During the third year of the grant, we continue to expand our access to existing databases and incorporate new capabilities into our One Door Access System (ODAS). To broaden ODAS’s information access we are working with existing commercial database vendors to develop integrated access methods for their products via the ODAS. During the third quarter, we completed the development of an access module that provides ODAS with the capability of accessing Silver Platter databases. Silver Platter, a commercial database vendor, provides over 200 databases to its clients. In addition, two new database access methods were implemented and integrated with the ODAS prototype, ODBC—to access X-based databases (e.g., Paradox, Foxpro, Dbase) and DXP—to access databases provided on CD-ROM by Silver Platter.

In conjunction with the National Library of Medicine (NLM), we have incorporated their Unified Medical Language System (UMLS) products into the ODAS. Specifically, we have integrated both the UMLS Metathesaurus—a database of standard vocabularies and classifications used in the field of biomedicine—to help users narrow or broaden the scope of their searches and
the UMLS Information Sources Map—a database that describes the available electronic information sources in machine-readable form to provide automatic access to those sources.

Year 3 of the project has also seen continued development of our "gopher" server as well as implementation of a World Wide Web (WWW) server. During the third quarter we went on-line with an EHAP WWW server. By year end, we will have a working prototype of the ODAS system that incorporates wider information access capability and benefits from our cooperative efforts. Our collaborators include: the National Library of Medicine and the Micromedix Project with Georgetown University and our in-state alliances with Environmental Medicine Curriculum Committee, Area Health Education Centers (AHEC) Libraries, and the Charleston Academic Libraries Consortium (CALC).

Objectives

1. To build and maintain the basic computer and network structure for information handling.

2. To support the Education Initiative.

3. To support Seminars, Research, and Risk Assessment.

4. To provide operational support of EHAP's overall internal computing and communications.

Milestones and Products for Third Quarter, Year 3

1. Established a development partnership with Silver Platter. This will enable us to work extensively on interfaces with these commercial databases. In fact, the DXP (Data Exchange Protocol) interface for ODAS was completed and integrated with the ODAS prototype during the quarter.

2. Completed the interface for PC type databases. This new interface allows ODAS to interrogate X-based databases, (Foxpro, Paradox, Dbase), using Microsoft's Open Database Connectivity product.

3. Held the first Information Systems Review February 27-28. The review panel included: Sherrilynn S. Fuller, Health Sciences Library and Information Center, University of Washington; John L. Shnase, Director, Advanced Technology Group, Biomedical Communications Center, Washington University School of Medicine; and Karen T. Hackleman-Dahlen, Associate Professor and Head of Information Services, The University of Illinois. The group reviewed all aspects of
the Information System portion of the grant and will make recommendations as to how the program might proceed to better meet the objectives. They reviewed both the objectives of the program and the methods being used to achieve them. We expect their report by the end of April.

4. Implemented and brought on-line the EHAP WWW server.

5. Completed design of the Research Computing Network and installed new SGI machines in biometry to facilitate research there.

6. The new ODAS database design, developed during the second quarter, was implemented to support the access of external databases in a client-server environment.

7. Implemented development of two data access methods and integrated these with the ODAS prototype. The first method uses Microsoft's Open Database Connectivity (ODBC) product to access X-based databases (e.g., Paradox, Foxpro, Dbase, Access) residing on PCs. The second access method uses the Data Exchange Protocol (DXP) to access databases provided on CD-ROM by Silver Platter. The ODAS now provides the capability to access relational databases, X-based databases, and Silver Platter databases simultaneously, via a single user interface.

8. Initiated development of a PC-based ODAS client application. The current ODAS client executes on Silicon Graphics hardware. A PC-based client will make the ODAS more accessible to the target user community (e.g., rural physicians, researchers, academicians, clinicians).

9. continued development of the capability to access Z39.50-compliant databases via the ODAS. This capability will greatly increase the number of databases available through the system. We have successfully ported the Stanford University Z39.50 client software to the Silicon Graphics machine.

Milestones and Products Projected for Fourth Quarter, Year 3

1. Will begin design of an ODAS-based system for the MUSC Occupational and Environmental Medicine Office (OEMO) as an initial "beta-site" system. We will work closely with OEMO to understand their unique information access requirements, and update the prototype to meet their requirements.

2. Will continue development of the EHAP WWW Mosaic by connecting to other DOE sites, allowing interactive requests and forms and setting
up e-mail connections. We will also update the information on the WWW Mosaic on a quarterly basis to coincide with the quarterly report to DOE.

3. Will broadcast the EHAP WWW Mosaic site to other health centers and environmental agencies and "Web crawlers."

4. Will continue the development of the capability to access Z39.50-compliant databases via the ODAS. We will implement communications between the Stanford Z39.50 client and a Wide Area Information Server (WAIS). We will then begin to integrate a Z39.50 client application with ODAS.

5. Will continue development of a PC-based ODAS client, using the PowerBuilder application development tool.

6. Will begin the design of a distributed processing architecture for ODAS. The purpose of this initiative is to migrate the ODAS to a distributed client-server architecture in order to increase data access time. In addition, this architecture will be entirely PC-based, which will make it a viable information access solution for a larger user community.

7. We have identified MUSC's Occupational and Environmental Medicine Office (OEMO) as an initial "beta-site" for the ODAS prototype. We will work closely with OEMO to understand their unique information access requirements, and we will update the prototype to meet these requirements as feasible.

8. Will demonstrate the ODAS to the Silver Platter database corporation.