PACIFIC NORTHWEST AGRICULTURAL SAFETY AND HEALTH (PNASH) CENTER

NIOSH ANNUAL REPORT

CDC/NIOSH Cooperative Agreement #2 U50 OH07544-08

FISCAL YEAR 2008

(October 1, 2008 to September 30, 2009)

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Pacific Northwest Agricultural Safety and Health Center
Annual Report to NIOSH - Fiscal Year 2009
CONTRACT 2 U50 OH07544-08

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APPENDIX

Peer-Reviewed Publictions

R1: Hofmann-J; Keife- M; Furlong-C; De Roos-A; Farin-F; Fenske-R; van Belle-G; Checkoway-H. *Serum cholinesterase inhibition in relation to paraoxonase (PON1) status among organophosphate-exposed agricultural pesticide handlers.* Environmental Health Perspectives, Sept 2009; 117(9).

E1: Hofmann-JN, Carden-A, Fenske-RA, Ruark-HE, Keifer-MC. *Evaluation of a clinic-based cholinesterase test kit for the Washington state cholinesterase monitoring program.* American Journal of Industrial Medicine, 2008; 51(7).

Concluded Project Final Reports

P4: Point-of-view Video Analysis of the Impact of a Faller Safety Training Program
P6: Further Skills Retention in Fishing Safety Training

I. EXECUTIVE SUMMARY

The Pacific Northwest Agricultural Safety and Health (PNASH) Center, established in 1996, serves Alaska, Idaho, Oregon, and Washington with a goal of reducing occupational disease and injury among agricultural operators, workers, and their families. Due to the importance of all agricultural industries to the Northwest, our scope of work has long included farming, fishing, and forestry sectors. The PNASH Center's emphasis is on injury and illness prevention and health promotion, especially among populations not well represented in current research, including hired laborers, migrant/seasonal workers, women, and children. Our approach is to:

- Work in partnership with employers, workers, agencies and other research and service organizations.
- Develop innovative research and intervention programs that focus on problem solving.
- Take solutions to the workplace through training, outreach, and participatory research.

In recognition that the agricultural worker and community are the foundation of a strong agricultural industry, PNASH's theme is "Safe and Sustainable Agricultural Workplaces and Communities."

The 2008 Fiscal Year (FY), the third year of our NIOSH awarded five-year program, saw a great deal of project progress across all projects. Each of our twelve NIOSH projects had significant activity and two new projects were funded through our regional Small Grant Program. In addition, three new projects were awarded to the NIOSH PNASH Center through other federal and state agencies – these projects launched in the fall of 2009. We invite you to review our mid-cycle accomplishments and look forward to the results of these studies as we conclude this cycle's work over the remaining two years.

CENTER HIGHLIGHTS/ACCOMPLISHMENTS FOR 2008

1 Health and Safety in Western Agriculture: New Paths, Nov. 2008, Cle Elm, WA.
A PNASH sponsored participatory conference focused on new worker populations, research avenues, and innovative approaches for the prevention of disease and injury in agriculture. Participants included 126 academic and governmental researchers, health care providers and community service providers.
Online Proceedings: http://depts.washington.edu/pnash/2008conference/
Papers: Journal of Agromedicine, October-December 2009; 12(4).

2 Res 1: Risk Factors for Cholinesterase Depression among Pesticide Handlers
As of Summer 2009, this project has enrolled a total of 274 agricultural pesticide handlers. During the past year, 63 handlers participated in the study's computer-based survey, with a total of 67 clinic visits. Descriptive analyses of survey data from 154 study participants during the 2006-2007 spray seasons have been performed. Analyses of ChE inhibition in relation to PON1 status based on data collected during the 2006 and 2007 spray seasons was published in September 2009, and the relationship between ChE inhibition and self-reported exposures has been submitted for publication. By improving our understanding of the causes of ChE depression, we can help the agricultural community to reduce the burden of acute and chronic pesticide-related illnesses among handlers. Currently, project team members are coordinating with state agricultural and health agencies and other PNASH Center education efforts to disseminate risk factor messages to pesticide handlers. Education will take place through both agency in-service training and pesticide recertification courses over the coming years. Likewise, we are in the process of communicating to study participants their genetic results. With the article on PON1 and cholinesterase inhibition published, these research findings will be shared with study participants. Determining the most appropriate way to structure this communication is supported by Pilot Project 7: "Responding to Uncertain Results in Research: A pilot study of pesticide handlers responses to PON1 status."

Publication: Serum Cholinesterase Inhibition in Relation to Paraoxonase-1 (PON1) Status among Organophosphate-Exposed Agricultural Pesticide Handlers. Hofmann JN, Keifer MC, Furlong CE, De Roos AJ, Farin FM, Fenske RA, van Belle G, Checkoway H. Environ Health Perspect. 2009 Sep;117(9):1402-8. Epub 2009 Jun 9.

2 Res 2: Neurobehavioral Assessment of Pesticide Exposure in Children

The second year of data collection for the Neurobehavioral Study began and is ongoing. To date, 102 children have completed neurobehavioral testing, 21 of them have completed the second neurobehavioral test session and 128 families have been interviewed. Study recruitment has been active throughout Summer 2009, taking the project team to six community events/locations including a recruitment drive collecting information on pesticide knowledge and beliefs conducted at the county fair in July - 510 adults completed the survey. The survey's results will be used in the development of study communications.

3 Res 3: Enhancements to ChE Monitoring: Oxime Reactivation and OP-ChE Adducts

Accomplishments for the past year include expanding and improving sensitivity of the HPLC/MS/MS method for analyzing cholinesterase adducts. This method was applied to human plasma samples following in vitro exposure to OP pesticides. The oxime reactivation assay was successfully applied to both human and rat plasma samples providing kinetic information regarding cholinesterase inhibition and reactivation. One ongoing challenge is to develop an HPLC/MS/MS method with sensitivity and specificity sufficient to measure cholinesterase OP adducts in rat plasma. Experiments are in progress to evaluate more sensitive instruments and alternate methods of sample preparation.

4 Prev 1: Interventions to Minimize Worker and Family Pesticide Exposures

This field-based study tests and disseminates best agricultural pesticide solutions developed by industry experts that includes managers, workers, and pesticide safety educators. In the summer of 2009, project investigators surveyed farmers and pesticide applicators with a walk-through evaluation of their operations, identifying unique and practical safety solutions developed on-the-farm. To date, 22 practical pesticide safety solutions have been identified and documented by visiting nine different orchards and conducting 42 interviews (managers and handlers). In addition, the project team has moved forward with development of previously identified needs and solutions for: a protype mixer-loader splash shield; PPE fit and cleaning procedures; and validating a field analytic for pesticide residue using fluoro-specrephotometry. The project's Expert Working Group (EWG) met to generate and review safety measures to ensure the relevancy and success of the project. The EWG includes twelve members of the agricultural community.

5 Edu 2: Reality Tales:

Ladder injury stories were presented at existing community health worker (CHW) ladder safety training sessions at three farmworker camps. Evaluations took place with participants one week after their training. Results: 29 farmworkers (45% women) all of whom were tree fruit pickers ranging in ages from 14-61 (mode 22). The majority remembered at least one story (86%), what happen, (83%) the precipitating cause and consequences (79%), (72%) identified a lesson in the story and 79% could suggest how the injury could have been prevented. The most common response to what they liked about the story was how well people can learn from the stories of others. In additional the CHW survey, we have surveyed a random sample of the Good Fruit Grower readership (n=190) to measure if the article on worker's stories about ladder injuries was read by the grower/producer audience and if the key message was retained. 40% recalled reading the article about workers ladder injury stories and 69% correctly identified the key probable cause of the injury event. Additionally, the survey demonstrated that the article was popular enough that the trade magazine is requesting additional health and safety articles.

6 Pilot: Fallers Point-of-View Video Observation Study

This pilot study concluded in Summer 2009 (see final report in appendix). The study demonstrated the feasibility of putting a camera on a hardhat for point-of-view observation of work activities in a remote location. The captured video was clear, and in most cases, easy to interpret. The project showed the good potential for coding video data and quantifying work behaviors essential to safety. One of the challenges that the project confronted was the degree of comfort that the worker's had working with the equipment in place. This project may lead to future training programs using the unique video data obtained in this study.

7 Pilot 6: Further Skills Retention in Fishing Safety Training

This pilot study concluded in Summer 2009 (see final report in appendix). The results of this study are important to commercial fishing vessel safety trainers and the US Coast Guard by providing evidence on commercial fishing survival education skills decay. These results are contributing to decision making on refresher training. A skills decay rate from 100% competency to 76.5% in a time period of 18 to 24 months from initial training demonstrates a high rate of decay for survival skills in an industry that has the highest fatality rate in the U.S. Further research could identify an optimum interval of refresher training would be by providing periodic refresher training of skills and measuring retention rates.

8 New PNASH Funded Small Grants/Pilot Projects

FFA community mobilization for safe agricultural ATVs and tractor ROPS use (Murphy, PNASH Pilot, 2009-10) PNASH is partnering with a local chapter of the FFA (The National Organization of Agriculture Students) to pilot a student-run project to collect local data on ATV and tractors, present it back to their community for feedback, and then design an innovative local safety campaign.

Reducing workloads for older loggers in physically demanding logging tasks with synthetic rope (Garland, PNASH PIlot, 2009-10) This pilot project will assess the ergonomic and economic benefits of using synthetic rope to replace wire rope in standardized logging tasks for older workers (>age 40) compared to current practices and younger workers (prior research). The project will also show the next generation of forest operations researchers that heart rate measures can contribute to research on safety and productivity improvement.

9 External PNASH Projects and Awards

Concluded - Yakima Valley and North Central Washington Air Monitoring for Insecticides (Fenske, WA DOH, 2007-2009) In 2008, air monitoring studies were conducted by the University of Washington in two orchard regions during the peak application season for organophosphate insecticides. The studies investigated whether air concentrations presented a breathing hazard for nearby residential communities. Summary and Full Report at: http://www.doh.wa.gov/ehp/Pest/driftresults.htm

New - Ergonomic evaluation and development of best practices for the use of mobile work platform technology in orchards (Fenske, UW MAAF, 2009-11) The PNASH Center is working to 'design-in' safety measures into developing agricultural technologies, such as mobile platforms. Mobile platforms are self-propelled and self-guided all terrain vehicles with an adjustable height platform that carries a team of 4-8 workers, allowing for rapid and repetitive hand work without the change in position or tasks associated with ladder work. This project will evaluate new mobile platform technologies with regard to their impact on potential musculoskeletal disorders, safety risks, and productivity.

New - Aggravating factors of asthma in a rural environment (Keifer, NIH&CDC, 2009-2013)
This community-based project characterizes ambient triggers of asthma in the rural setting by following 50 asthmatic community participants, geo-temporally plotting their exacerbations and comparing these with known agricultural exposures. Subsequently, ambient sampling with an innovative and adaptable sampler will confirm the nature of the exposures and an informational campaign will share the findings with the public, clinicians and the scientific community.

New - Confronting the health risks of climate change: integrating science and public health practice to improve preparedness for worsening heat events, air pollution and environmental degradation in the NW (Principal Investigator: Richard Fenske, CDC, 2009-12) This 3-year project aims to develop an evidence-based forecast of health impacts for different communities. Read the UW News Release: UW researchers to study impacts of climate change on health in the Pacific Northwest

TOTAL CENTER BUDGET

08/09 Original Budget: $1,387,258 TC
07/08 Unobligated Balance Carryforward: $472,861 TC
08/09 NIOSH Supplement: $6,250 TC
Total 08/09 Budget: 1,866,369 TC
Total 08/09 Committed Cost Sharing: 156,000 TC
Total 08/09 Program Income: 4,710 TC

1. Actual Expenditures: $1,540,876 TC
2. Estimated In-kind Support Value: $50,000 TC
3. Outside Funding: $378,891TC ($156,000 actual cost sharing + $4,291 program income + $218,600 external projects)

CENTER PROJECTS

Administrative, Planning and Outreach Core
Research 1: Risk Factors for Cholinesterase Depression among Pesticide Handlers
Research 2: Neurobehavioral Assessment of Pesticide Exposure in Children
Research 3: Enhancements to Cholinesterase Monitoring: Oxime Reactivation & OP-ChE Adducts
Research 5: Assessment of Job-related Exposures for Diarrheal Illness in Farmworker Families
Prevention 1: Interventions to Minimize Worker and Family Pesticide Exposures
Education 1: Introducing a Cholinesterase Test Kit into Clinical Practice
Education 2: Reality Tales: Storytelling to Translate Agricultural Health and Safety Research
Pilot 3: Inhibition of Cholinesterase by Pharmacological and Dietary Agents
Pilot 4: Point-of-view Video Analysis of the Impact of a Faller Safety Training Program
Pilot 6: Further Skills Retention in Commercial Fishing Safety Training
Pilot 7: Responding to Uncertain Results in Research: A Pilot Study of Pesticide Handlers Responses to PON1 status
Pilot 8: Investigation of the Apparent Discrepancy between Observed Cholinesterase Depression among Pesticide Handlers in Washington and Regulatory Estimates of Exposure.

Ongoing Projects: 10
Projects completed this fiscal year: 2
Pilot 4: Point-of-view Video Analysis of the Impact of a Faller Safety Training Program
Pilot 6: Further Skills Retention in Commercial Fishing Safety Training
Projects dropped/discontinued in this fiscal year: None
New Projects: None funded by NIOSH
New Pilot/Feasibility Projects: 2
Pilot 10: Reducing Workloads for Older Loggers in Physically Demanding Logging Tasks with Synthetic Rope
Pilot 11: FFA Community Mobilization for Safe Agricultural ATVs and Tractor ROPS Use

CENTER INVESTIGATORS

Scientific Investigators: 17
Program Support Staff: 8

STATES SERVED: Washington, Idaho, Oregon, Alaska

REGIONAL ACTIVITIES: AK, CA, CO, ID, OR, TX, WA, and some that span USA

CENTER PRODUCTS

Presentations

- 9/30/2008 - Fishing Safety Workshops, Sitka, AK
  A 12 part workshop series of safety workshops given to commercial fishermen and marine safety instructors.
- 9/30/2008 - 10/10/2008 - Wal-Mart Community Meeting
  Project presentation at Wal-Mart, Hood River OR.
- 11/11/2008 - New Paths: Health and Safety in Western Agriculture, Cle Elum, WA
  Fluorescent Tracer Manual Workshop.
- 11/11/2008 - New Paths: Health and Safety in Western Agriculture, Cle Elum, WA
  Biomonitoring State of the Science: Where Is New Technology Going? Panel.
- 11/12/2008 - New Paths: Health and Safety in Western Agriculture, Cle Elum, WA
  Round Table Discussion: Using Community-Based Participatory Research to Identify and Address Occupational.
  Work Hazards among Contract Forest Workers
- 11/12/2008 - New Paths: Health and Safety in Western Agriculture, Cle Elum, WA
  Keynote: New Paths, New Travelers.
- 11/12/2008 - New Paths: Health and Safety in Western Agriculture, Cle Elum, WA
  Ag Center Successes and New Directions.
- 11/12/2008 - Proceedings: New Paths: Health and Safety in Western Agriculture, Cle Elum, WA
  Round Table Discussion: Biomonitoring Phase II: A Discussion of Existing and Potential Technologies.
- 11/12/2008 - New Paths: Health and Safety in Western Agriculture Conference, Cle Elum, WA
  Roundtable Discussion: Community Air Exposures to Pesticides – Public Concerns and Known Risks.
- 11/12/2008 - New Paths: Health and Safety in Western Agriculture, Cle Elum, WA
  Roundtable Discussion: How Can We Overcome the Economic and Cultural Barriers to Preventing and Treating Heat Illnesses?
- 11/12/2008 - New Paths: Health and Safety in Western Agriculture, Cle Elum, WA
  Oral presentation of project findings for risk factors for occupational pesticide exposure.
- 12/10/2008 - presentation at Jesuit High School, Portland OR
  "How do we know if it's harmful?" presentation at Jesuit High School, Portland OR
- 1/8/2009 - 21st Annual Occupational and Environmental Health Conference, Semiahmoo, WA
  Development of Exposure Biomarkers for Organophosphorus Pesticides presentation.
- 2/10/2009 - UW Medicine Mini-Medical School Series.
  Dangerous Business: Workplace Hazards. Televised presentation at UW Medicine Mini-Medical School Series.
- 4/21/2009 - Washington Community Health Workers/Promotores Network Spring Intensive Training
  Presenting ladder safety workshop at the Washington Community Health Workers/Promotores Network Spring Intensive Training.
- 8/9/2009 - NIOSH AgFF Program Safety and Health Workshop. Cincinnati, OH
  Fluorescent Tracer Technique: Research to Practice. Platform presentation.
- 8/11/2009 - NIOSH AgFF Program Safety and Health Workshop. Cincinnati, OH
  Assessment of Chronic Pesticide Exposure in Children project presentation.
- 8/11/2009 - NIOSH NORA Agricultural, Forestry, Fishing Workshop, Cincinnati, OH. PNASH overview.
- 8/19/2009 - Partnerships that Work Conference, Opportunities Industrialization Center (OIC) Farmworker Investment Program, Yakima, WA
  Participation and PNASH informational exhibit.
- 9/8/2009 - JENESYS-POMRAC-Kanazawa University Joint Symposium
  Keynote speaker. Measurement of exposure to organophosphorus pesticides: enhancements to

cholinesterase monitoring.

Publications

Article published, professional (juried publication)

- Hofmann-JN, Crowe-J, Postma-J, Ybarra-V, Kiefer-MC
  Perceptions of environmental and occupational health hazards among agricultural workers in Washington state.
  AAOHN J 2009 Aug; 26: 0
- Hofmann-JN, Carden-A, Fenske-RA, Ruark-HE, Keifer-MC
  Evaluation of a clinic-based cholinesterase test kit for the Washington state cholinesterase monitoring program.
  American Journal of Industrial Medicine 2009; 51 (7)
- Hofmann-J; Keifer- M; Furlong-C; De Roos-A; Farin-F; Fenske-R; van Belle-G; Checkoway-H
  Serum cholinesterase inhibition in relation to paraoxonase (PON1) status among organophosphate-exposed agricultural pesticide handlers.
  Environmental Health Perspectives Sept 2009; 117(9)

Article published, feature (trade publication)

- Dzugan-J
  Retention of learned survival skills studied
  AMSEA Marine Safety Update 3/10/2009; 24(1):
- Sharpe-E
  New workforce, new issues
  Environmental Health News Autumn 2008;
- Murphy-H
  It's just seconds to a grain bin entrapment
  Western Farmer Stockman October 2008
- Murphy-H
  Cholinesterase inhibition
  Good Fruit Grower March 2009
- Murphy-H
  Aches, pains, and strains
  Good Fruit Grower Jan 2009
- Helen Murphy
  Talking with your work force
  Good Fruit Grower November 2008
- Knopp-M
  Recognizing the perils of pesticide exposure
  Clinicians Review
- Murphy-H
  Avoiding ladder injuries
  Good Fruit Grower Sept 2008

Brochure

- *Spanish language version of NIOSH agriculture NIHL brochure, "Can you hear me?"*
  In press at NIOSH

Fact Sheet

- Murphy-H
  Sintomas y senales de ataque de calor y agotamiento de calor
  Calendario para los trabajadores agricolas! 2008-2009 Calendar

Manuscripts

- Crowe-J, Galvin-K
  'A changing mindset' - Describing what it takes to keep agricultural pesticide handlers safe

- Hofmann-JN, Keifer-MC, DeRoos-AJ, Fenske-RA, Furlong-CE, van Belle-G, Checkoway-H
  Occupational determinants of serum cholinesterase inhibition among organophosphate-exposed agricultural pesticide handlers in Washington State.
  Occ and Environ Med Submitted
- Hofmann-JM, Keifer-MC, Checkoway-H, DeRoos-AJ, Farin-FM, Fenske-RA, Richter-RJ, van Belle-G, Furlong-CE
  Biomarkers of sensitivity and Exposure in Washington state pesticide handlers.
  Paraoxonases in Inflammation, Infection and Toxicology Submitted

Education / Training / Outreach

Curriculum (short course)
- *Fluorescent tracer kit - containing instructions and materials to conduct FT training*

Thesis or dissertation
- *Characterization of Bioaerosols and Bacterial Surface Contamination at a Large Washington Dairy Operation*
- *Determinants of serum cholinesterase inhibition among Washington state pesticide handlers Organophosphate-exposed Agricultural Pesticide Handlers in Washington State*

Website or webpage established
- *Proceedings: Health and Safety in Western Agriculture: New Paths*
- *Pesticides and Health*

Newsletter
- *NW Forest Worker Safety Review*
- *PNASH quarterly enews*

CD-ROM
- *"Reality Tales" Story Corps recordings*

Course manual
- *Fluorescent tracer manual: An educational tool for pesticide safety educators*

Evaluation instrument / tool
- *Faller "helmet cam" Point-of-view video recorder*
- *Schematic prototype model for a shield to protect mixers from splash*
- *SOP: In vivo studies with rats and OP pesticies*
- *SOP: ChE determination using 96-well plate assay*
- *SOP for analyzing Uvitex OB with fluoro-spectrophotometry*

Exhibit material
- *Posters, fact sheets, flyers, displays, and radio announcements*

Poster
- *Educating through games*
- *Implementation of a portable cholinesterase monitoring kit in a clinical setting: A normalization process approach*
- *Assessment of chlorpyrifos exposure in agricultural workers during airblast applications*
- *Introducing a portable cholinesterase monitoring kit into clinical practice: A normalization process model approach*
- *Acetaminophen interference in organophosphate pesticide testing*
- *Validation of Microbial Recovery from Surfaces by Various Sampling Methods*
- *Communicating occupational and genetic risk factors research results to agricultural pesticide handlers in Washington state*
- *Assessment of chronic pesticide exposure in children*
- *Assessment of pesticide exposure in children*
- *Trees kill: Key factors in logging safety*
- *Introduction of a portable cholinesterase monitoring kit into clinical practice: A normalization process model approach*

- *Pilot Organophosphorus Pesticide Air Monitoring Project*
- *Development of a sensitive and specific exposure biomarker assay for organophosphate pesticides using HPLC and tandem mass spectrometry*
- *Serum cholinesterase inhibition in relation to paraoxonase (PON1) status among organophosphate-exposed agricultural pesticide handlers*
- *Serum cholinesterase inhibition in relation to paraoxonase 1 status among organophosphate-exposed agricultural pesticide handlers*
- *Occupational health and safety of cedar block cutters on the Olympic Peninsula*
- *Interventions to minimize worker and family pesticides*
- *Expert working group model for informing pesticide safety research*

PowerPoint Presentation (for distribution)

- *Fluorescent tracer technique: research to practice*
- *Determinants of cholinesterase inhibition in pesticide handlers*
- *Serum cholinesterase inhibition in relation to paraoxonase (PON1) status among organophosphate organophosphate-exposed agricultural pesticide handlers*
- *Serum cholinesterase inhibition in relation to paraoxonase status among agricultural pesticide handlers*
- *Risk factors for occupational pesticide exposure*
- *Serum cholinesterase inhibition in relation to paraoxonase status among agricultural pesticide handlers*
- *Biomarkers of sensitivity and exposure in Washington State pesticide handlers*
- *Life events calendar*

Video / DVD

- *Fluorescent tracer kit DVD*
- *Workers talk about PON1*
- *Una guia para la salud y la seguridad del trabajador del bosque*

Conferences

- 9/30/2008 - 9/28/2009:
  External Advisory Committee meetings - biannual.
- 9/30/2008 - 9/29/2009: Ag Center Directors Meetings
  NIOSH Ag Center's quarterly meetings.
- 11/1/2008 - 11/17/2008:
  The potential partnership with the national oral history project StoryCorps was explored with the major commodity groups in the state. They felt this would be a more suitable way to gather producer's stories.
- 11/11/2008 - 11/13/2008: Health and Safety in Western Agriculture: New Paths, Cle Elum, WA
  Health and Safety in Western Agriculture: New Paths, Cle Elum, WA
- 11/18/2008 - 11/18/2008:
  The fourth in a series Expert Working Group Meetings during the course of the project. Pesticide education was provided.
- 2/12/2009 - 2/12/2009:
  The fifth in a series Expert Working Group Meetings during the course of the project. Pesticide education was provided.
- 2/25/2009 - : Washington Governor's Ag Safety Day
  Health Fair at WA Ag Safety Day
- 4/10/2009 - 4/12/2009: Washington State Community Health Worker/Promotora Network Annual Spring Retreat.
  Washington State Community Health Worker/Promotora Network Annual Spring Retreat

- 6/10/2009 - 6/10/2009:
  The sixth in a series Expert Working Group Meetings during the course of the project.
- 9/30/2009 - 11/1/2009:
  Key informants in the grower community advised the project against gathering growers together for story telling groups. They felt that producers were less likely have ladder injury/ heat related illness and a storytelling venue may not be appealing.

Other Products

Database
- *2008 PNASH Center evaluation data report*

Questionnaire or survey instrument
- *Pesticide exposure history questionnaire*
- *Practical solutions interview questionnaire*

Report (unpublished)
- *ConneX summer college course*
- *Fallers point-of-view video observation study - Final report*
- *Point-of-view video analysis protocol*
- *Results of research: Drill conductor refresher training intervals*
- *Good Fruit Grower Magazine reader 2008 survey results*
- *Year*-End Report to NIOSH
- *2008 PNASH Center annual report*
- *Pacific Northwest Agricultural Center Renewal and Progress Report*

II. ADMINISTRATION, PLANNING, AND OUTREACH

PROJECT TITLE
Administrative, Planning and Outreach Core

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PROJECT DESCRIPTION
The Administrative and Planning and Outreach Core provides the administrative infrastructure and support for the entire Center program and assists in the implementation of individual project objectives. It ensures that project activities are well coordinated within the Center and are of high scientific quality and responsive to stakeholder needs. The components of this core include:

- Management.
- Pilot Project Program.
- Internal and External Advisory Committees.
- NIOSH Agricultural Center Collaboration.
- Agricultural Community Outreach and Education Program.

PROJECT START AND END
Start: 9/30/2006 End: 9/29/2011

PROJECT BUDGET
1 Actual Project Expenditures: $236,154 Total Costs
2 Estimated In-kind Support Value: $50,000 Total Costs
3 Outside Funding: $226,816 Total Costs

PROJECT AIMS
1 Management – **Ongoing**
The Administrative and Planning Core provides the organization, internal communications, and facilities for the conduct of research, education, translation, and intervention activities. Highlights of the 2007 FY include: Permanent hire of Rachel Schwartz, Research Coordinator. Ms. Rachel Schwartz supports the research activities for Matthew Keifer’s projects.
New External Research Awards:

- Matthew Keifer (NIH&CDC, 2009-2013) Aggravating factors of asthma in a rural environment. In partnership with the Northwest Community Education Center/Radio KDNA and the Yakima Valley Farmworker's Clinic.
- Richard Fenske (UW DEOHS, 2009-11) Ergonomic evaluation and development of best practices for the use of mobile work platform technology in orchards. In partnership with the WSU extension and the WA Tree Fruit Research Commission.

- Richard Fenske, (CDC, 2009-12) Confronting the health risks of climate change: integrating science and public health practice to improve preparedness for worsening heat events, air pollution and environmental degradation in the NW. In partnership with the UW Northwest Center for Public Health Practice. Read UW News Article: UW researchers to study impacts of climate change on health in the Pacific Northwest

2 Pilot Project Program – **Ongoing**
In the 2008 FY, PNASH's small grants program RFA resulted in 7 pre-proposals, 6 final proposals and 3 funded projects. The program was administered by PNASH with the goal of stimulating and supporting new and expanded research, prevention/intervention, and education/translation activities in the area of occupational safety and health in Northwest farming, forestry and fishing. The funded projects include:
- Helen Murphy (PNASH Pilot, 2009-10) FFA Community Mobilization for Safe Agricultural ATVs and Tractor ROPS Use. In partnership with the Zillah FFA (The National Organization of Agriculture Students).
- John Garland (PNASH Pilot, 2009-10) Reducing workloads for older loggers in physically demanding logging tasks with synthetic rope. In partnership with state contract logging associations.

3 Internal and External Advisory Committees – **Ongoing**
The Internal Advisory Committee (IAC) meets monthly, assisting the Principal Investigator and project investigators in making scientific and administrative decisions in the operation of the Center. The External Advisory Committee (EAC) provides the Center with overall guidance on program direction and relevance of activities to the region and the nation. In FY2008, the EAC convened in-person in November 2008 in conjunction with the PNASH-hosted conference, Health and Safety in Western Agriculture: New Paths, Nov. 2008, Cle Elm, WA. Two new external advisors joined in the 2008/09 year and one stepped down.

4 NIOSH Agricultural Center Collaboration – **Ongoing**
PNASH continues to serve an active participant in the Agricultural Centers Evaluation Program, NIOSH's NORA and participated this year in two NIOSH collaborative forums: NIOSH Agriculture, Forestry, Fishing Workshop, August 11-12, Cincinnati, OH and Western States Occupational Network (WESTON), Sept 24-25, Denver, CO.

5 Agricultural Community Outreach and Education Program – **Ongoing**
The ACOEP is the Center's foundation for building relationships and sharing information with producers, farmworkers, health care providers, extension specialists, government workers, and other researchers and educators. The Center's ACOEP continued with its strategic plan and regular commitments:
- Hosting Health and Safety in Western Agriculture: New Paths, Nov. 2008, Cle Elm, WA
- Co-hosting the Washington Governor's Ag Safety Day and coordinating the health fair
- Planning the Western Migrant Stream Forum and Research Reception
- Participating and providing educational training to the Washington State Community Health Worker Network.
- Editing and publishing the Northwest Forest Worker Update newsletter.
- Regional education presentations. (See below.)

PROJECT ACCOMPLISHMENTS and CHALLENGES
Hosting conference, Health and Safety in Western Agriculture: New Paths, Nov. 2008, Cle Elm, WA. A participatory conference focused on new worker populations, research avenues, and innovative approaches for the prevention of disease and injury in agriculture. Participants included 126 academic and governmental researchers, health care providers and community service providers.

Online Proceedings: http://depts.washington.edu/pnash/2008conference/

Papers: Journal of Agromedicine, October-December 2009; 12(4).

NIOSH Agriculture, Forestry, Fishing Workshop, August 11-12, Cincinnati, OH. An invitation workshop facilitated by NIOSH to stimulate collaboration between investigators from both within NIOSH and those external to NIOSH.

PNASH new project awards and collaborations:

- Matthew Keifer (NIH&CDC, 2009-2013) Aggravating factors of asthma in a rural environment. In partnership with the Northwest Community Education Center/Radio KDNA and the Yakima Valley Farmworker's Clinic.
- Richard Fenske (UW DEOHS, 2009-11) Ergonomic evaluation and development of best practices for the use of mobile work platform technology in orchards. In partnership with the WSU extension and the WA Tree Fruit Research Commission.
- Richard Fenske, (CDC, 2009-12) Confronting the health risks of climate change: integrating science and public health practice to improve preparedness for worsening heat events, air pollution and environmental degradation in the NW. In partnership with the UW Northwest Center for Public Health Practice. Read UW News Article: UW researchers to study impacts of climate change on health in the Pacific Northwest
- Helen Murphy (PNASH Pilot, 2009-10) FFA Community Mobilization for Safe Agricultural ATVs and Tractor ROPS Use. In partnership with the Zillah FFA (The National Organization of Agriculture Students).
- John Garland (PNASH Pilot, 2009-10) Reducing workloads for older loggers in physically demanding logging tasks with synthetic rope. In partnership with state contract logging associations.

PROJECT PRODUCTS

Presentations

- 11/12/2008 - New Paths: Health and Safety in Western Agriculture, Cle Elum, WA. Fluorescent Tracer Manual Workshop.
- 11/12/2008 - New Paths: Health and Safety in Western Agriculture, Cle Elum, WA
  Roundtable Discussion: How Can We Overcome the Economic and Cultural Barriers to Preventing and Treating Heat Illnesses?
- 11/12/2008 - New Paths: Health and Safety in Western Agriculture Conference, Cle Elum, WA
  Roundtable Discussion: Community Air Exposures to Pesticides – Public Concerns and Known Risks.
- 11/12/2008 - Proceedings: New Paths: Health and Safety in Western Agriculture, Cle Elum, WA
  Round Table Discussion: Biomonitoring Phase II: A Discussion of Existing and Potential Technologies.
- 11/12/2008 - New Paths: Health and Safety in Western Agriculture, Cle Elum, WA
  Round Table Discussion: Using Community-Based Participatory Research to Identify and Address Occupational Work Hazards among Contract Forest Workers.
- 11/12/2008 - New Paths: Health and Safety in Western Agriculture, Cle Elum, WA
  Keynote: New Paths, New Travelers.
- 11/12/2008 - New Paths: Health and Safety in Western Agriculture, Cle Elum, WA
  Ag Center Successes and New Directions.
- 2/10/2009 - UW Medicine Mini-Medical School Series
  Dangerous Business: Workplace Hazards. Televised presentation at UW Medicine Mini-Medical School Series.
- 4/21/2009 - Washington Community Health Workers/Promotores Network Spring Intensive Training
  Presenting ladder safety workshop at the Washington Community Health Workers/Promotores Network Spring Intensive Training..
- 8/11/2009 - NIOSH NORA Agricultural, Forestry, Fishing Workshop, Cincinnati, OH
  PNASH overview.
- 8/12/2009 - NIOSH NORA Agricultural, Forestry, Fishing Workshop. Cincinnati, OH. Fluorescent Tracer Technique: Research to Practice. Platform presentation.

- 8/19/2009 - Partnerships that Work Conference, Opportunities Industrialization Center (OIC) Farmworker Investment Program, Yakima, WA. Participation and PNASH informational exhibit.

Publications

Article published, feature (trade publication)

- Murphy-H. *Talking with your work force.* Good Fruit Grower November 2008.
- Murphy-H. *Aches, pains, and strains.* Good Fruit Grower Jan 1, 2009.
- Murphy-H. *Cholinesterase inhibition.* Good Fruit Grower March 1, 2009.
- Murphy-H. *It's just seconds to a grain bin entrapment.* Western Farmer Stockman October 2008.
- Sharpe-E. *New workforce, new issues.* Environmental Health News Autumn 2008.
- Knopp-M. *Recognizing the perils of pesticide exposure.* Clinicians Review

Brochure

- *Spanish language version of NIOSH agriculture NIHL brochure, "Can you hear me?"* In press at NIOSH.

Fact Sheet

- Murphy-H. *Sintomas y senales de ataque de calor y agotamiento de calor.* Calendario para los trabajadores agricolas! 2008-2009 Calendar.

Education / Training / Outreach

Curriculum (short course)

- *Fluorescent tracer kit - containing instructions and materials to conduct FT training*

Course manual

- *Fluorescent tracer manual: An educational tool for pesticide safety educators*

Video / DVD

- *Fluorescent tracer kit DVD*

Website or webpage established

- *Pesticides and Health*
- *Proceedings: Health and Safety in Western Agriculture: New Paths*

Newsletter

- *NW Forest Worker Safety Review*
- *PNASH quarterly enews*

Poster

- *Assessment of chlorpyrifos exposure in agricultural workers during airblast applications*
- *Pilot Organophosphorus Pesticide Air Monitoring Project*
- *Educating through games*

Conferences

- 9/30/2008 - 9/28/2009: External Advisory Committee meetings - biannual.
- 9/30/2008 - 9/29/2009: Ag Center Directors Meetings. NIOSH Ag Center's quarterly meetings.
- 11/11/2008 - 11/13/2008: Health and Safety in Western Agriculture: New Paths, Cle Elum, WA
- 2/25/2009: Washington Governor's Ag Safety Day. Health Fair at WA Ag Safety Day

Other Products

Database

- *2008 PNASH Center evaluation data report*

Report (unpublished)

- *Good Fruit Grower Magazine reader 2008 survey results*

Year-End Report to NIOSH

- *Pacific Northwest Agricultural Safety and Health Center Year End Report (FY07/08)*
- *Pacific Northwest Agricultural Safety and Health Center Progress Report and Annual Renewal*

STATES PROJECT WAS ACTIVE IN

AK, CA, CO, ID, OR, TX, WA, and some that span USA

COLLABORATION

Alaska Marine Safety Education Assn. (AMSEA)
Central Washington Occupational Medicine
Harborview Occupational Medicine Clinic
Heritage University
Idaho Mountain States Group
National Institute for Occupational Safety and Health (NIOSH)
NIOSH Agricultural Centers
Northwest Communities Education Center/Radio KDNA
Oregon growers and shippers organizations
Oregon Health & Sciences University
Oregon State University Agricultural Extension
Pesticide Incident Reporting and Tracking Panel (WA DOH PIRT)
Pesticide Laboratory, Centers for Disease Control and Prevention
US Environmental Protection Agency
Washington State University
Washington State University Cooperative Extension
Washington State Labor and Industries
Washington State Department of Agriculture
Washington State Department of Health
Washington State Department of labor and Industries
UW Center for Ecogenetics and Environmental Health
UW Department of Environmental and Occupational Health Laboratory
UW Northwest Center for Occupational Safety and Health
UW Pediatric Environmental Health Specialty Unit
Yakima Valley Farm Workers Clinic

External Advisory Committee members:

Juan Bocanegra, Evergreen State College Labor Education & Research Center
Deborah Carter, Northwest Horticultural Council
Betty Ann Cohen, Central Washington Occupational Medicine
Jim Doornink, Doornink Fruit Ranch
Leda Garside, Tuality Healthcare’s ¡Salud! Services
Barbara Lee, Director, National Children's Center for Rural and Agricultural Health and Safety
Karen Lewis, Extension Educator, Washington State University
Carol McCormick, Outreach Coordinator, Columbia Valley Community Health
Eric Zakarison, Zakarison Partnership

III. CENTER PROJECTS

PROJECT TITLE

Res: Risk Factors for Cholinesterase Depression among Pesticide Handlers

PROJECT OFFICERS(s)

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HOST ORGANIZATION

University of Washington
Environmental and Occupational Health Sciences
Box 357234
Seattle, WA 98195

PROJECT DESCRIPTION

In 2004, the Washington State Department of Labor and Industries (L&I), under mandate from the Washington State Supreme Court, initiated a new cholinesterase (ChE) monitoring program for agricultural workers who handle toxicity class I or II organophosphate (OP) or N-methyl-carbamate (CB) pesticides. The ChE enzyme, which plays an essential role in the regulation of neural signaling, is inhibited by OP and CB pesticides. Washington is only the second state in the Union to establish a ChE monitoring program; California has required ChE monitoring since 1974. In contrast to the California monitoring program, the Washington program benefits from a single laboratory provider, a central data repository (L&I), provision of the vast majority (>80%) of ChE tests by three main clinics, and an inspection team that reviews work practices and conditions at workplaces where ChE depressions occur. Although these investigations have revealed several potential risk factors, none of these factors have been confirmed through a comparison against work practices and conditions among a reference group of handlers who did not have depressed ChE activity. These characteristics of the newly established ChE monitoring program offer researchers an unprecedented opportunity to investigate determinants of overexposure to OP and CB pesticides. The aim of this study is to identify and characterize risk factors for ChE depression among handlers participating in the Washington State ChE monitoring program. Approximately 1,200 handlers will be recruited over a 5-year period in collaboration with the three main occupational medicine clinics in agricultural regions of Washington State. A participant's risk of ChE depression will be evaluated with respect to workplace, behavioral, and genetic characteristics (paraoxonase or PON1 status). Exposure information will be obtained using a computer-based survey instrument with audio-recorded questions and icon-based responses that are displayed on the touch screen Tablet PC. We will collect exposure data before ChE activity status is determined. Reported exposures will be validated through worksite visits for a subset of study participants. Blood specimens will be collected and analyzed for determination of PON1 status for each study participant. Epidemiologic studies are needed to verify animal-based findings that PON1 status correlates with susceptibility to certain OPs. The results of this study will improve our understanding of potential routes and mechanisms of pesticide overexposure, and will help to prevent such exposures among pesticide handlers. The effectiveness of educational materials developed in response to identify risk factors will be evaluated in terms of their impact on the prevalence of ChE depression and the prevalence of reported risk factors among participating handlers.

PROJECT START AND END

Start: 1/10/2006 End: 9/29/2011

PROJECT BUDGET

1 Actual Project Expenditures: $ 251,939 Total Costs
2 Estimated In-kind Support Value: None
3 Outside Funding: None

PROJECT AIMS

1 Enroll 50% of Washington State pesticide handlers who undergo repeat ChE testing in an ongoing cross-sectional study. **- Ongoing**
To date, a total of 274 agricultural pesticide handlers have been enrolled in this study. During the past year, 63 handlers participated in the study, with a total of 67 visits (i.e., occasions when participating handlers completed the survey and/or provided a blood sample for PON1 testing). Enrollment has been somewhat lower than expected due to an overall decrease in the number of workers participating in the state ChE monitoring program, likely due to work reorganization or reduced use of organophosphate and carbamate insecticides.

2 Collect information about likely key risk factors for pesticide over-exposure from participating handlers. **- Ongoing**
Self-reported information about potential sources of pesticide exposure was collected for a total of 67 participant visits during the 2009 spray season. Descriptive analyses of survey data from 154 study participants during the 2006-2007 spray seasons have been performed.

3 Characterize PON1 status in blood specimens from each participant. **- Ongoing**
PON1 status is hypothesized to be a biological marker of susceptibility to some organophosphate pesticides including chlorpyrifos. A total of 64 blood specimens for PON1 testing were collected from participating handlers during the 2009 spray season. These blood specimens have been analyzed by Dr. Clement Furlong and colleagues to determine PON1 status based on the two-substrate assay, as well as plasma PON1 activity levels. Genotyping assays for the C-108T polymorphism in the PON1 promoter region and the Q192R polymorphism in the PON1 coding region will also be performed. Blood specimens from 163 participants during the 2006-2007 spray seasons have been tested for PON1 status and genotype.

4 Determine which risk factors are associated with ChE inhibition, including workplace conditions, behavioral factors, and PON1 status. **- Ongoing**
Analysis of ChE inhibition in relation to self-reported exposures and PON1 status based on data collected during the 2006 and 2007 spray seasons was published in September 2009. Analyses of data collected during 2008 and 2009 are ongoing.

5 Evaluate the impact of educating workers and growers about risk factors for ChE depression. **- Ongoing**
Project team members are coordinating with state agricultural and health agencies to disseminate project risk factor messages to pesticide handlers. Education will take place through both agency in-service training and pesticide recertification courses over the coming year. The evaluation will take place in subsequent years of the project when data about work practices and workplace conditions are available over an extended time period.

PROJECT ACCOMPLISHMENTS and CHALLENGES

- This year the project partnered with three additional occupational and community health clinics to increase recruitment: Lourdes Occupational Health Center, Mattawa Community Medical Center, and Yakima Worker Care. This expansion helped to maintain participation rates, as the overall number of periodic tests

in Washington State's Cholinesterase Monitoring program has been consistently decreasing since 2005. This also presented new logistical challenges as the number of field staff did not increase.
To date, a total of 274 agricultural pesticide handlers have been enrolled in this study. During the past year, 63 handlers participated in the study, with a total of 67 visits (i.e., occasions when participating handlers completed the survey and/or provided a blood sample for PON1 testing). Enrollment continues to be lower than expected in the originally expected due to an overall decrease in the number of workers participating in the state ChE monitoring program, likely due to work reorganization or reduced use of organophosphate and carbamate insecticides.

- Determining the most appropriate way to return genetic results has also been a challenge. Since the article on PON1 and cholinesterase inhibition was published in September 2009, there are now specific research findings that the team plans to share with participants. Determining the most appropriate way to structure this communication is supported by Pilot Project 7: "Responding to Uncertain Results in Research: A pilot study of pesticide handlers responses to PON1 status."

PROJECT PRODUCTS

Presentations
- 11/12/2008 - New Paths: Health and Safety in Western Agriculture, Cle Elum, WA
  Oral presentation of project findings for risk factors for occupational pesticide exposure.

Publications
Article published, professional (juried publication)
- Hofmann-J; Keife- M; Furlong-C; De Roos-A; Farin-F; Fenske-R; van Belle-G; Checkoway-H
  Serum cholinesterase inhibition in relation to paraoxonase (PON1) status among organophosphate-exposed agricultural pesticide handlers
  Environmental Health Perspectives Sept 2009; 117(9)
- Jofmann-JM, Keifer-MC, Checkoway-H, DeRoos-AJ, Farin-FM, Fenske-RA, Richter-RJ, van Belle-G, Furlong-CE
  Biomarkers of sensitivity and Exposure in Washington state pesticide handlers.
  Paraoxonases in Inflammation, Infection and Toxicology. Submitted
- Hofmann-JN, Keifer-MC, DeRoos-AJ, Fenske-RA, Furlong-CE, van Belle-G, Checkoway-H
  Occupational determinants of serum cholinesterase inhibition among organophosphate-exposed agricultural pesticide handlers in Washington State.
  Occ and Environ Med. Submitted

Education / Training / Outreach
Thesis or dissertation
- *Determinants of serum cholinesterase inhibition among Washington state pesticide handlers Organophosphate-exposed Agricultural Pesticide Handlers in Washington State*

Poster
- *Serum cholinesterase inhibition in relation to paraoxonase 1 status among organophosphate-exposed agricultural pesticide handlers*
- *Serum cholinesterase inhibition in relation to paraoxonase (PON1) status among organophosphate-exposed agricultural pesticide handlers*

PowerPoint Presentation (for distribution)

- *Life events calendar*
- *Biomarkers of sensitivity and exposure in Washington State pesticide handlers*
- *Serum cholinesterase inhibition in relation to paraoxonase status among agricultural pesticide handlers*
- *Risk factors for occupational pesticide exposure*
- *Serum cholinesterase inhibition in relation to paraoxonase status among agricultural pesticide handlers*
- *Serum cholinesterase inhibition in relation to paraoxonase (PON1) status among organophosphate organophosphate-exposed agricultural pesticide handlers*
- *Determinants of cholinesterase inhibition in pesticide handlers*

Other Products

Questionnaire or survey instrument

- *Pesticide exposure history questionnaire*

STATES PROJECT WAS ACTIVE IN

Washington

COLLABORATION

Central Washington Occupational Medicine
Department of Entomology and Environmental Toxicology, Washington State University
Farmworker Education Program, Washington State Department of Agriculture
Lourdes Clinic
Pesticide Incident Reporting and Tracking Panel, Washington State Department of Health
Scientific Advisory Committee, Washington State Cholinesterase Monitoring Program
WAState Department of Health
WA Department of Labor and Industries
WorkCare, PLLC
Yakima Worker Care and Sunnyside Worker Care

PROJECT TITLE

Res: Neurobehavioral Assessment of Pesticide Exposure in Children

PROJECT OFFICERS(s)

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HOST ORGANIZATION

Oregon Health & Science University
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3181 SW Sam Jackson Park Road
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PROJECT DESCRIPTION

The goal of the proposed study is to extend our previous work to identify possible health effects from chronic exposure to organophosphate pesticides in school-age children (5-12 years) and determine if performance is correlated with current home pesticide exposure or an estimate of lifetime measure of exposure. This 5-year plan of research will: (1) establish an optimal exposure measurement protocol; (2) recruit a cohort of 150 exposed and 150 non-exposed control children; (3) compare neurobehavioral performance of children of applicators to children of controls in a cross-sectional study, and relate neurobehavioral performance of all children to estimates of (potential) home dust exposure and estimates of lifetime exposure; (4) repeat the same measurements in a second year to obtain longitudinal data that will characterize developmental progress and relate that progress to exposure estimates; (5) develop one-page English/Spanish brochures for the various communities to describe research outcomes and their implications for school, work, home and clinical diagnosis.

PROJECT START AND END

Start: 1/10/2006 End: 9/29/2011

PROJECT BUDGET

1 Actual Project Expenditures: $ 282,541 Total Costs
2 Estimated In-kind Support Value: None
3 Outside Funding: None

PROJECT AIMS

1 Establish a sampling protocol to characterize Organophosphate (OP) exposures in urine metabolites in children over a spraying season. Obtain self-reports of pesticide use by applicators and family members using an icon-based interview approach to develop an estimate of lifetime pesticide exposures in the children tested. **- Ongoing**

- Data from the Sampling Study collected during the 2008 pesticide application season (May through September) are currently being analyzed. Urine samples were collected from children before, during and after pesticide application periods.
- Dr. Dana Barr from the CDC has agreed to analyze the urine samples and we expect to get the results in November 2009.
- Scoring methods to assess lifetime exposure to pesticides using the Life History Calendar have been developed and will be presented at the American Public Health Association Meeting in November 209.

2 Recruit a cohort of 150 school-age children whose parents are active OP pesticide mixer-loader-applicators, and an age- and gender-matched control group (N=150); and implement procedures for maintaining contact with the sample over two application seasons. **- Ongoing**

- Recruitment materials have been developed and used by our community research assistant to present the project and recruit families to participate in the Neurobehavioral Study (Aim 3)
- The project has been presented at over 25 different community events during the past year (e.g., ESL classes, street fairs and festivals, churches, school open houses, soccer tournaments, and job fairs).
- We are also working with the Columbia Gorge Fruit Growers to recruit families for the study.
- A Recruitment Study collecting information on pesticide knowledge and beliefs was conducted at the County Fair in July. Five hundred and ten adults completed a survey asking about pesticide knowledge and beliefs. The goal of this study was to recruit families to participate in the Neurobehavioral Study and also to identify common knowledge and beliefs about pesticides to use in the development of communications from the study (Aim 5).
- To date over 300 people have been recruited to participate in the study.

3 Conduct a cross-sectional study of neurobehavioral performance in 5-12 year old children of pesticide mixer-loader-applicators, compared to same-age control children, and relate performance of all children to home dust exposures. **- Ongoing**

- Seventy-five families participated in Year 1 of the Neurobehavioral Study (November, 2008 – January, 2009), completing home interviews and neurobehavioral testing.
- Dust samples were collected from 48 homes. These samples were analyzed at the University of Washington Laboratory.
- An additional Research Assistant was hired to assist with data collection during Year 1 and we have added an additional part-time Research Assistant for the ongoing testing.
- The second year of data collection for the Neurobehavioral Study began in September and is ongoing. To date, 102 children have completed neurobehavioral testing, 21 of them have completed the second neurobehavioral test session (Aim 4) and 128 families have been interviewed.

4 Examine neurobehavioral performance of the same 300 children in the following (second) year to determine if home pesticide exposures affect neurodevelopment. **- Ongoing**

- Families have been contacted and asked to complete questionnaires assessing pesticide exposure in the past year and to collect a dust sample from the home.
- We have begun retesting children from Year 1 of the Neurobehavioral Study (21 children have completed the second neurobehavioral test session).

5 Develop a series of communications to the orchard worker, orchard owner, school and medical communities in Hood River that describe the research outcomes and targeted implications. **- Ongoing**

- Recruitment materials (posters and handouts) have been developed to present the project to the community. (Aim 2)
- A classroom presentation was given to local high school students to present information about pesticide exposure and methods used to assess health effects.
- Information collected from the Recruitment Study (Aim 2) will be used to develop communications for study families.
- An Advisory Board meeting was held in February 2009 and consisted of members of the grower organization, researchers from Oregon State University and the Agricultural Extension Office, and a represented from a local health care clinic.

PROJECT ACCOMPLISHMENTS and CHALLENGES

- 128 families have participated in the Neurobehavioral Study (including home interviews, neurobehavioral testing and home dust sample collection)
- 21 families returned for follow up Neurobehavioral testing
- 510 participants completed Pesticide Knowledge and Belief Survey. The goal of this activity was to recruit families to participate in the Neurobehavioral Study and also to identify common knowledge and beliefs about pesticides to use in the development of communications from the study.

PROJECT PRODUCTS

Presentations

- Rohlman-DS, Hohn-E, Fuchs-M, Huszar-S. (October, 2009). *Assessment of Health Effects of Children Living in an Agricultural Community.* Northwest Children's Environmental Health Forum, Tukwila WA.
- Rohlman-DS, Fuchs-M, Hohn-E, Huszar-S. (August, 2009). *Assessment of Chronic Pesticide Exposure in Children.* National Institute of Occupational Safety and Health (NIOSH) Agricultural, Forestry, and Fishing Workshop, Cincinnati OH.
- Rohlman-DS. (June, 2009). *Neurobehavioral Methods for Assessing Performance in Adults and Children in Cross-Cultural Applications.* Faculty of Medicine, Menoufia University, Shebin El Kom, Egypt.

Education / Training / Outreach

Exhibit material

- *Posters, fact sheets, flyers, displays, and radio announcements*

Poster

- *Assessment of pesticide exposure in children*
- *Assessment of chronic pesticide exposure in children*

High School and Middle School Presentations: *How do we know if it's harmful?*

- *Jesuit* High School, Portland OR December 2008
- *Hood* River High School, Portland OR, February 2009
- Middle School Math and Science Conference, Portland OR, April 2009

Project Presentations for Recruitment:

Event	Number of Participants	Date
Annual Columbia Gorge Job Fair, The Dalles, OR	~600	March 2009
Speaker Baldemar Mendoza, agro-ecologist from Oaxaca at Bethel United Church of Christ in White Salmon, WA	20	April, 2009
The 30th Annual NW Cherry Festival Open Air Market: Maraschino Magic, The Dalles, OR	500	April 2009
ESL classes in Hood River and The Dalles, OR	60	May-June 2009
Summer Soccer Camp, White Salmon, WA	110	June 2009
Columbia Gorge Soccer League Tournament, Odell, OR	~500	July-Aug 2009
4H Soccer Tournament for children, Odell, OR	500	July-Aug 2009
Hood River County Fair, Odell, OR	~5,000	July 2009
Jammin's July Street Festival, The Dalles, OR	~2,000	July 2009

Summer School, Hood River, OR	8	July 2009
Walk-in Movies, Hood River, OR	~500	June-Aug 2009
2009 COED Soccer League (Community Education), Hood River, OR	~500	July 2009
WyEast Vista Apartments for Farm Workers, Hood River, OR	24	Aug 2009
Soccer Games at the Catholic Church in Hood River, OR	200	June-Sept 2009
Mexican Independence Day Celebration, Jackson Park organized by Radio Tierra	200	Sept 2009
School Open Houses: WestSide Elementary School; The Dalles Middle School, May Elementary School, ParkDale Elementary School	~800	Sep 2009
Elementary and Middle School Soccer games, White Salmon, WA	300	Sep -Oct 2009

Other Products

- Two *summer* students were involved in the Recruitment Study and with the Neurobehavioral Study
- *Posters*, flyers, displays, and radio announcements were developed

STATES PROJECT WAS ACTIVE IN:

Oregon, Washington

COLLABORATION

Hood River community members
Members from the Oregon growers and shippers organizations
Members of the Oregon State University Agriculture Extension Office

PROJECT TITLE
Res: Enhancements to Cholinesterase Monitoring: Oxime Reactivation & OP-ChE Adducts

PROJECT OFFICERS(s)
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HOST ORGANIZATION
University of Washington
Environmental and Occupational Health Sciences
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PROJECT DESCRIPTION
The overall goal of this proposal is to improve the specificity, sensitivity and reliability of cholinesterase monitoring, thereby providing a tool to detect and reduce overexposure of agricultural workers to cholinesterase (ChE)-inhibiting pesticides.

PROJECT START AND END
Start: 1/10/2006 End: 9/29/2011

PROJECT BUDGET
1 Actual Project Expenditures: $ 172,202 Total Costs
2 Estimated In-kind Support Value: None
3 Outside Funding: None

PROJECT AIMS
1a Develop/validate a sensitive, accurate and robust analytical procedure based on HPLC/MS/MS for the measurement of OP-adducts to plasma ChE (butyryl ChE, BuChE). **- Met**

- The analytical method was expanded to include methylated organophosphorus cholinesterase adducts. These adducts are biomarkers for methyl paraoxon and similar OP pesticides. Another improvement to the method was the addition of a custom-synthesized internal standard, specifically, a ^{13}C-labeled nonapeptide with the same amino acid sequence as the peptide isolated from human and rat plasma cholinesterase.
- Plasma samples from a pilot study where rats were orally exposed to chlorpyrifos were analyzed for cholinesterase adducts and unadducted cholinesterase. Because rat plasma has only approximately 5% of the concentration of cholinesterase that is present in human plasma, our current method appeared to lack sensitivity needed to detect low levels of exposure to OPs in rats. Efforts are in progress to evaluate whether more sensitive HPLC/MS/MS systems are capable of quantifying low-level OP exposures in rats. Two instruments were identified on the UW campus that are available for sensitivity evaluation and use on this project if successful. Evaluation of the first instrument has been completed. Sensitivity for the peptide standards and adducts in human plasma extracts was approximately two-fold better than the system currently being used. However, adducts in rat plasma extracts again were not detected. The other system available is of a substantially different design and is widely used for low concentrations of peptides. Standards of the target cholinesterase peptide and adduct have recently been analyzed on this system and results are forthcoming.

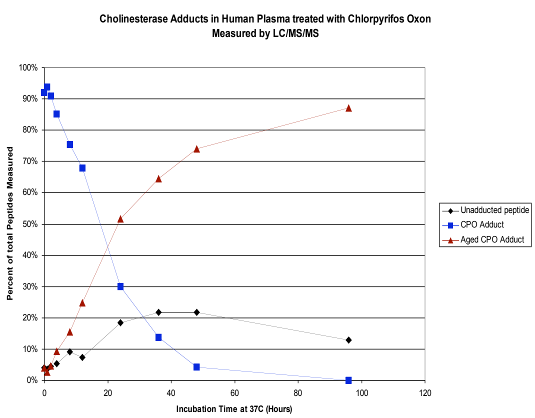
- Another possible limitation to measuring cholinesterase adducts in rat plasma is that the sample preparation method was developed for human plasma cholinesterase and has not been optimized or validated for use in other species. It may be that rat cholinesterase is different enough such that the enzymatic digestion procedure utilized does not produce the same peptide adduct. Efforts are in progress to evaluate another proteolytic enzyme (chymotrypsin) that is known to produce more predictable peptides than the relatively non-specific enzyme (pepsin) presently being used.

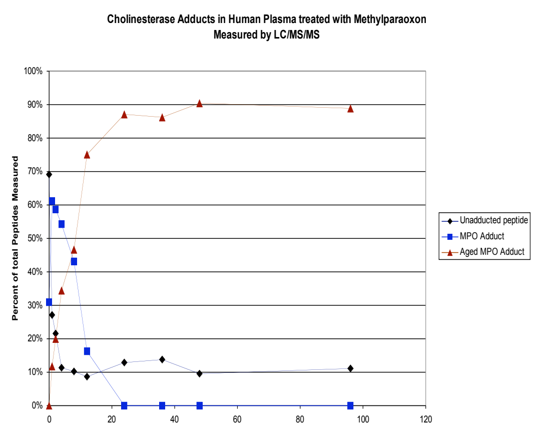
1b Evaluate the potential of oxime reactivation followed by measurement of ChE activity for confirmation of depressed ChE activity. **- Met**

- In years 1 and 2, we developed assays to measure cholinesterase activity in human and rat plasma using a 96-well microplate reader. We also developed an oxime reactivation procedure for inhibited cholinesterase in human plasma. During the present year, we developed a similar assay for reactivating rat plasma butyrylcholinesterase using the oxime 2-PAM. These assays were used to measure cholinesterase inhibition and reactivation in rats exposed *in vivo* to chlorpyrifos and humans exposed *in vitro* to chlorpyrifos oxon (CPO) and methylparaoxon (MPO). Results are described below in Aim 2.

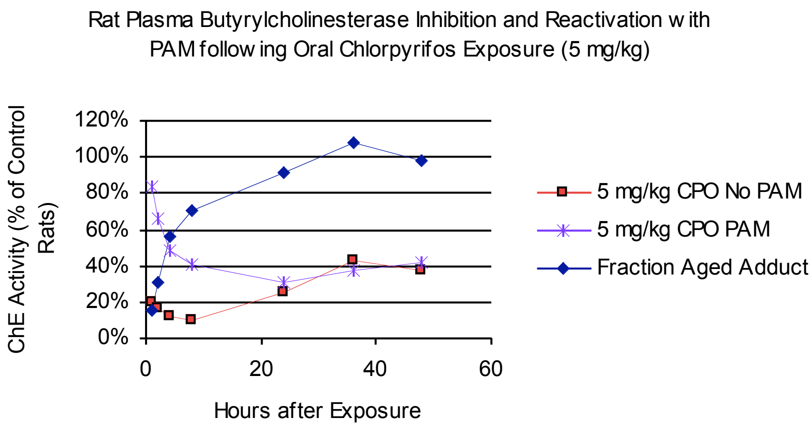
2 Evaluate the relationships between OP-adduct levels, reactivatability of ChE, and ChE activity in vitro, in vivo in rats, and in humans exposed to OP pesticides. **- Ongoing**

- An *in vitro* experiment was conducted where human plasma was incubated with either chlorpyrifos oxon or methylparaoxon at concentrations previously shown to inhibit approximately 80% of the plasma cholinesterase activity. Samples were collected over ninety-six hours and analyzed by LC/MS/MS for OP adducts and using the oxime reactivation assay to measure cholinesterase inhibition and adduct aging. We were able to measure OP adducts to human plasma cholinesterase following exposure to both OP pesticides. As shown in the figures below, there are differences in the reaction kinetics for formation and subsequent aging of the adducts resulting from the two OPs. Specifically, the chlorpyrifos oxon adduct forms more rapidly, but ages more slowly as compared with the adduct formed from methylparaoxon. The conclusions regarding the kinetics of inhibition and aging are similar for the oxime reactivation assay and the direct measurement of the adducts using LC/MS/MS.

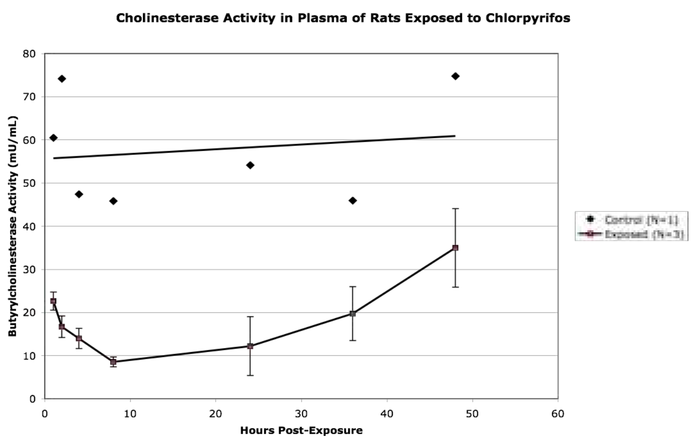




- A pilot range-finding study was conducted where twenty-four rats were exposed to chlorpyrifos. The pesticide was dissolved in corn oil and given by oral gavage. Six rats were dosed at either 1, 5, or 10 mg/kg and the remaining six rats received corn oil only to serve as unexposed controls. Blood was drawn 1, 2, 4, 8, 24, 36, and 48 hours after dosing. The figures below show the time course for inhibition of rat butyrylcholinesterase as well as subsequent aging and apparent recovery of activity. Inhibition reached a maximum between eight and twenty-four hours after oral exposure. Aging was nearly complete by the thirty-six hour time point as determined by the inability of the oxime to restore activity.



A second *in vitro* experiment was conducted where human plasma was again incubated with chlorpyrifos oxon. However, for this experiment, a larger number of replicate samples and one additional time point were collected to improve statistical power. Four samples were collected at each of eleven time points from 0 to 96 hours. Presently, samples are stored at -80°C and will be analyzed by LC/MS/MS for OP adducts and using the oxime reactivation assay to measure cholinesterase inhibition and adduct aging.



3 Research to practice: Incorporate the assays developed in Aim 1 with the practice of OP pesticide exposure monitoring in Washington state. **- Ongoing**

- This aim is slated to commence in year 5.

PROJECT ACCOMPLISHMENTS and CHALLENGES

- Accomplishments for the past year include expanding and improving sensitivity of the HPLC/MS/MS method for analyzing cholinesterase adducts. This method was applied to human plasma samples following in vitro exposure to OP pesticides.
- The oxime reactivation assay was successfully applied to both human and rat plasma samples providing kinetic information regarding cholinesterase inhibition and reactivation.
- One ongoing challenge is to develop an HPLC/MS/MS method with sensitivity and specificity sufficient to measure cholinesterase OP adducts in rat plasma. Experiments are in progress to evaluate more sensitive instruments and alternate methods of sample preparation. Another challenge has been obtaining analytical

standards for the MS method. Several standards are being or have already been synthesized by collaborators, but have not yet been provided for our use.

PROJECT PRODUCTS

Presentations

- Simpson-C.D [2009] *Measurement of exposure to organophosphorus pesticides:enhancements to* cholinesterase *monitoring.* JENESYS-POMRAC-Kanazawa University Joint Symposium. Kanazawa, Japan **(keynote speaker)**
- Murphy-H (Chair), Gee-S, Keifer-M, Simpson-C [2008]. Biomonitoring State of the Science: Where Is New Technology Going? New Paths Conference, Cle Elum, Washington.
- Paulsen-M [2009]. Development of Exposure Biomarkers for Organophosphorus Pesticides. 21st Annual Occupational and Environmental Health Conference, Semiahmoo, Washington.
- Paulsen-M, Simpson-C [2008]. Development of a Sensitive and Specific Exposure Biomarker Assay for Organophosphate Pesticides using HPLC and Tandem Mass Spectrometry. New Paths Conference, Cle Elum, Washington.
- 1/11/2008 - New Paths: Health and Safety in Western Agriculture, Cle Elum, WA
- "Biomonitoring State of the Science: Where Is New Technology Going?" panel.
- 1/8/2009 - 21st Annual Occupational and Environmental Health Conference, Semiahmoo, WA
- Development of Exposure Biomarkers for Organophosphorus Pesticides presentation.
- 9/8/2009 - JENESYS-POMRAC-Kanazawa University Joint Symposium
- Keynote speaker. Measurement of exposure to organophosphorus pesticides:enhancements to
- cholinesterase monitoring.

Publications

Education / Training / Outreach

- *During* year 3, two undergraduate students and one graduate student (Joe Kim, Giang Ong, and Alizee Barbier-Maderou) who have worked on these projects, have developed knowledge and skills related to measuring, understanding and mitigating pesticide exposures in farmworkers.
- *SOP: In vivo studies with rats and OP pesticies*
- *SOP: ChE determination using 96-well plate assay*

Poster

- *Development of a sensitive and specific exposure biomarker assay for organophosphate pesticides using HPLC and tandem mass spectrometry*

STATES PROJECT WAS ACTIVE IN

National - U.S.

COLLABORATION

Dana Barr, Ph.D.
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PROJECT TITLE

Res Pilot: Assessment of Job-related Exposures for Diarrheal Illness in Farmworker Families

PROJECT OFFICERS(s)

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HOST ORGANIZATION

University of Washington
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PROJECT DESCRIPTION

It is hypothesized that occupational and environmental exposure pathways from livestock operations (in particular cattle operations) pose a significant risk of exposure to zoonotic bacterial contamination (e.g. Campylobacter spp., Salmonella spp., E.coli O157:H7) for farmworkers and their families. In addition to on the job workplace exposures to livestock handlers, livestock handling farmworkers may unwittingly expose themselves and their families through transportation of job-related bacterial contamination to the household. Additionally, farmworkers may reside in close proximity to livestock operations which result in environmental contamination of their homes by a variety of pathways (e.g. through bioaerosol or well water contamination). The primary objective of the proposed project is to assess job-related exposures for farmworkers and their families to three common zoonotic bacterial pathogens (Salmonella spp., Campylobacter spp., and E.coli O157:H7).

The specific aims of the proposed project are: 1) Adaptation, development, and/or validation of methods for sampling of bacteria on surfaces (e.g. vehicle and household carpets, worker apparel, and other workplace, vehicle and household surfaces); 2) Assessment of fomitic surfaces, bioaerosol, and water as workplace exposure pathways; 3) Assessment of the paraoccupational (or take-home) exposure pathway for three zoonotic pathogens (Salmonella spp., Campylobacter spp., and E.coli O157:H7); and 4) Assessment of residential proximity to job-related livestock operations as an exposure pathway. This study will specifically address NIOSH priorities for a special occupation at risk (farmworkers) as identified in the National Occupational Research Agenda (NORA). Additionally this study will develop or adapt novel methods for occupational-related sampling for pathogenic microorganisms.

D. PROJECT START AND END

Start: 1/10/2006 End: 9/29/2009

E. PROJECT BUDGET

1 Actual Project Expenditures: $56,724 Total Costs
2 Estimated In-kind Support Value: None
3 Outside Funding: None

PROJECT AIMS

1 Adaptation, development, and/or validation of methods for sampling of bacteria on surfaces (e.g. vehicle and household carpets, worker apparel, and other workplace, vehicle and household surfaces).

- Met, final data analysis ongoing

We have completed our experimental work towards this aim. However, we have not finished the statistical analysis or preparation of a manuscript on the information. We plan to have accomplished the statistical analysis and manuscript submission in 2010. In brief, we examined several of the most commonly used bacterial sampling methods for surfaces, including swabbed (traditional and flocked), contact plates, and rinse/elute methods. Additionally we evaluated a novel sampling device called the M-Vac, a vacuum assisted rinse and elute method. Each method was evaluated in laboratory trials on multiple surfaces, including steel, glass, wood, tile, carpet, and cloth. Efficiencies of recoveries were evaluated for several organisms, including *E.coli*, *Staphylococcus aureus*, and *Bacillus spp*. These organisms represent appropriate surrogates for most bacterial types expected in the agricultural setting. Initial results were highly variable and organism dependent. We expected that the application and drying of the organisms onto test surfaces was partly responsible. We evaluated numerous application methods from spotting on the surface, to spreading, to spray application of various types. The organism most susceptible to drying, E. coli, was recovery and analyzed by both culture and PCR-based methods. Results suggest that considerable inactivation during drying was affecting the apparent recovery efficiencies. In subsequent trials we evaluated several parameters that may affect certain surface methods (e.g. pressure and retesting for contact plates). Over a range of pressures common in the use of contact plates, recoveries were not significantly affected by pressure applied. However, recoveries remained somewhat variable, and retesting of the same location found that up to 4 successive contact plates should be applied to a location to yield optimum recoveries. The M-vac was found to be a relatively efficient means to recover some organisms (*Bacillus* spores) but was difficult to compare to other methods due to the discrepancies in area sampled. Also the size of the unit, made field sampling inconvenient.

2 Assessment of fomitic surfaces, bioaerosol, and water as workplace exposure pathways. **- Partially Met, sampling completed**

Our enrollment in this study was limited. However, we completed sampling on three farms. We evaluated surface samples using both contact plates and swabs; bioaerosols using multistage and single stage impactors, and swirling impingers; and water by membrane filtration. Samples were analyzed by culture based methods and individual isolates characterized by biochemical and/or sequencing methods. Bulk air and water concentrates were also evaluated by pyrosequencing. This high throughput sequencing method allowed us to examine the overall bacterial population to genera level. Analysis of data is still ongoing.

3 Assessment of the para-occupational (or take-home) exposure pathway for three zoonotic pathogens (Salmonella spp., Campylobacter spp., and E. coli O157:H7). **- Partially met, sampling completed**

Again we were met with recruitment difficulties, which limited our ability to collect more than pilot data. We were able to only recruit two individuals that would allow us to follow them fro mthe workplace to their home. The two individuals represented two of the farms (one organic the other conventional). Sampling was completed on three occasions. Analysis of data is still ongoing.

4 Assessment of residential proximity to job-related livestock operations as an exposure. **- Terminated**

Due to limited recruiting we were not able to collect sufficient data to evaluate the relationship of residential proximity to livestock operations.

PROJECT ACCOMPLISHMENTS and CHALLENGES

Our major accomplishment in this study was the thorough testing and evaluation of various surface sampling methods. Once data analysis is finalized, this study should offer a good means to evaluate common surface sampling options.

Our largest challenge in this study was clearly recruitment. In our initial interaction with farmers in the study location, we were met with skepticism and a lack of enthusiasm for participation in the study. We were warned by collaborators in the area that the target population (dairy farmers) had been recently sued by community groups and were “gunshy” of letting researchers onto their farms for fear of the “spin” that might be put on published research by activist groups. We were warned to proceed slowly and earn their trust. We continued this approach, but were unable to gain sufficient enrollment at the initially proposed location. In the past year we attempted to shift our location to improve enrollment. We were able to recruit the head of the Washington Dairymen’s association and one of his friends to participate, but we again unable to secure additional study participants.

PROJECT PRODUCTS

Publications

Manual

- 2 manuscripts in preparation.

Education / Training / Outreach

Thesis or dissertation

- *Characterization of Bioaerosols and Bacterial Surface Contamination at a Large Washington Dairy Operation*

Training

- 2 undergraduate summer interns

STATES PROJECT WAS ACTIVE IN

Washington

COLLABORATION

Microbial-Vac Systems, Inc.
Environmental Sciences Program, Heritage University
Washington State Dairy Federation

PROJECT TITLE

Prev: Interventions to Minimize Worker and Family Pesticide Exposures

PROJECT OFFICERS(s)

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HOST ORGANIZATION

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PROJECT DESCRIPTION

The overall objective of this five-year project is to identify and test practical interventions that reduce pesticide exposures of agricultural workers and their families, and to disseminate these "best practices" into agricultural workplaces and workers' homes in the Northwest and around the nation. We define interventions very broadly, including changes in product use and innovations in application equipment, as well as changes in specific work practices. We will work closely with producers, workers, and our regional land-grant institutions to develop cost-effective interventions that are acceptable to both employers and employees. Specific aims are as follows:

1 Convene an Expert Working Group to define intervention strategies appropriate to the Northwest tree fruit industry. We will Identify orchard managers and workers, industrial hygienists, and pesticide safety educators in Washington, Oregon, and Idaho to serve as members of the group; develop short-term and long-term strategies for minimizing pesticide exposures among producers, workers, and their families; propose and prioritize specific interventions for testing in ongoing field studies; propose a model expert working group process for developing best practices in agricultural health and safety.

2 Conduct worksite intervention studies of pesticide applicator exposure. We will Identify chemical protective clothing (CPC) failures and exposure-related worker behaviors with fluorescent tracer techniques; test the effectiveness of interventions proposed by the Expert Working Group to reduce handler exposures through fluorescent tracer evaluation, biological monitoring, and work practice observations; test the effectiveness of interventions to reduce children's exposures due to transmission of agricultural chemicals from the workplace to the home.

3 Demonstrate and evaluate a novel pesticide applicator safety training program. We will demonstrate and evaluate a novel computer-based safety training with pesticide handlers and managers for use in the tree fruit industry.

4 Translate Best Practices into a document for a national audience. We will establish a national partnership group with key organizations involved in worker safety; conduct audience research to define document format and content; convene a national workshop on best practices; field-test best-practices document with target audiences; partner with NIOSH to produce a best-practices document and associated web-based resources valuable to employers, workers, and educators.

PROJECT START AND END
Start: 1/10/2006 End: 9/29/20011

PROJECT BUDGET
1 Actual Project Expenditures: $282,168 Total Costs
2 Estimated In-kind Support Value: None
3 Outside Funding: None

PROJECT AIMS

1 Convene an Expert Working Group to define intervention strategies appropriate to the Northwest tree fruit industry. **- Partially Met**
- The Expert Working Group met four times with the research team to develop pesticide safety measures for field testing. New members were recruited to replace those that had left.
- Completed analysis of Key Informant Interviews for: potential pesticide safety measures to evaluate, the role of workplace 'safety culture' in minimizing worker exposure; and audience research for the manual.
- Second phase of the peer literature review and pesticide safety intervention review.

2 Conduct worksite intervention studies of pesticide applicator exposure. **- Ongoing**
- Identified, documented and evaluated unique practical solutions for pesticide safety
- Developed and validated the laboratory analytical method for the fluorescent tracer Uvitex OB

3 Demonstrate and evaluate a novel pesticide applicator safety training program. **- Ongoing**
The key informant interviews showed computer-based training not to be the preferred format for pesticide safety education. This aim now has a less significant role. The system will be demonstrated and the participating managers and handlers will provide feedback and complete an evaluation.

4 Translate Best Practices into a document for a national audience. **- Ongoing**
Continuous development has been taking place on communication messages and materials, audience research, imagery library, and planning for a regional/national workshop. The workshop plan has been developed and is scheduled for June 2011. National participant outreach and a survey will take place in Spring 2010. Funding will be applied for to NIOSH and EPA in Summer 2010.

PROJECT ACCOMPLISHMENTS and CHALLENGES
- Completed analysis of Key Informant Interviews for: potential pesticide safety measures to evaluate, the role of workplace 'safety culture' in minimizing worker exposure, and audience research for the manual.
- Conducted four EWG meetings and used the Northwest data from four sources on pesticide injuries, expsooures and risk factors to identify needs for practical solutions. Provided pesticide education at three meetings.
- The EWG and the research team successfully developed a common language around pesticide safety and handling, Examples include using the term 'safety measure' instead of 'intervention' and the term 'solution' for 'best practices.'
- Based on the EWG members' interest in current problems and needs, the project is drawing on unique practical solutions for safety measures that orchards have already developed and implemented on their own. The identified 'practical solutions' are now being documented and evaluated. Those that have been selected through a process of validation and external review will be included in the final document.
- Developed and validated the practical solutions interview questionnaire.
- Identified and documented 22 solutions by visiting 9 different orchards and conducting 42 interviews

(managers and handlers).

- Developed and validated laboratory procedures for analyzing Uvitex OB with fluoro-spectrophotometry. Uvitex OB will be used as a surrogate for pesticides for testing some interventions.
- Developed a prototype model for a shield to protect mixers from splash in collaboration with the EWG.
- Initiated the development of several practical solution studies regarding personal protective equipment including, checklist, fit check, and cleaning PPE.

PROJECT PRODUCTS

Presentations

- Galvin-K. Fluorescent Tracer Technique: Research to Practice. Platform at the 2009 NIOSH AgFF Program Safety and Health Workshop. Aug 09. Cincinnati.
- Galvin-K, Palmández P, Tchong-French M, Fenske RA. Expert Working Group Model for Informing Pesticide Safety Research. Poster at the 2009 NIOSH AgFF Program Safety and Health Workshop. Aug 09. Cincinnati.
- Palmández-P, Galvin-K, Tchong-M, Fenske-RA. Interventions to Minimize Worker and Family Pesticides. Poster presented at the New Paths: Health and Safety in Western Agriculture conference. Nov 08. Cle Elum.

Publications

Manuscript

- Crowe-J, Galvin-K
  'A changing mindset' - Describing what it takes to keep agricultural pesticide handlers safe

Education / Training / Outreach

- Galvin-K. Fluorescent Tracer Manual. Workshop presented at the New Paths: Health and Safety in Western Agriculture conference. Nov 08. Cle Elum.

Evaluation instrument / tool

- *Schematic prototype model for a shield to protect mixers from splash*
- *SOP for analyzing Uvitex OB with fluoro-spectrophotometry*
- *Practical solutions interview questionnaire*

Poster

- *Interventions to minimize worker and family pesticides*
- *Expert working group model for informing pesticide safety research*

PowerPoint Presentation (for distribution)

- *Fluorescent tracer technique: research to practice*

Conferences

- 11/18/2008 - 11/18/2008:
  The fourth in a series Expert Working Group Meetings during the course of the project. Pesticide education was provided.
- 2/12/2009 - 2/12/2009:
  The fifth in a series Expert Working Group Meetings during the course of the project. Pesticide education was provided.
- 6/10/2009 - 6/10/2009:
  The sixth in a series Expert Working Group Meetings during the course of the project.

STATES PROJECT WAS ACTIVE IN

Washington, Oregon, Idaho

COLLABORATION

12 agricultural handlers, supervisors, producers and educators who form the EWG.
9 growers that have contributed to the ‘Practical Solutions’.
NIOSH
US EPA
Washington State University – Cooperative Extension

PROJECT TITLE

Edu: Introducing a Cholinesterase Test Kit into Clinical Practice

PROJECT OFFICERS(s)

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HOST ORGANIZATION

University of Washington
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PROJECT DESCRIPTION

This project's aim is to enhance and simplify worker monitoring for pesticide overexposure by introducing a portable testing kit, the Test-mate ChE test system, into an existing, state-wide cholinesterase monitoring program. Washington State OSHA (known as WISHA) mandates the monitoring of cholinesterase for agricultural workers who are likely to work with pesticides for more than 30 hours in a 30 day period. This year, over 2000 baseline tests were done in Washington between January-September 2009. The measurement of cholinesterase by WA clinics presently depends on sending samples across the state to a central lab. This Test-mate system employs the Ellman methodology (same as the laboratory) and a battery powered, portable, light emitting diode based photo analyzer which measures the activity of both plasma and erythrocyte cholinesterase using just 10 microliters of blood. The blood sample can be obtained from a finger stick sample or venipuncture. The kit has been used in countries around the globe and has been reported upon in many studies in the published literature. It has shown good performance when compared to laboratory based systems. Easy to apply in a clinician's office, the Test-mate will be made available to clinics to facilitate its introduction into clinical practice by developing "use models" based on the way the clinic conducts testing. Once developed, these use models will be used to disseminate the technology to other clinics in the area. Data gathering throughout the study period has assessed the usability of the kit from both clinical and grower perspectives and inter- and intra-kit variability, and will eventually assess the effectiveness of training and the accuracy of the Test-mate against the gold standard laboratory. The use of the Test-mate will also permit evaluation of new cholinesterase depression verification techniques developed by the Agricultural Center (Simpson Project). Monitoring workers for overexposure to pesticides is a labor and resource intensive process. This research-to-practice project will take a proven methodology, reconfirm its value and introduce it into the cholinesterase testing process with the aim of reducing the work and cost of testing and improving the quality of information and response time of the cholinesterase monitoring process.

PROJECT START AND END

Start: 1/10/2006 End: 9/29/2011

PROJECT BUDGET

1 Actual Project Expenditures: $63,633 Total Costs
2 Estimated In-kind Support Value: None
3 Outside Funding: None

PROJECT AIMS

1 To work with a single clinic in Washington state to design a "use model" for onsite ChE testing using the Test-mate ChE system. **- Met**

- We continue to have a strong working relationship with Central Washington Occupational Medicine (CWOM) of Yakima, WA. As we develop questions and use model procedures, we continue our dialogue to ensure that the project is responsive to their needs and that they are still eager to work with us. CWOM clinical staff has provided the project with important information as to the feasibility of clinical introduction of the Test-mate.
- In addition to CWOM, we have established a working relationship with two additional medical clinics that monitor pesticide workers in Central Washington. We interviewed key informants in regards to ChE monitoring at each clinic in order to identify and contextualize several work-related factors pertaining to usage of the Test-Mate kit.
- The identification of work-related factors that would potentially promote or inhibit successful adoption of the kit, which was completed in 2008-09 by graduate MPH student Randy Treadwell, will contribute directly to the creation of a formal use model.

2 To identify clinic-specific issues that interfere with use of the Test-mate system and adapt the "use model" to resolve these issues. **- Ongoing**

Through discussion among the UW research team and interviews with key clinical informants knowledgeable about ChE testing, several possible clinic-specific issues have been identified, including;

- Clinical Laboratory Improvement Amendments (CLIA) certification: We have researched the requirements and questioned clinical personnel if such a licensure would be both logistically and financially feasible for their clinic. In the clinics that we interviewed, every informant believed that identifying a lab director and obtaining the proper licensure, if they did not already possess it, would be feasible. If the clinics are not yet CLIA certified, we will work with them to ensure that they become so before they will be given a Test-mate kit to work with. The laboratory director must be qualified to manage and direct the laboratory personnel and the performance of moderate complexity tests and must be eligible to be an operator of a laboratory.
- Costs vs. benefits – determining how many tests a clinic must perform to make the Test-mate cost efficient. This is something we aim to address in FY 09/10. In FY 08/09 we did address the financial feasibility of incorporating the kit and the costs of staff training, though a comprehensive cost benefit analysis has not been done.
- Physical space for blood storage, environmental and time requirements: To date, we have worked on lab experiments to test the validity of the test kit as temperature and time change. In the coming future, we will expand upon this testing. During the interview process with clinical personnel we attempted to evaluate how well they perceived the Test-Mate kit would perform during site visits to large grower operations, a service that some larger clinics including CWOM offer their clients.
- Although a formal training course/manual and use model is a goal for the upcoming year, in 08/09, Randy Treadwell concentrated on identifying clinic-specific factors that could positively or negatively impact the successful research-to-practice transition of the Test-Mate ChE kit into clinical practice.
- Simultaneous use of multiple test kits in order to increase sample output and evaluate any variance between kits and/or between technicians.

The research team will further investigate these and additional issues as they arise. Conversational interviews with clinic staff have made this an iterative process. The factors that were identified through these key informant interviews can now be validated though more interviews with additional clinics.

3 To expand participation to three to five clinics with smaller ChE monitoring programs and adapt the use model for dissemination to other clinical providers. **- Ongoing**

Although the Test-Mate kit has not yet been given to additional clinics, key informant interviews pertaining to the work-practices surrounding ChE monitoring have been conducted at various clinics. Once a training program/ use model is formalized, these same clinics will be recruited to participate in implementing smaller ChE in-clinic testing programs.

4 To determine the potential for the Test-mate to augment or replace laboratory-based cholinesterase testing based on the performance of the Test-mate in the clinic setting and the cost of incorporating the Test-mate into the monitoring system. **- Future**
The feasibility of using the Test-Mate kit in conjunction with or even replacing the current laboratory-based ChE testing method was assessed during the key informant interviews conducted at participating clinics.

5 To introduce to clinics two new methods for ChE inhibition verification. **- Future**
We will focus on this aim in the final year of the project (2010-11).

PROJECT ACCOMPLISHMENTS and CHALLENGES

Accomplishments

- Identified several work-related factors that may have a direct impact on the research-to-practice transition of the Test-Mate Cholinesterase Monitoring kit.
- Established successful relationships with additional medical clinics and grower operations WA State.

Challenges

- Due to the small sample size of the study, it is difficult to predict uptake of the Test-mate kit in other clinics.
- The likelihood of successful and sustained Test-Mate kit adoption was limited. Additional prospective studies need to be conducted to not only identify and contextualize new work-related factors pertaining to ChE monitoring but to also validate the factors that were identified during FY 08/09.

PROJECT PRODUCTS

Publications

Article published, professional (juried publication)

- Hofmann-JN, Carden-A, Fenske-RA, Ruark-HE, Keifer-MC
  Evaluation of a clinic-based cholinesterase test kit for the Washington state cholinesterase monitoring program. American Journal of Industrial Medicine, 2008; 51(7).

Education / Training / Outreach

Poster

- *Introduction of a portable cholinesterase monitoring kit into clinical practice: A normalization*
- *process model approach*
- *Implementation of a portable cholinesterase monitoring kit in a clinical setting: A normalization*
- *process approach*
- *Introducing a portable cholinesterase monitoring kit into clinical practice: A normalization process*
- *model approach*

STATES PROJECT WAS ACTIVE IN

Washington

COLLABORATION

Central Washington Occupational Medicine
EQM Research, Inc.
Mattawa Community Medicine
Scientific Advisory Committee for the WA State Cholinesterase Monitoring Program
Yakima Worker Care and Sunnyside Worker Care

PROJECT TITLE

Edu: Reality Tales: Storytelling to Translate Agricultural Health and Safety Research

PROJECT OFFICERS(s)

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HOST ORGANIZATION

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PROJECT DESCRIPTION

The goal of this project is to use the ancient oral tradition of storytelling to translate health and safety research and education for agriculture producers and workers on two critical issues: ladder injuries and heat stress. Through this novel educational communication strategy, the ultimate objective is to reduce the incidence of ladder injuries and heat stress. The project will develop and reproduce ‘reality tales’ told by workers or those closely related who have either direct or indirectly experiencedthese health problems. These then will be placed within three communication channels - facilitated community health worker educational sessions in farmworker camps, local call-in radio talk shows, and a magazine favored by agricultural producers. The educational rational is that storytelling as opposed to instructions or data is more relevant, memorable, and persuasive thus better engaging the audience members to effect personal behavior change. Year 1 will define the take home educational messages and issues to be communicated (behavioral, technical and social) through thestorytelling methodology by a review of current research findings and prevailing educational interventions for ladder injuries and heat stress. Also in Year 1 the project will determine which communication channels are the most influential and best means to connect with the stakeholder agricultural producers and workers. Year 2 the project will gather agriculture workers who have directly or indirectly experienced heat related illnesses, ladder injuries or near miss ladder accidentsto form ‘story groups’. The project will engage these groups to recount, discuss, document, and evaluate their stories for model educational narratives. Year 3 will develop pilot storytelling narratives and field test them in three cycles with members of the target audiences. Year 4 will place the storytelling narratives in three communication channels; i) face to face community health worker-lead educational sessions in farmworker camps; ii) local call-in radio talk shows and; iii) as articles in a grower magazine. Year 5 the project will evaluate the use of narratives in these three channels as well as document the project through a user’s manual, presentations and publications. We will also produce and disseminate storytelling narratives for others to use locally and nationally.

PROJECT START AND END

Start: 1/10/2006 End: 9/29/2011

PROJECT BUDGET

1 Actual Project Expenditures: $80,652 Total Costs
2 Estimated In-kind Support Value: None
3 Outside Funding: None

PROJECT AIMS

1 Define the key take-home educational messages to be communicated (behavioral, technical and social) through the storytelling methodology by a review of current research findings and prevailing educational materials aimed at preventing ladder injuries and heat stress. **- Met**

2 Determine the most effective means to reach agricultural producers and workers by identifying their preferred communication channels. **- Met**

3 Gather agriculture workers who have directly or indirectly experienced heat related illnesses, ladder injuries or near-miss ladder accidents to form “story groups.” **- Partially Met**

- Key informants in the grower-producer community advised the project against gathering growers together for story telling groups for two reasons: i) they felt that producers were less likely to have either a ladder injury or heat related illness and ii) a storytelling group venue would not be an appealing setting to recount an accident.
- The potential partnership with the national oral history project StoryCorps was explored with the major commodity groups in the state. They felt this would be a more suitable way to gather producer's stories.
- From November '08 to January '09 the PI invited producers who '*had a life changing agriculture related injury, near miss or illness that through the telling of which could help prevent similar events in others*' to participate in one of two StoryCorps recording sessions.
- Recruitment was conducted through radio announcements (Spokane Public Radio and KUOW Public Radio), articles in commodity newsletters and magazines, and through poster sessions and presentations at four annual commodity group meetings (Washington State Dairy Federation, Washington Grain Alliance, Washington Cattlemen's Association, Washington State Crop Association

4 Engage these worker story groups to recount, discuss, document, and evaluate their stories for model educational narratives. **- Partially Met**
10 individuals recorded their stories by recounting it to a family member, work colleague or close friend in two sessions (Spokane February 10th and Seattle February 12th) with the StoryCorps recording team. The events recounted included two tractor roll over incidents, a grain bin accident, combine amputation, ATV death, ATV rollover, being struck from bales of hay, bull fatality, ATV near miss, and a fall into a manure tank.

5 Develop pilot storytelling narratives and field-test them in three cycles with members of the target audiences. **- Partially Met**

6 Place the storytelling narratives in three communication channels; 1) face-to- face Community Health Worker (CHW) -led educational sessions in farmworker camps, 2) local radio call-in talk shows, and 3) a popular growers’ magazine. **- Partially Met**
Trained 50 Community Health Workers how to conduct ladder safety training with integrating the stories into the training.

7 Evaluate the use of the storytelling narratives in all three communication channels. **- Future**

- We tested the use of the stories within CHW face-to-face ladder safety training sessions in 3 farmworker camps, a week after training . 29 farmworkers (45% women) all of whom were tree fruit pickers ranging in ages from 14-61 (mode 22) participated. The majority remembered at least one story (86%), what happen,(83%) the precipitating cause and consequences (79%), (72%) identified a lesson in the story and 79% could suggest how the injury could have been prevented. The most common response to what they liked about the story was that it was how well people can learn from the stories of others.
- Surveyed a random sample of the Good Fruit Grower readership (n=190) to measure if the article on workers stories about ladder injuries was read by the grower producer audience and if the key message was retained. 40% recalled reading the article about workers ladder injury stories and 69% correctly

identified the key managerial issue workers mentioned as a probable cause of the injury event.

8 Document the project through a user's manual, presentations and publications; produce and disseminate storytelling narratives. **- Future**

PROJECT ACCOMPLISHMENTS and CHALLENGES

Accomplishments

- Successfully gathered agriculture related injury stories from both Hispanic farmworkers (ladder injuries) and Anglo producers/growers (mixed)
- Integrated the Hispanic stories in ladder training in farmworker camps.
- The Hispanic stories were remembered a week later, details, causes and consequences were recalled, and the lessons of the stories and means of prevention were identified. Workers felt that learning through other people's stories was an effective training method.
- The key messages for agriculture managers and owners from the workers stories were published in a widely read tree fruit magazine (Good Fruit Grower) and were correctly identified by those surveyed.
- The article was read by an adequate number of readers to the point that the magazine is asking for more articles.

Challenges - Lessons Learned

- Workers in Agriculture - both Hispanic and Anglo - were extremely reluctant to share their stories about their AG related injuries, illness or near misses because this is synonymous to admitting failure.
- The only available time to train farmworkers in the camps was in the afternoon, when workers are tired and less interested in receiving training. This proved to be a challenge in getting enough people to participate, listen and concentrate.
- Likewise our sample size for the evaluation was small.
- While partnering with StoryCorps gave the project a publicity lift, it was so expensive that we could not move forward with any other activities such as editing and disseminate the stories until the next fiscal year of funding.

PROJECT PRODUCTS

Publications

Article published, feature (trade publication)

- Murphy-H
  Workers tell of ladder injuries
  Western Farmer Stockman August 2008; Vol 131 No 8: 0
- Murphy-H
  Avoiding ladder injuries
  The Good Fruit Grower Sept 1, 2008; Vol 59 No. 14: 0

Education / Training / Outreach

CD-ROM

- *"Reality Tales" Story Corps recordings*

Conferences

- 12/18/2007 - 12/18/2009:

Semi-finalists storyteller selection

- 11/1/2008 - 11/17/2008:
  The potential partnership with the national oral history project StoryCorps was explored with the major commodity groups in the state. They felt this would be a more suitable way to gather producer's stories.
- 4/10/2009 - 4/12/2009:
  Washington State Community Health Worker/Promotora Network Annual Spring Retreat
  Washington State Community Health Worker/Promotora Network Annual Spring Retreat
- 9/30/2009 - 11/1/2009:
  Key informants in the grower community advised the project against gathering growers together for story telling groups. They felt that producers were less likely have ladder injury/ heat related illness and a storytelling venue may not be appealing.

STATES PROJECT WAS ACTIVE IN

Washington

COLLABORATION

Columbia Valley Community Clinic
Good Fruit Grower Magazine
Northwest Horticultural Council
Spokane Public Radio Station
StoryCorps
Washington Association of Community and Migrant Health Centers
Washington Cattlemen's Association
Washington Grain Alliance
Washington State Community Health Worker/Promotora Network
Washington State Crop Association
Washington State Dairy Federation

IV. SMALL/PILOT PROJECTS

PROJECT TITLE

Pilot 3: Inhibition of Cholinesterase by Pharmacological and Dietary Agents

PROJECT OFFICERS(s)

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HOST ORGANIZATION

University of Washington
Environmental and Occupational Health Sciences
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PROJECT DESCRIPTION

Overall goal: To evaluate the possible interference of dietary and pharmacological agents with the cholinesterase test for organophosphate pesticide exposure.
Specific aim: To determine whether quinine and acetaminophen, when consumed at realistic therapeutic concentrations, cause significant depression of cholinesterase activities.

PROJECT START AND END

Start: 9/30/2007 End: 9/29/2009
No cost extension requested through 9/29/2010

PROJECT BUDGET

1. Actual Project Expenditures: $16,141 Total Costs
2. Estimated In-kind Support Value: None
3. Outside Funding: None

PROJECT AIMS

1 Monitoring cholinesterase levels in the blood of 15 healthy adults while they ingest 3g of acetaminophen per day for 6 days (75% of the maximum dose). **- Met**

This section of the study was completed successfully during July and August 2008. A prescreening test of liver enzyme levels in the blood of 21 volunteers lead to the elimination of 5 people due to high liver enzymes. This precaution was designed to prevent liver damage by acetaminophen administered in our study. One individual chose to withdraw for personal reasons following the prescreening blood draw. Our targeted enrollment of 15 healthy adults (ages 23-51) ingested acetaminophen at 75% of the maximum daily dose for 6 consecutive days. High liver enzymes were detected in the blood of one participant after which their acetaminophen dose was stopped but blood draws continued through day 6 and liver enzyme levels returned to normal. Daily blood samples (serum and whole blood) of all participants were stored at -80°C for later cholinesterase analyses. Analysis of cholinesterase levels in blood is currently underway in our laboratory and will be presented in future reports.

2 Monitoring cholinesterase levels in the blood of 10 healthy adults after ingestion of quinine-laden tonic water alone, vodka alone, and the two combined. **– Future**

3 *In vitro* testing of cholinesterase depression in blood after addition of quinine or acetaminophen. **- Future**

PROJECT ACCOMPLISHMENTS and CHALLENGES

1 Monitoring cholinesterase levels in the blood of 15 healthy adults while they ingest 3g of acetaminophen per day for 6 days (75% of the maximum dose).
- Analysis of pseudocholinesterase levels in serum was completed. Results suggest that 75% of the maximum dose of acetaminophen, when taken for 6 consecutive days, would not cause a decrease in pseudocholinesterase activity of the blood. Therefore, acetaminophen does not interfere with the standard test for pesticide exposure.
- Renewal of IRB approval was granted by the UW Human Subjects Review Board on June 30, 2009.
- Ongoing work includes analysis of acetylcholinesterase levels in the whole blood samples collected from the above study participants.

2 Monitoring cholinesterase levels in the blood of 10 healthy adults after ingestion of quinine-laden tonic water alone, vodka alone, and the two combined. **- Future**
Insufficient funding to complete Aim #2. Remaining funds were allocated to completion of Aims #1 & #3.

3 *In* vitro testing of cholinesterase depression in blood after addition of quinine, quinidine or acetaminophen. **- Future**
Dose-response for quinidine inhibition of butyrylcholinesterase in human plasma determined.

PROJECT PRODUCTS

Presentations

Publications

Education / Training / Outreach

Poster
- *Acetaminophen interference in organophosphate pesticide testing*

Conferences

Other Products

STATES PROJECT WAS ACTIVE IN

Washington

COLLABORATION

None

PROJECT TITLE

Pilot 4: Point-of-view Video Analysis of the Impact of a Faller Safety Training Program
See Appended Final Report

PROJECT OFFICERS(s)

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HOST ORGANIZATION

Oregon Health & Science University
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PROJECT DESCRIPTION

A video observation study of loggers at work, concentrating on fallers, using video equipment attached to a hardhat for a first person point of view. The study will tested the feasibility of using new video technology in an innovative approach to observe fallers at work in a remote work environment. Observation of actual work practices is the most reliable method to determine training effectiveness. Point-of-view video observation provides a way to gain access to the remote work situation in the woods in the most unobtrusive manner. The project addresses the PNASH research agenda for Northwest forestlands by developing methods to identify and measure positive safety behaviors, and also develops an innovative strategy for obtaining data on work behaviors of lone workers and remote locations. A successful pilot project will provide a basis for evaluating the effectiveness of safety training for loggers, and may be used to provide feedback to loggers to promote safe behaviors.

PROJECT START AND END

Start: 9/30/2007 End: 9/29/2009

PROJECT BUDGET

1 Actual Project Expenditures: $41,496 Total Costs
2 Estimated In-kind Support Value: None
3 Outside Funding: None

PROJECT AIMS

1 Develop specific procedures to obtain and manage video data of worker behavior in logging. **- Met**

2 Develop an analytical framework to implement the five-step faller safety plan, and code observable behaviors in the database of video files. **- Met**

3 Perform appropriate statistical analyses to detect changes in relevant behavior between Time 1 (prior to training with the safety booklet) and Time 2 (following training with the safety booklet), and determine the sample size needed to obtain statistical power. **- Met**

4 Document points of interest for researchers, related to equipment needs, subject participation and burden, resulting image quality, ability to assess job performance with video analysis software, and the time required for each phase of the project. **– Met**

PROJECT ACCOMPLISHMENTS and CHALLENGES

See Appended Final Report

Small cameras were mounted on hardhats for workers to wear and record their activities. Two conceptual frameworks were applied to safe work behavior: one identifying five critical action steps in falling a tree: (1) Assess the area, (2) Assess the tree, (3) Establish a safe work area, (4) Fall the tree, and (5) Get in the clear. A second framework coded the "direction of view" during the felling of each tree as a way to quantify awareness of the surrounding environment. A reliability test was conducted on the coding for direction of view, with substantial agreement on views toward the tree, tree up, and ahead; moderate agreement for views to the sides and down, and fair for views back. Coding the video files was time-intensive, taking about 6 hours for each 1 hour of video on each pass to apply different codes. Two fallers were observed in each of four skill categories: beginning students with previous training but little or no field experience; two beginning students after 6 months (the same fallers); two advanced students; and two professional fallers. Data included the time and count of each action step per tree event, and the time and count of directions of view while falling the tree. The results helped to confirm the application of the five action steps in practice and characterize how consistently fallers follow them. Quantification of behavior detected significant differences between groups and between individual fallers. Notably, the professional fallers were considerably faster than any of the students, cutting a tree in an average of less than 1 minute. Also, the time interval for getting in the clear may have been too long (away too quickly) for beginning students, and too short for one of the professional fallers. Fallers were different in several aspects among the different skill categories, and also exhibited differences individually. Analyzing the direction of view while falling trees highlighted, as one example, a regular check back toward the escape route by professional fallers. A power analysis conducted from the gathered data, noting the size of a significant difference in action time and the typical variation for beginning students, concluded a future study to evaluate student training would require at least 10 trees per faller, and ten observed students. The students in the study wore the camera-mounted helmets without any complaints, but both the professional fallers felt the camera was distracting – with a small length of cord running down the back of the helmet inside the collar, a slight weight on one side, and a change from their normal helmet. Professional fallers work at a very rapid pace amidst heavy brush and branches, performing very hazardous work, and any distraction should be avoided. An improved design might solve the issues, but appropriate cordless equipment is not (yet) available. The current camera-mounted helmet could be used well with students, if a safe work environment is assured. One idea for future use of the unique video files obtained from the study involves developing training materials to allow students to look over the shoulder of a professional and see directly the steps, fluidity, and pace of the work.

PROJECT PRODUCTS

Education / Training / Outreach

Evaluation instrument / tool

- *Faller "helmet cam" Point-of-view video recorder*

Poster

- *Trees kill: Key factors in logging safety*

Other

- *Fallers point-of-view video footage*

Other Products

Report (unpublished)

- *Fallers point-of-view video observation study - Final report*
- *Point-of-view video analysis protocol*

STATES PROJECT WAS ACTIVE IN: Oregon

COLLABORATION: Oregon State University

PROJECT TITLE

Pilot 6: Further Skills Retention in Fishing Safety Training

See Appended Final Report

PROJECT OFFICERS(s)

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HOST ORGANIZATION

Alaska Marine Safety Education Association (AMSEA)
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PROJECT DESCRIPTION

Commercial fishing continues to have one of the highest rates of occupational fatalities in the U.S. This occupation is often a family operation. Thus this project fits PNASH's goal of reducing occupational injury in the commercial fishing sector. It will also strengthen PNASH's partnerships and collaboration with the fishing industry, safety trainers and U.S. Coast Guard regulators.

One basic question will be asked: what is the skills decay rate over an 18 to 24 month time period of the four survival skills originally taught as part of the Drill Conductor (DC) course? This will help determine the regulatory interval for DC refresher training that the Coast Guard is currently considering and requesting input regarding. From Phase One of this project in 2007, we obtained data on skills decay in one and three month intervals. This helped determine intervals for emergency drills that are conducted by DCs. In this second proposed phase, the skills decay of the DCs themselves who are actually conducting the drills after being initially certified to do so, would be measured to ascertain the appropriate time interval for refresher training of the DCs.

This project would study the skills retention of at least 30 people trained and tested during the initial Phase One period. This would provide quantitative data. A similar but modified questionnaire would be used in Phase Two as in the previous Phase 1 project, to collect qualitative data.

PROJECT START AND END

Start: 1/1/2008 End: 9/29/2009

PROJECT BUDGET

1 Actual Project Expenditures: $13,544 Total Costs
2 Estimated In-kind Support Value: $ None
3 Outside Funding: None

PROJECT AIMS

1 At this time (4/12/09) 47% of the post testing of fishermen has been completed. It is anticipated that the post testing will be completed for all 30 fishermen as scheduled by June, 2009. Data from the post testing is being kept on a database which will be given to the UW designated statistician. All objectives are on schedule and no problems have been encountered. We will be able to complete the project this year and spend out the contract by 9/29/2009 as originally planned. **- Met**

2 This research is ongoing. The results will be reported to the Coast Guard for their Proposed Rulemaking which will determine the length of time for refresher training of Drill Conductors. As there currently is no refresher training requirement, this research may lead to this being a requirement which would update the survival skills of commercial fishermen who suffer from the highest fatality rate of any industry on a regular basis. **– Ongoing**

PROJECT ACTIVITIES / ACCOMPLISHMENTS

See Appended Final Report
28 of the original 30 Phase 1 subjects were contacted and agreed to be tested in the original skills previously taught. Results demonstrated that after an interval of 18 to 24 months, the skills retention rate further decayed to a mean score of 76.5% ± 11.1 (std dev): another 9.4% decrease (t-test p-value < 0.001) from their 3 month post training retest (the original training started them out at a 100% performance level).

During 2008, AMSEA used the research data from this project to write input into a U.S. Coast Guard Advance Notice of Proposed Rulemaking on refresher training intervals for Drill Conductors. This is the only formal research that has ever been conducted specific to safety training skills retention in the commercial fishing industry. The Coast Guard has used the input from this PNASH study to propose a refresher training period interval.

The Advance Notice of Proposed Rulemaking which took place in 2008, will be followed by a Notice of Proposed Rulemaking (NPRM) in 2010. This NPRM will seek further input on the longer retention rates of training to write a Final Rule. We intend to write to the public docket on the 2010 NPRM and thus provide useful data from this project on the interval for DC refresher training so that the Coast Guard can establish a Final Rule.

Finally, the qualitative survey that accompanied this Phase II will be used by AMSEA staff to help our training program better address more effective training for fishermen in terms of timing, facilitation and promotion.

PROJECT PRODUCTS

Presentations

- 9/30/2008 - Fishing Safety Workshops, Sitka, AK
  A 12 part workshop series of safety workshops given to commercial fishermen and marine safety instructors.

Publications

Article published, feature (trade publication)

- Dzugan-J
  Retention of learned survival skills studied
  AMSEA Marine Safety Update 3/10/2009; 24(1): 0

Other Products

Report (unpublished)

- *Results of research: Drill conductor refresher training intervals*

STATES PROJECT WAS ACTIVE IN

Alaska

COLLABORATION

29 Alaska commercial fisherman and their associated businesses
U.S. Coast Guard rulemaking personnel

PROJECT TITLE

Pilot 7: Responding to Uncertain Results in Research: A pilot study of pesticide handlers responses to PON1 status

PROJECT OFFICERS(s)

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HOST ORGANIZATION

University of Washington
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PROJECT DESCRIPTION

This small grant project aims to understand how pesticide handlers understand early results froma study that could have health implications for them individually. Our project builds on anexisting study that provided pesticide handlers with individual results regarding theirparaoxonase (PON1) status, their cholinesterase (ChE) levels, and their risk behavior asdetermined through a survey. We propose conducting 1-1 interviews with a targeted subset ofparticipants who have requested and received information about their PON1 status in 2008.These interviews will explore what motivates participants to request results, even when thoseresults are of unknown clinical significance. We will also examine the impact of different typesof information on risk perception and risk behavior. In addition, we hope to explore participantinterest in receiving research results generally, to understand how participants may use results tomake decisions, and to identify alternative strategies for communicating results.Advocates of genetic research have hypothesized that genetic information will helppromote healthy behaviors in individuals. Current research about the impact of geneticinformation on risk perception and risk behaviors is quite limited, particularly in a pesticidehandler population. Returning results is also seen as a practice that enhances trust betweenparticipants and researchers. Yet, if there is a mismatch between participants and researcherexplanatory models of susceptibility, we may do more harm than good, unintentionally.We have a strong, interdisciplinary team that brings expertise in community engagement,outreach and education, ethics research, epidemiology, and environmental health research to thisproject. This project will lead to insights for PNASH investigators about returning results anddissemination strategies with a priority population, and will provide preliminary data for futureresearch projects about dissemination of individual research results and risk perceptions. Specifically, this project addresses three NORA priority areas: Risk Communication (primary),Special Populations at Risk (secondary), and Chemical Exposures (secondary).

PROJECT START AND END DATES

Start: 9/30/2008 End: 9/29/2010

PROJECT BUDGET

1 Actual Project Expenditures: $890 Total Costs
2 Estimated In-kind Support Value: many early costs offset by the ChE Risk Factors project activities
3 Outside Funding: None

PROJECT AIMS

1 Explore worker motivations behind requesting personal PON1 test results. **- Met.**
- Field staff conducted interviews with 9 workers regarding their interest In PON1 test results, information needs, and genetic research in general.
- Field staff also gathered and shared observations from informal interactions with workers in the clinic during study recruitment.

2 Describe how workers used or interpreted their results in the absence of known scientific significance or clinical importance. **- Met.**
- We learned in the interviews that workers had little recollection about receiving the results.
- The study team created a video for use during informed consent and recruitment that used an interactive scenario to explain the issues behind PON1 more clearly.

3 Examine the impact of different information (PON1 status, ChE levels, or risk survey information) on participant understanding of risk. **- Met.**
- Workers interviewed were clearly concerned about exposure risks and were interested in any information that might help tell them about their exposures.
- We learned from informal discussions that workers were very interested in getting their ChE levels returned to them (currently, the clinic practice is to return to the employer directly and to the worker upon request).
- It was unclear from the limited conversations what impact, if any, the risk surveys had on their understanding of risk.

4 Test and modify conclusions from informant interviews. **- Future**
- We plan to conduct further interviews following the PON1 disclosures in the coming year to improve upon the information gained from these limited interviews.
- If this is possible, we will modify the interview guide and protocol.

5 Explore worker attitudes toward workplace genetic testing generally. **- Future.**
- See Aim 1 above.

6 Outline alternative approaches to returning results or communicating with participants about project progress in future projects. **- Future**.
- We had several team discussions regarding the approach to returning results and communicating with participants during the coming year.
- The team has revised the letter and is considering follow-up phone calls this year.
- We would also like to pursue an internal peer review process to clarify what can be said about the implications of the PON1 status in the letter.

PROJECT ACCOMPLISHMENTS and CHALLENGES

- This project faced a major challenge of recruiting workers for interviews post-season. Several of them were unreachable. In light of limited data, we supplemented with observations from field staff.
- We had several discussions as a team about the ethics of returning results and the responsibility of the research team toward workers and the researcher-participant relationship.
- The graduate students on the team prepared and competitively submitted poster abstracts to major meetings in public health (APHA), genetics (ASHG), and community-based research (CCPH). All abstracts included all team members, reflecting the collective nature of the work and contributions of all members.

PROJECT PRODUCTS

Presentations

- Cunningham-R, Jansen-C, Beima-K, Negrete-M, Fryer-Edwards-K, Palmandez-P, Hofmann-J, and Keifer MC. Communicating occupational and genetic risk factors research results to agricultural pesticide handlers in Washington State. Poster presented at the 2009 APHA Annual Meeting, Philadelphia, PA.
- Beima-K, Hofmann-J, Jansen-C, Cunningham-R, Negrete-M, Palmandez-P, Keifer-MC, Fryer-Edwards-K. When the Findings are Not Certain: Dissemination and Disclosure Options for Ecogenetics Research. Poster to be presented at the 2009 American Society of Human Genetics meeting, Honolulu, HI.
- Beima-K, Fryer-Edwards-K, Hoffman-J, Negrete-M, Palmandez-P, Keifer-MC. Researcher Obligations toward Participants: A Case Study in Returning Results of Unknown Clinical Significance. Accepted for the Campus-Community Partnerships for Health Meeting, 2009 (Meeting cancelled due to financial constraints).

Publications

Education / Training / Outreach

- A short educational video in Spanish was developed that taught viewers about cholinesteraseand PON1 Status. The video was created to be played in clinic wait rooms and during any down time in the survey process. The video turned out to be difficult to integrate into the clinic setting though was viewed by several participants.

Poster

- *Communicating occupational and genetic risk factors research results to agricultural pesticide handlers in Washington state*

Video / DVD

- *Workers talk about PON1*

Conferences

Other Products

STATES PROJECT WAS ACTIVE IN

Washington

COLLABORATION

Central Washington Occupational Medicine

PROJECT TITLE

Pilot 8: Investigation of the Apparent Discrepancy between Observed Cholinesterase Depression among Pesticide Handlers in Washington and Regulatory Estimates of Exposure.

PROJECT OFFICERS(s)

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HOST ORGANIZATION

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PROJECT DESCRIPTION

This small project uses population-based predictions of cholinesterase (ChE) depression that would be expected based on regulatory decision-making frameworks and compares those predictions with observed outcomes in Washington state. Blood ChE monitoring among pesticide handlers in Washington state in 2004-2007 revealed greater than 20% plasma ChE depression in an average of 15% of workers tested each year. Those data present a unique opportunity to examine assumptions employed by regulatory agencies in conducting risk assessment of pesticide use. Pesticide handler exposure assumptions are based in large part on limited studies conducted by pesticide registrants (manufacturers) and submitted to the Pesticide Handlers Exposure Database (PHED) maintained by US EPA and Health Canada. In some cases those studies entail both collection of exposure measurements and of biomonitoring data, presenting a second opportunity for comparison of predicted and observed exposures. This project reviews chlorpyrifos-handling studies in PHED, using population-based prediction of ChE depression that would be expected based on default assumptions used in the regulatory decision-making framework, and compares those predictions to pesticide exposure outcomes in Washington State, focusing on early season use of chlorpyrifos.

PROJECT START AND END

Start: 9/30/2008 End: 9/29/2009 (extension until 9/29/2010 requested)

PROJECT BUDGET

1 Actual Project Expenditures: $ 32,843 Total Costs
2 Estimated In-kind Support Value: None
3 Outside Funding: None

PROJECT AIMS

1 Generate a probabilistic prediction (cumulative population distribution) of plasma cholinesterase (ChE) depression among professional handlers of chlorpyrifos in the agricultural sector in WA State and compare it to observations made under the auspices of the Washington State Department of Labor and Industries (WADL&I) cholinesterase monitoring program. – **Ongoing**

2 Generate estimates of chlorpyrifos doses likely to result from failure to practice appropriate personal hygiene or properly employ PPE, to determine the extent to which such failures might explain observed plasma ChE depression in WA State handlers. – **Ongoing**

3 Reexamine the ratio of chlorpyrifos doses predicted from dosimetry to those estimated from biomonitoring in the 13 Pesticide Handlers Exposure Database (PHED) chlorpyrifos studies for which both types of data are available. - **Ongoing**

PROJECT ACTIVITIES / ACCOMPLISHMENTS

- *Specific Aim 1.* Data (2005-2007) from the WADL&I ChE monitoring program have been obtained and compiled. Data from 2008 will be added. Implementation of Specific Aim 1 logically follows completion of Specific Aim 3 and has been largely deferred.

- *Specific Aim 2.* Narrative reports from required post-hoc ChE depression investigations have been input to a database to permit easier identification of common behaviors associated with ChE depression. Reports by Morrisey et al. (Causal Factors for Pesticide-related Illness: Five years monitoring WA agricultural workers (2003-2007), undated poster presentation, WA DOH) and Hofmann et al. (Occupational determinants of serum cholinesterase inhibition among organophosphate-exposed agricultural pesticide handlers in Washington State, submitted) have also been reviewed. Generally ChE depression and/or illness among handlers appear to be associated with lack of, or misuse of, appropriate PPE. However, in the WADL&I database and WA DOH report, only cases of ChE depression or illness were investigated and corresponding behaviors in the unaffected population are not available. In contrast, Hofmann et al. did investigate both affected and unaffected individuals and were able to report rates of ChE depression and test for significance of particular behaviors. Preliminary analysis has been conducted of reported ChE depression associated with use of half-rather than full-face respirators and failure to wear chemically resistant footwear. In each case, the surface area of skin involved is sufficient to plausibly permit chlorpyrifos exposure that could explain associated ChE deficits. Information regarding urinary metabolite data collected for a subset of Hofmann et al.'s study population is being sought to supplement this analysis.

- *Specific Aim 3.* All 13 PHED studies involving handler exposure to chlorpyrifos have been obtained. Data from those studies have been entered into an Excel database and subjected to additional analyses. The studies encompass 165 volunteers classified as mixer/loaders, applicators, cleanup workers or scouts. Estimates of exposure based on dosimetry have been compared to estimates of exposure based on observed biomarker excretion. A key parameter in determination of the ratio of predicted to observed dose is the assumed dermal bioavailability. Importantly, assumption that the dermal bioavailability of chlorpyrifos can be conservatively estimated as 3% is clearly not supported by the PHED chlorpyrifos handler data. Additional observations include the following: 1) Results presented in registrant studies were not uniformly reproducible. 2) Creatinine adjustments were sometimes made in a manner that amounted effectively to no correction for incomplete collection of urine. 3) Background levels of the chlorpyrifos metabolite TCP in the urine of the volunteers were chronically elevated over general population levels as reported in NHANES. In some cases background levels were so high as to suggest recent high level exposure in contravention of the experimental protocol and sufficient to mask subsequent exposure in the PHED trial. Oral presentation of these results is scheduled for November 2009.

PROJECT PRODUCTS

Presentation

Kissel JC, Tanenbaum E, Shirai JH. Comparison of Dosimetry-based Exposure Predictions and Biomonitoring Results in Chlorpyrifos Handler Studies from PHED. Annual meeting of the ISES, Minneapolis, November 1-5, 2009.

STATES PROJECT WAS ACTIVE IN: Washington

COLLABORATION: Washington State Department of Labor and Industries

APPENDIX

Peer-Reviewed Publictions
R1: Hofmann-J; Keife- M; Furlong-C; De Roos-A; Farin-F; Fenske-R; van Belle-G; Checkoway-H. *Serum cholinesterase inhibition in relation to paraoxonase (PON1) status among organophosphate-exposed agricultural pesticide handlers.* Environmental Health Perspectives, Sept 2009; 117(9).

E1: Hofmann-JN, Carden-A, Fenske-RA, Ruark-HE, Keifer-MC. *Evaluation of a clinic-based cholinesterase test kit for the Washington state cholinesterase monitoring program.* American Journal of Industrial Medicine, 2008; 51(7).

Concluded Project Final Reports
P4: Point-of-view Video Analysis of the Impact of a Faller Safety Training Program
P6: Further Skills Retention in Fishing Safety Training

FINAL REPORT

PROJECT TITLE

Pilot 4: Point-of-view Video Analysis of the Impact of a Faller Safety Training Program

See Appended Final Report

PROJECT OFFICERS(s)

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PURPOSE OF STUDY

Working as a faller in logging is one of the most dangerous jobs in Oregon. Considering direct observation to be the most reliable method to evaluate safe work practices, the Fallers Point-of-view Video Observation Study tested the feasibility of using a helmet camera to directly observe fallers at work and compare safe behaviors among fallers at different skill levels.

HIGHLIGHTS OF STUDY

Aim 1: Develop specific procedures to obtain and manage video data of worker behavior in logging.

Equipment. Observation data was obtained using the following equipment.

- Two Viosport POV.1 lightweight cameras, each attached to a standard hardhat, with a 5-foot cable connected to a recorder unit secured in a belt pack
- High-capacity rechargeable batteries and charger
- 2 gb SD card for camera with a write speed of at least 2.5 mb/sec. (write speed of 20 mb/sec. video card on second camera)
- High-capacity computer file storage (500gb external hard drive, 8gb memory stick)

Jeff Wimer, manager of the Student Logging Training Program at Oregon State University, worked as a consultant in the study, and provided access to study participants from students in the OSU logging training program, and from a crew of two professional fallers.

Aim 2: Develop an analytical framework to implement the five-step faller safety plan, and code observable behaviors in the database of video files.

The basic conceptual framework for work behavior in this study was derived from previous work in faller safety, using critical "action steps" in a five-step faller safety plan (OR-FACE 2007):
(1) Assess the area, (2) Assess the tree, (3) Establish a safe work area, (4) Fall the tree, and
(5) Get in the clear. Each felled tree was viewed as an event, and the five action steps were identified as they occurred for each tree.

A second applied framework for faller behavior coded the "direction of view" during the felling of each tree. Characterizing direction of view may be a way to quantify an awareness that experienced loggers seem to possess that improves safety in a hazardous environment. Plotting direction was made possible by orientation to the tree. Six basic directions were observed: tree, tree up, ahead, back, sides, and down.

Coding involved first identifying the felled trees in each video file and applying time markers. The action steps were then coded for each tree event. Coding for action steps was reviewed by a logging safety consultant to check accuracy. Separate coding was then conducted for direction of view during the felling of each tree. A reliability test was conducted for this stage of coding, using a second coder. Infraclass correlations between the two coders were very high for views toward the tree (0.987), tree up (0.966), and ahead (0.946); moderate for views to the sides (0.744) and down (0.628); and fair for views back (0.413).

Specific Aim 3: Perform appropriate statistical analyses to detect changes in relevant behavior between Time 1 (prior to training with the safety booklet) and Time 2 (following training with the safety booklet), and determine the sample size needed to obtain statistical power.

This aim was modified when it became clear that student fallers could not begin falling trees without the safety instruction contained in the *Fallers Logging Safety* booklet. The study design was modified to assess differences between fallers at different skill levels. Data collection involved four categories of fallers: two beginning students were observed during their first experiences falling trees, and again 6 months later; and observations were conducted with two advanced students and two professional fallers.

Coded behaviors for the action steps and direction of view were summarized in three scales:
(a) a measure of time in seconds for each behavior, (b) time as a percentage of the total time in each event to standardize widely different periods for different fallers and different trees, and
(c) the count of each behavior in each tree event or falling episode. Differences between the four categories of fallers on these dependent variables were analyzed with one-way analysis of variance. The two categories of beginning students – first time out, and with 6 months of experience – were the same individuals, but they were treated as distinct categories and placed in the model with the other groups. With only two subjects, confirming a significant difference between the two observation periods with the appropriate paired t-test statistic is unlikely; virtually none of the large differences in values for the two observations of the beginning students proved significant, even with apparently large differences.

Tree events were the unit of analysis for faller behaviors. Each data collection period recorded multiple tree events with repeated behaviors that made it possible to distinguish statistically significant differences between some of the individual fallers, due to the number of trees. Professional fallers readily supplied the power to make comparisons with only one observation session less than one full work day. During a 4-hour period, one professional faller cut 125 trees. In contrast, a beginning student during a first hands-on experience cut 2 trees in the same amount of time. The beginning students at 6 months, and the advanced students raised the number to about 10 trees in 4 hours.

A power analysis concluded that 10 tree events are needed to detect a small but significant difference between individual fallers; and 10 fallers are needed to detect a small but significant difference in a group of fallers following training or an intervention. Wider variation existed in other instances, however, which reduced statistical power. About 20 trees per faller could be necessary. This analysis suggests that student fallers would need to be observed for at least 1 week of work, and ideally for several weeks to accumulate enough tree events to make meaningful individual comparisons.

Specific Aim 4: Document points of interest for researchers, related to equipment needs, subject participation and burden, resulting image quality, ability to assess job performance with video analysis software, and the resources required for each phase of the project.

Regarding equipment to collect video data, one of the most interesting lessons occurred right away, when the best system selected during the grant-proposal period was 6 months later obsolete. The equipment selected from Viosport was superior to anything seen before. The next lesson occurred a few months later, when the second camera purchased of the same new camera model was a couple hundred dollars cheaper than the first. Equipment and technology breakthroughs in this area are occurring rapidly.

Faller participation was easiest for student trainees, where there appeared to be no discomfort wearing a video-mounted hardhat. Both professional fallers complained of the distraction of the hardhat, in some cases due to the cord, but also for the slight weight on one side of the helmet, and apparently for the change from their normal experience. These issues present a complex problem for designing an adequate version of a camera hardhat that would pose no extra risk for a worker in an extremely hazardous environment.

Image quality was very good. Quality settings were reduced to a minimum to reduce file sizes, and the view was not compromised. Ability to distinguish and code behavior for action steps was fairly easy, but several corrections occurred on second viewing, even after the first view was checked by the logging consultant. Coding direction of view was more difficult, particularly for beginning students, but the reliability test between two coders indicated a surprisingly high level of agreement.

Equipment costs were reasonable, and collecting and assembling hardware components was simple. Fallers work in pairs, and two cameras were sufficient for the study (once both worked properly). Travel time was significant; delivering the helmet cameras with new batteries and retrieving them with data, and recruiting fallers, all involved journeys to remote rural areas where logging was conducted or where loggers lived.

Coding required the most time, though the investment was moderate relative to other reported times coding video data.[1-3] Coding time for each of the two code sets (action steps, and direction of view), at the fastest pace, was about 6 hours to each 1 hour of video. Making additional passes to document other points of interest would presumably take the same amount of time. Multiple passes may be compulsory. Video data is streaming and complex, and demands rapid comprehension and notation to code. Concentrating on more than one behavioral element at a time, in this study at least, was not possible.

RELEVANCE OF FINDINGS

This study provided unique access to observe workers in a remote, highly mobile, and hazardous work environment. The logging safety consultant on the study, with extensive experience in logging, was fascinated by the opportunity to look over the shoulder of professional fallers at work cutting trees. He responded with the following comment:

> Using a video camera mounted to a hardhat was a unique idea that allowed the viewer to see the cutting process from the cutter's eye, without bystander influence. One major benefit I saw from the video work was the confirmation of the five steps a professional cutter uses. I formulated these steps from observation of faller practices, but the cutters may have been influenced by my presence.

Results of the video observation confirmed the use of the five action steps in safe falling, and provided details on how they are followed in practice. The resulting video files could also be used for training new fallers. The point-of-view perspective of the camera gave a close, direct experience of the faller's actions and direction of view. One major benefit in utilizing this technology, according to the study's logging safety consultant, would be to use it to train new cutters, and let novices see the steps taken, the fluidity of motion, and pace required for effective cutting.

Coding observed work behavior in the video files provided additional, quantified information to distinguish differences between fallers at different skill levels and highlight points of concern. This aspect of the study demonstrated the feasibility of quantifying critical behaviors to confirm impressions that might (or might not) be noticed by a competent observer, such as a trainer or supervisor.

SCIENTIFIC REPORT

1.0. Background

Hazards in logging are a well-recognized area of concern in occupational safety, corresponding to the focus on traumatic injuries in the PNASH Occupational Research Agenda for Northwest Forestlands [4].The Fallers Point-of-view Video Observation Study originated as a plan to evaluate the effectiveness of a *Fallers Logging Safety* booklet, published by OR-FACE in 2007. Observation of actual work practices is the most reliable method to determine training effectiveness, but observing fallers at work posed unusual challenges. A personal observer may be exposed to danger while traveling to a remote, unfamiliar location on unpaved mountain roads, and also by the dangers involved in the logging operation. Further, an observer would be unable to enter the falling zone while a faller is at work on a tree, and could not make close observations or record multiple points of interest at once through an entire episode. Finally, fallers work alone or in pairs, and workers would have a heightened sense for the presence of an observer at any distance, for that person's safety would be a constant concern. Point-of-view video observation appeared to provide a way to gain access to the remote work situation in the woods in the most unobtrusive manner. This pilot project tested the feasibility of collecting and using video observation data to assess safe work practices for fallers.

Video observation studies are common in clinical studies of medical care, education research, and ergonomic assessments [1-3]. These studies, however, use mounted cameras in a fixed location. A "digital hardhat" has been developed in the last few years for use in construction and engineering work to allow interactive video conferencing between a remote office and a project site, but this requires a reliable signal to a remote computer, which is usually not possible at a logging site. Lightweight "lipstick" cameras have also become common in the past few years to record sports activities, attached to a handlebar or helmet. Recently, digital storage capacity has been expanded to 30 gb for up to 100 hours of continuous video recording without uploading to a remote server.

New video technology makes it possible to consider the use of video for direct observation of worker behavior in logging. Currently, evaluation of logging safety training programs has relied on outcomes represented by self-report satisfaction and knowledge surveys [5], and analysis of aggregated Workers' Compensation injury data [6]. Observation of safety training outcomes in actual behavior may improve the reliability and sensitivity of evaluation results.

2.0. Specific Aims

The highlights in the previous section introduced the central accomplishments of the video observation project according to its specific aims.

Aim 1: Develop specific procedures to obtain and manage video data of worker behavior in logging.

Aim 2: Develop an analytical framework to implement the five-step faller safety plan, and code observable behaviors in the database of video files.

Aim 3: Perform appropriate statistical analyses to detect changes in relevant behavior between Time 1 (prior to training with the safety booklet) and Time 2 (following training with the safety booklet), and determine the sample size needed to obtain statistical power.

Aim 4: Document points of interest for researchers, related to equipment needs, subject participation and burden, resulting image quality, ability to assess job performance with video analysis software, and the resources required for each phase of the project.

Details related to the accomplishment of the specific aims, and the study results, are presented and discussed below in appropriate sections.

3.0. Procedures

Procedures in the fallers point-of-view video observation study developed in three phases, related to equipment, data collection, and analysis.

3.1. Equipment

The first phase of the study involved shopping for equipment at a reasonable cost with the following capacities: (a) endure rugged, all-weather conditions, (b) record up to 8 hours of continuous video and audio, requiring storage of at least 2 gb, (c) compact recorder/battery unit that can be worn by an active worker, (d) battery pack that will provide power for up to 8 hours. In addition, the equipment had to be reliable. Only the Viosport POV.1 camera unit met all of these criteria unequivocally. The availability of customer support was another important factor in the decision.

The POV.1 unit holds 4 AA batteries. High-quality lithium AA batteries can record about 10 hours, and were put in use first. Subsequently, for less expense, rechargeable nickel/metal hydride AA batteries (2900mAh) were found with comparable capacity. The recording device can be adjusted to various pixel densities and frames per second to achieve over 8 hours of recording at lower levels. The lower-quality video was completely adequate for the purpose and reduced the file sizes for easier handling. File size for each 4-6 hour video episode was three-fourths to one gigabyte. The SD storage disk in the recorder unit was 2 gb, the maximum capacity for the unit at the time.

Additional equipment for managing the video files included a 500 gb external hard drive for backup storage, and a DVD burner and an 8 gb memory stick to transfer files between computers, and pass files to the expert consultant and second coder.

Two standard hardhats were purchased, along with hardware to securely bolt the camera mounts to the hardhats. Belt packs small enough to be worn unobtrusively were found to hold the recorder/battery unit. The 5-foot cable connecting the camera to the recorder ran through a Velcro patch glued to the back rim of the helmet, then down the back of the neck under the jacket collar, leaving only a few inches of exposed cable.
For video analysis, Transana qualitative analysis software was purchased from the University of Wisconsin-Madison Center for Education Research (www.transana.org). Transana allows users to transcribe data, identify and assign keywords to clips, arrange and rearrange clips, create complex collections of interrelated clips, explore relationships between applied keywords, and share data files.

3.2. Data Collection

Data collection involved delivering the helmet cameras to the participating fallers, and reading the study consent form and obtaining signed approval for all workers in the crew. Fallers turned on the camera as soon as they exited their vehicle. In some instances, participants turned off the camera at intervals, but this did not interfere with recording tree events. Both professional fallers turned off their cameras early and resumed wearing their own hardhats, apparently due to discomfort. In both instances, a sufficient number of trees was observed to make comparisons with the student fallers. Following each observation session, the study logging safety consultant collected the helmets, and the research associate retrieved them to upload the video files from the recorder and refresh the batteries.

3.3. Analysis

Video files were uploaded into the Transana video analysis software and transcribed at first to locate all activities. This procedure was quickly circumscribed to focus only on tree events as the point of interest, identifying the five action steps in faller safety, and then direction of view during the falling of each tree. Time markers delimited the clips for each action and codes were applied. The video transcripts with time markers were then reviewed by the study's logging safety consultant to confirm, correct, and interpret the coding of the five action steps. The coding produced a database of actions associated with each tree event, including sequences and time in each action.

Closer attention was then directed to the felling of each tree, coding for direction of view. Each clip previously filed for the action "Fall Tree" was segmented into finer clips for different views and organized in a separate set of nested cabinets in Transana. Once the first substantial batch of data was coded for direction of view, a second coder was employed to code the same files independently to test interrater reliability.

Coding required the most time, though the investment was moderate relative to other reported times coding video data.[1-3] Coding time for each of the two code sets (action steps, and direction of view), at the fastest pace, was about 6 hours to each 1 hour of video. Making additional passes to document other points of interest would presumably take the same amount of time. Multiple passes may be compulsory. Video data is streaming and complex, and demands rapid comprehension and notation to code. Concentrating on more than one behavioral element at a time, in this study at least, was not possible.

Coding action required close observation and interpretation of what was occurring. Operational definitions for the action steps often included direction of view as a component, and a view could occur in a split second. Repeated viewing was necessary to capture certain behaviors, such as a sudden glance up to assess the tree again upon approach before placing the saw for the first cut.

Once all coding was completed, the data were exported from Transana into Excel, and cleaned, summarized, and arranged. Data bits included the faller, tree, action or view codes, time start, time end, and duration for each clip. Additional variables were calculated from these base data. The completed data files were then imported into SPSS for final statistical analysis and reporting.

4.0. Methodology

The primary aim of this study was to demonstrate the effective use of point-of-view video observation to identify and quantify safe work behaviors for fallers in a remote work environment. Certain principal research questions guided the study design and methods.

1. Do fallers conscientiously follow the five critical action steps in safe falling (assess the area, assess the tree, develop a safe work area, fall the tree, get in the clear)?

2. How does training and experience affect faller safety behavior?

3. Can awareness of the environment be observed and quantified?

4.1. Study Design

The study design involved video observation of working fallers, aiming to characterize safe work behaviors and identify significant behavioral differences between fallers at various skill levels. As a pilot study, the main concern was to demonstrate the feasibility of using video observation as a research tool acceptable to fallers and capable of producing useful data. Four skill categories were selected for theoretical interest and potential differences: (a) beginning students with previous training but little or no experience in the field, (b) the same beginning students with 6 months experience, (c) advanced students with a year or more of experience, and (d) professional fallers. For purposes of this study, the beginning students with no experience, and with 6 months experience, were assumed to be independent groups.

Two fallers were observed in each skill category over one work day (the average session for data collection was about 4 hours; student fallers work a 4-hour shift). Participants were selected by convenience, but targeted to represent each skill category. Data collection occurred in natural work conditions to minimize the observer effect, and no efforts were made to standardize the type of forest, trees, or equipment of the fallers. Consequently, situational variations produced differences unrelated to skill level.

4.2. Participants

Study participants were selected from volunteers in the Student Logging Training Program at Oregon State University, with the consent of the OSU Forest Engineering Department. The study's logging safety consultant was the manager of the OSU student training program. The two professional fallers were recruited through personal contact of the study's logging safety consultant with an independent contract cutter.

4.3. Analytical Frameworks

Two analytical frameworks were used to evaluate safe work behavior for fallers: action steps surrounding the falling of each tree, and direction of view during the falling of the tree.

4.3.1. Action Steps

The basic conceptual framework for work behavior in this study was derived from critical "action steps" developed from previous observation of fallers at work. The action steps compose a five-step faller safety plan (OR-FACE 2007): (1) Assess the area, (2) Assess the tree,
(3) Establish a safe work area, (4) Fall the tree, and (5) Get in the clear. A primary goal of this study was to operationalize these action steps, identify them in the collected video data, and characterize actual use in the field by fallers. Following are the applied definitions of the terms.

1. ASSESS THE AREA - Identify hazards in the work area, including snags, danger trees, hanging limbs, uneven ground, power lines, or roads. Operational definition: view scans up and around.

2. ASSESS THE TREE - Look up at the tree to determine the lean, canopy weight, and other forces that will influence the falling direction; find an opening; assess wind, terrain, and potential impacts. Operational definition: view directly at tree, up at tree, and ahead in the direction of fall; may involve discussion with others.

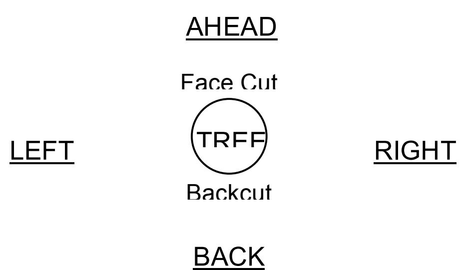
3. ESTABLISH A SAFE WORK AREA - Clear the area around the tree and plan at least one escape route back and to the side of the falling direction. Operational definition: view ground area behind and around tree, or use saw to clear brush, branches, stumps in area.

4. FALL THE TREE - Make a clean face-cut, make a backcut that protects the hinge; keep wedges within reach, bring saw back to idle before using wedges. Operational definition: begin when saw is applied to tree, end at move away from tree to other action.

5. GET IN THE CLEAR - Get away from the stump as soon as the tree is committed to fall; keep an eye on the tree and watch for impacts. Operational definition: begin with movement away from tree during fall, end when tree hits ground, or in some instances, when view up at tree indicates tree is hung up and not falling.

4.3.2. Direction of View

Several fatal injuries in Oregon logging have involved a young, inexperienced logger working alongside an experienced logger, with different results for the two workers. When a sudden hazard occurred, the experienced worker escaped to safety and the younger worker did not. Some difference in awareness related to experience is evident in these incidents.



Direction of view was used as an analytical framework in this study to indicate situational awareness. Although there was interest in observing direction of view while walking in the woods or during other activities, identifying direction was too complex without a specific orientation, because a direction of view such as “ahead” could subsequently be “right” or “back” as the subject moved and turned. In nonwork activities, there was also the possibility that a view was not related to mental activity: was the faller scrutinizing or simply staring? The critical point of interest for direction of view was during the falling of the tree – during the most hazardous work activity – and the tree provided a central reference point to make direction of view meaningful. Coding marked every change in six possible views: toward the tree, tree up, ahead, back, either side (combining left-right), and down. The coder first identified the direction of fall, and with that established orientation, marked and coded each delimited video clip as the view changed.

4.4. Interrater Reliability

Coding accuracy for the action steps was established by expert review and a second review by the original coder. Most actions were appropriately marked and identified in the initial coding by the study’s research associate applying the operational definitions for each of the five action steps, but several instances were added or modified by the logging expert. Interpretation was necessary to define certain actions. Contribution by an expert consultant was an important feature of reliably coding the action steps.

Direction of view involved a more structured and definite application of codes to observed behavior. A researcher could be expected to apply codes independently with a reliable degree of accuracy. Judging the actual direction of view and the instant of a changing view in a rapidly changing scene, however, posed significant challenges. The camera mounted on the helmet performed very well, without jostling or turning at a skewed angle, but was located about 6 inches above eye level and did not always record precisely what the faller was viewing. Audio capacity provided valuable input for interpreting activity by the sound of the saw, or hammer on a wedge during the falling episode. Considering the high degree of uncertainty and frequent interpretation required during coding, a test for interrater reliability was essential to determine the feasibility of coding for direction of view at all in these dynamic circumstances.

Once video files were obtained for the two beginning students and the two professional fallers, and coded for direction of view during the falling of each tree, a second coder was employed to code the same files independently to test interrater reliability. The coder was trained with a personal introduction to the Transana software and the video files, and was given written instructions for coding, with definitions for each direction-of-view code. A few questions on procedures and interpretation followed, but all coding activity was completely independent.

The interrater reliability test revealed a few areas for improvement in the coding for direction of view. Due to a small number of instances, side views to left and right were collapsed into one category. In addition, all "up" directions except "tree up" were collapsed into the indicated direction. Views across a distance were often difficult to identify as "up" or not. Poor results in the reliability test indicated the codes for "ahead" and "ahead up," for example, should be made into one code.

Analysis for the reliability test also resulted in dropping the code for the presence of a person in a view. The extraneous feature only applied to the student fallers – the professional fallers worked as a team, but alone – and the additional information to explain a direction of view would require similar information for situational factors that applied in other instances, such as working near a hung tree or a surrounding canopy, or other factors perhaps only the faller could perceive. Such factors, as observed, were removed from the coding structure and included instead in the interpretation of results. Overall, the positive results in the reliability test made the coding task for the remaining video files easier by renewing confidence in the ability to achieve useful results.

4.5. Data and Statistical Tests

All data in the study corresponded to tree events. Each tree was associated with a particular faller in one of the skill categories and numbered in sequence. All action and view codes provided information on the clip time start, time end, and duration. From these base data, additional variables were constructed to characterize behavior per tree, including (a) total count of each action type, (b) total time of each action type, (c) total count of all actions, (d) total time of all actions, and (e) first actions.

The completed data files were imported into SPSS for final statistical analysis and reporting. Comparisons between the categories of fallers at different skill levels were conducted with one-way analysis of variance to examine significant differences in the time and count of each action per tree. Dunnett's C test was used, because the samples and variance for each category were significantly different.

The reliability test compared the results of the two coders on the time recorded for directions of view in the test-set of trees, using intraclass correlations (ICC) in a two-way random-effects analysis of variance.

5.0. RESULTS

5.1. Data Collection

Six fallers wore a video-mounted hardhat 1 day at work falling trees in a remote forest location. Two fallers were beginning students with previous training but little or no field experience; these two fallers were observed again after 6 months. (One of the beginning students was observed on two occasions, due to a repeat session after one of the camera units failed on the first use in the field.) Two other fallers were advanced students with 1 or more years of experience. Two fallers were professionals with at least 10 years of experience. All together, the fallers represented pairs in four progressive skill categories.

Video data files for each observation session ranged from 1 hour 15 minutes to 4 hours, average duration 3 hours 8 minutes. All student fallers wore the camera from entry to exit from the woods, often in segments with brief intervals when the camera was turned off. One professional faller wore the camera for 4 hours and then switched to his regular hardhat; the second professional faller switched after 1 hour 15 minutes.

TABLE 1. Participant Observation Sessions and Felled Trees

Participant	Date	Duration	Number Felled Trees
1.1. Student Beginning	May 9, 2008	3 hrs 30 min.	2
1.2. Student Beginning	May 23 & Jul 24, 2008	8 hrs 50 min.	10
2.1. Student at 6 mos.	Oct 30, 2008	3 hrs 50 min.	7
2.2. Student at 6 mos.	Nov 18, 2008	2 hrs 55 min.	9
3.1. Student advanced	Oct 30, 2008	3 hrs 50 min	11
3.2. Student advanced	Mar 10, 2009	2 hrs	10
4.1. Professional faller	Oct 3, 2008	1 hr 15 min.	22
4.2. Professional faller	Oct 3, 2008	4 hrs	125
Totals	8 sessions	30 hrs 10 min.	196

The total number of observed trees felled was 196, ranging from 2 to 125 per session. The average number of trees was 24 per faller, median 10, indicating the skewed range, with the one professional faller observed for 4 hours falling 125 trees.

5.2. Action Steps

Quantifying the presence of the five action steps in faller safety – assess the area, assess the tree, develop a safe work area, fall the tree, and get in the clear – as applied by the fallers in this study to each tree event, showed general but not complete observance. Even critical actions that could be expected to occur without exception, such as “assess tree” and “get in clear” were not performed for every tree (see Table 2). Consistent use of the five steps was observed for the beginning students, and one of the advanced students, and one of the professional fallers.

Some variation in applying the action steps to each tree event occurred due to favorable conditions or previous preparation. The beginning student fallers, for example, worked in a group, where others helped develop a safe work area; and the forest floor was often open and clear. Both professional fallers devoted time on arrival to develop a safe work area over a wide area. Similarly, assessing the area might occur with dedication upon approaching a new area, and be repeated only once a few trees were felled; or at the speed the professional fallers were working, the action of assessing the following tree occurred in the moment of getting in the clear as the current tree was falling. Despite all of these situational or dynamic exceptions, the low use of the safety actions by the second professional faller raises concern (see Table 3). Viewing the video files for the two professional fallers produced an impression of different work styles. Coding and analyzing the observed work activities quantified the differences.

TABLE 2. Percentage of Tree Events Including Specific Safety Actions

Faller Skill Categories		Number of Trees	Assess Area (as first	Assess Tree (as first	Safe Work Area (as first	Fall Tree (as first	Get in Clear (as first
Category 1. Students Beginning	Faller 1	2	50% (50%)	100% (50%)	100%	100%	100%
	Faller 2	10	80% (80%)	100% (10%)	80% (10%)	100%	100%
Category 2. Students 6 months	Faller 1	7	100% (100%)	100%	86%	100%	100%
	Faller 2	9	89% (78%)	89%	67% (22%)	100%	89%
Category 3. Students Advanced	Faller 1	11	100% (91%)	100%	91% (9%)	100%	100%
	Faller 2	10	70% (60%)	100% (40%)	50%	100%	90%
Category 4. Professionals	Faller 1	22	55% (45%)	91% (14%)	96% (41%)	100%	100%
	Faller 2	125	29% (21%)	70% (26%)	67% (44%)	100% (9%)	85%

Observation of the tree events also indicated common sequences in applying the action steps. The logical order in the model was not always the order followed in practice (see first acts in Table 2). Assessing the area was commonly the first act as expected, but developing a safe work area was also a common beginning; and occasionally, the faller went directly to assess the tree. Only the second professional faller chose to directly fall a number of trees without previous preparatory actions.

Summarizing the time devoted to each action step reveals significant differences between the faller skill categories. Most notably, a large difference was evident in the time falling the tree between the professional fallers and all student categories (see Table 4). The beginning students spent an average 6-7 minutes falling a tree, whereas the average time for the professional fallers was 48.6 seconds. Also, the beginning students after 6 months drew much closer to the advanced students, and the previous difference was no longer detectable. Another notable similarity occurred in the action of developing a safe work area, where the 6-month students and advanced students were not detectably different from the professional fallers.

Additional useful information is evident in the count of action steps per tree event. A difference in the count of an action step indicates that one faller (or category of fallers here) either did not perform an action performed by the other, or stopped one action to perform another action before returning to the original action, while the other faller performed the same action all at once. Both situations can be meaningful.

The observed difference in assessing the area between beginning students and the students at 6 months and advanced students (which were more alike) indicates that the beginning students may have overly relied on the presence of trainers to assess the area, alert them to hazards, and tell them what to do, rather than continually monitor the area for themselves (see Table 5). The other students worked together independently, without supervision, in a difficult setting, thinning trees in the midst of a forested area where the canopy, hung trees, and other hazards were present. The difference between these students and the professional fallers was partly due to these situational factors. The professional fallers worked in a safer setting on the edge of a clearcut, falling trees downhill, only occasionally surrounded by a worrisome canopy or interlaced treetops.

TABLE 3. Distribution of Tree Events by Number of Defined Safety Actions Present (Assess Area, Assess Tree, Develop Safe Work Area, Get in Clear; Exclude Fall Tree)

Faller Skill Categories		Number of Trees	4 of 4 Acts	3 of 4 Acts	2 of 4 Acts	1 of 4 Acts	0 Acts
Category 1. Students Beginning	Faller 1	2	50%	50%	-	-	-
	Faller 2	10	60%	40%	-	-	-
Category 2. Students 6 months	Faller 1	7	86%	14%	-	-	-
	Faller 2	9	44%	44%	11%	-	-
Category 3. Students Advanced	Faller 1	11	91%	9%	-	-	-
	Faller 2	10	40%	30%	30%	-	-
Category 4. Professionals	Faller 1	22	50%	41%	9%	-	-
	Faller 2	125	14%	38%	34%	14%	1%

Time was also a factor in the different counts of action assessing the area. The professional fallers worked fast, and assessing the area from one tree to the third or fourth involved only a few minutes. For student fallers, those few minutes were occupied in one tree event.

The low count for professional fallers assessing the tree also tells a story, which can only be adequately appreciated by directly observing them at work – which the video camera made possible. Student fallers were more uncertain and needed repeated efforts and discussion to assess a tree. The professional fallers approached a tree like a confident golfer, erect and sure: look up, look ahead, and quickly look up again the instant before setting the saw to the tree.

Another notable difference between student fallers and professional fallers is observed in the count of the action falling the tree. Student fallers were more likely to interrupt the falling process to reconsider, get instruction, or retrieve a wedge or ax from a distance away. The professional fallers almost never interrupted the action. A safety rule in logging requires that wedges and the ax for hammering them be kept within reach to avoid leaving the tree once a cut is made. The action count indicates the professional fallers were careful to follow this rule.

TABLE 4. Performance Time for Specific Action Steps per Tree Event

Faller Skill Categories	**All Actions** *Mean Time Seconds* (Stand. Dev.)	**Assess Area** *Mean Time Seconds* (Stand. Dev.)	**Assess Tree** *Mean Time Seconds* (Stand. Dev.)	**Safe Work Area** *Mean Time Seconds* (Stand. Dev.)	**Fall Tree** *Mean Time Seconds* (Stand. Dev.)	**Get in Clear** *Mean Time Seconds* (Stand. Dev.)
1. Students Beginning	742.0*[2,3,4] (281.8)	58.4 (60.3)	157.4*[3,4] (119.7)	109.2*[4] (86.2)	407.8*[2,3,4] (168.5)	9.2 (5.7)
Faller 1 *n=2*	780.7 (215.4)	15.8 (22.3)	299.6 (225.1)	59.5 (69.0)	396.8 (39.3)	9.0 (2.3)
Faller 2 *n=10*	734.3 (302.5)	66.9 (62.5)	129.0 (80.5)	119.2 (88.9)	410.0 (185.7)	9.2 (6.2)
2. Students 6 months	320.3*[1,4] (218.3)	33.7*[4] (32.5)	46.4*[4] (54.2)	32.1 (44.6)	200.5*[1,4] (163.6)	7.5*[4] (3.9)
Faller 1 *n=7*	395.6 (265.3)	41.0 (32.1)	73.6 (70.9)	20.5 (14.4)	252.3 (212.9)	8.2 (3.0)
Faller 2 *n=9*	261.7 (166.6)	28.1 (33.7)	25.3 (24.1)	41.1 (57.9)	160.3 (109.7)	6.9 (4.5)
3. Students Advanced	246.1*[1,4] (121.3)	51.9*[4] (47.3)	35.3*[1,4] (25.8)	55.9 (70.6)	96.6*[1,4] (58.7)	5.8 (4.0)
Faller 1 *n=11*	272.4 (141.3)	69.4 (46.5)	22.7 (15.9)	60.3 (80.5)	112.7 (62.1)	7.3 (3.3)
Faller 2 *n=10*	217.1 (93.5)	32.5 (42.1)	49.0 (28.2)	51.1 (61.9)	78.8 (52.1)	5.6 (4.7)
4. Professionals	89.3*[1,2,3] (50.6)	7.3*[2,3] (24.3)	5.9*[1,2,3] (7.6)	22.9*[1] (32.9)	48.6*[1,2,3] (16.6)	4.6*[2] (2.5)
Faller 1 *n=22*	124.7 (61.1)	13.5 (27.6)	9.0 (8.5)	42.4 (40.9)	53.0 (16.3)	6.9 (1.7)
Faller 2 *n=125*	83.1 (46.0)	6.3 (23.7)	5.4 (7.3)	19.4 (30.2)	47.8 (16.5)	4.2 (2.3)

* Significant difference of this faller skill category from other categories indicated, $p < 0.001$

TABLE 5. Count of Action Steps per Tree Event

Faller Skill Categories	All Actions Mean Count (Stand. Dev.)	Assess Area Mean Count (Stand. Dev.)	Assess Tree Mean Count (Stand. Dev.)	Safe Work Area Mean Count (Stand. Dev.)	Fall Tree Mean Count (Stand. Dev.)	Get in Clear Mean Count (Stand. Dev.)
1. Students Beginning *n=12*	7.92*[4] (2.35)	0.75*[2,3] (0.45)	1.92*[4] (0.79)	1.83 (1.33)	2.42*[4] (1.38)	1.0*[4] (0.0)
2. Students 6 months *n=16*	7.63*[4] (2.6)	1.56*[1,4] (0.81)	2.69*[4] (1.49)	1.25 (1.29)	1.19 (0.54)	0.94 (0.25)
3. Students Advanced *n=21*	10.1*[4] (6.13)	2.52*[1,4] (1.94)	3.52*[4] (3.64)	1.71 (1.79)	1.24 (0.7)	1.1 (0.54)
4. Professionals *n=147*	4.03*[1,2,3] (1.49)	0.38*[2,3] (0.6)	0.85*[1,2,3] (0.64)	0.88 (0.7)	1.05*[1] (0.26)	0.87*[1] (0.34)

* Significant difference of this faller skill category from other categories indicated, $p < 0.001$

5.3. Direction of View

Analyzing direction of view demonstrates the unique perspective of point-of-view video observation to evaluate worker behavior. A purposeful glance may last only a fraction of a second and occur too rapidly for an observer on the spot or a video camera at a different location to perceive or comprehend. The briefest coded view in this study of 0.1 seconds down may have been a purposeless anomaly, but similarly brief views of 0.2 seconds directed behind the tree, 0.3 seconds ahead, or 0.4 seconds to the side were likely to have been enough to assure the faller of the surrounding situation during a falling episode. The view moves, settles an instant, and returns to the task.

Once the action of falling the tree began, the professional fallers almost invariably looked ahead within the first seconds, then back to the tree. Other characteristic behaviors occurred in the direction of view for the professional fallers, not all easily interpretable. The logging safety consultant in the study provided insight for one feature that was often very rapid and almost imperceptible, but regular enough to indicate definite purpose.

No detectable difference between the different skill categories occurred in the time spent looking back behind the tree, though other fallers spent at least twice the total time at the tree on average, and beginning students much longer (see Table 6). The count of the direction of view back for beginning students was about the same as for professional fallers, and the count was significantly less for advanced students (see Table 7). Students always worked with another person nearby, and the reason for the views back or views to the side usually involved turning toward a person standing behind the tree, possibly giving instruction or assistance. The professional fallers, instead, appeared to be consciously checking their escape path and in some cases the canopy behind them. Side views appeared to occur with similar purpose, sometimes apparently casual, just checking the area, but in certain instances with a notable insistence that indicated awareness of a hazard in the surrounding canopy as the tree moved.

In direction of view while falling the tree, as for the action steps earlier, the beginning students were significantly different after 6 months of experience, and much more like the advanced students, though still significantly different in most respects from the professional fallers. The most distinct difference between all students and the professional fallers occurred in the view down. Both the time and count data show the professional fallers almost never looked down – meaning for one thing that their wedges were in a very convenient location.

TABLE 6. Direction of View Time per Falling Episode

Faller Skill Categories	**All Views**	**Tree View**	**Tree Up View**	**Ahead View**	**Back View**	**Sides View**	**Down View**
	Mean Time Seconds (Stand. Dev.)	Mean Time Seconds (Stand. Dev.)	Mean Time Seconds (Stand. Dev.)	Mean Time Seconds (Stand. Dev.)	Mean Time Seconds (Stand. Dev.)	Mean Time Seconds (Stand. Dev.)	Mean Time Seconds (Stand. Dev.)
Category 1. Students Beginning	361.5*[2,3,4] (155.0)	252.8*[2,3,4] (93.6)	11.5 (9.6)	30.5*[2,3,4] (17.4)	3.8 (11.3)	54.1 (64.1)	8.8*[4] (7.3)
Faller 1 *n=2*	397.9 (36.9)	269.9 (2.4)	18.1 (11.0)	46.9 (21.4)	21.0 (26.4)	30.2 (4.1)	11.7 (6.7)
Faller 2 *n=10*	354.3 (169.9)	249.4 (103.1)	10.2 (9.3)	27.2 (15.7)	0.4 (0.6)	58.9 (69.8)	8.2 (7.6)
Category 2. Students 6 months	168.3*[1,4] (107.3)	130.4*[1,4] (89.1)	6.6 (6.1)	11.5*[1] (9.9)	1.8 (2.8)	7.3 (8.8)	10.7*[4] (9.3)
Faller 1 *n=7*	211.4 (112.0)	168.3 (100.4)	10.9 (7.0)	11.5 (12.2)	3.7 (3.5)	6.4 (7.9)	10.6 (10.3)
Faller 2 *n=9*	134.8 (96.4)	100.9 (71.4)	3.3 (2.1)	11.5 (8.5)	0.3 (0.5)	7.9 (9.9)	10.9 (9.0)
Category 3. Students Advanced	96.4*[1,4] (58.7)	65.3*[1,4] (35.9)	16.0*[4] (17.1)	5.8*[1] (5.6)	0.9 (3.3)	3.1 (5.8)	5.2 (7.8)
Faller 1 *n=11*	112.4 (62.1)	71.8 (34.6)	20.2 (21.0)	6.1 (5.1)	1.6 (4.5)	4.3 (7.1)	8.5 (9.7)
Faller 2 *n=10*	78.8 (52.1)	58.2 (37.9)	11.5 (10.8)	5.6 (6.5)	0.2 (0.7)	1.8 (4.0)	1.6 (2.2)
Category 4. Professionals	48.2*[1,2,3] (16.8)	35.8*[1,2,3] (12.7)	4.0*[3] (2.9)	4.9*[1] (4.2)	1.3 (2.0)	1.7 (2.3)	0.5*[1,2] (1.4)
Faller 1 *n=22*	52.8 (16.3)	41.4 (14.2)	3.0 (3.2)	3.7 (3.9)	1.6 (1.9)	2.0 (2.6)	1.0 (2.5)
Faller 2 *n=125*	47.4 (16.9)	34.8 (12.2)	4.2 (2.8)	5.1 (4.3)	1.2 (2.0)	1.7 (2.3)	0.4 (1.1)

* Significant difference of this faller skill category from other categories indicated, p< 0.001

Advanced students spent a significantly higher amount of time and effort viewing the tree up, which occurred partly due to the setting: thinning trees in the middle of the forest. Several felled trees hung up, requiring careful treatment and frequent viewing of the tree up to monitor the obstructions holding it, while cutting again at the stump to bring the tree down.

In an effort to standardize comparisons among the faller skill categories – all occupied for different amounts of time at falling trees – correlation coefficients were obtained for the percentage of time given to each direction of view relative to the total time at the tree. Percentage in this context is an abstraction and it remains unclear how statistical significance should be interpreted in terms of actual significance, but one result may be useful to report. As a percentage of total time at the tree, the beginning students at 6 months spent significantly more time viewing the tree during the falling episode than advanced students (78.6% vs. 70% of total time), and apparently more than any other skill category, though not represented as statistically significant differences (results not directly represented in the tables). The students at 6 months also spent a significantly smaller proportion of total time viewing the tree up, not only from advanced students dealing with hung trees (4.4% vs. 15.5% of total time), but also less than the professional fallers (4.4% vs. 8.6%). The beginning-students category also spent a significantly smaller percentage of total time viewing the tree up (3.3%) compared to professional fallers. Although the students view the tree up longer in terms of actual time, while the professional fallers give only fractions of a second to the tree-up view, the pace of the professionals is so quick that the check occurs at more frequent intervals. These results suggest that goal fixation may be a hazard issue for student fallers, and that it persists past the initial training period under supervision.

TABLE 7. Direction of View Count per Falling Episode

Faller Skill Categories	**All Views** Mean Count (Stand. Dev.)	**Tree View** *Mean Count* (Stand. Dev.)	**Tree Up View** *Mean Count* (Stand. Dev.)	**Ahead View** Mean Count (Stand. Dev.)	**Back View** Mean Count (Stand. Dev.)	**Sides View** Mean Count (Stand. Dev.)	**Down View** Mean Count (Stand. Dev.)
1. Students Beginning *n=12*	64.67***2,3,4** (30.13)	29.58***2,3,4** (14.62)	6.67***4** (4.91)	8.92***2,3,4** (4.5)	1.08 (2.28)	16.0***2,3,4** (12.76)	2.42***4** (1.44)
2. Students 6 months *n=16*	29.38***1,4** (13.61)	12.56***1,4** (5.99)	3.75***3** (2.79)	4.25***1** (2.72)	0.94 (1.29)	3.63***1** (3.81)	4.25***4** (3.07)
3. Students Advanced *n=21*	31.52***1,4** (21.78)	13.24***1,4** (8.73)	9.43***2,4** (8.15)	4.05***1** (3.34)	0.14***4** (0.36)	1.81***1** (2.92)	2.86***4** (3.50)
4. Professionals *n=147*	14.07***1,2,3** (5.83)	6.66***1,2,3** (2.41)	1.91***1,3** (1.08)	2.86***1** (1.71)	0.90***3** (1.09)	1.37***1** (1.43)	0.37***1,2,3** (0.66)

* Significant difference of this faller skill category from other categories indicated, p< 0.001

5.4. Power Analysis: Observing Differences in Individual Behavior

As a cautionary note in the above comparisons, ability to detect differences between groups is restricted by the small number of fallers in the skill categories, and the small number of trees for some of the fallers. Results are shown for individual fallers, but statistical comparisons were only reported for skill categories to characterize differences.One significant difference between individual fallers in the study, however, indicates the kind of behavior that could be measured and tested with meaningful results.

In general, the mean time in the action to get in the clear (measured as the period from the turn away from the tree to the tree impact) appears to grow progressively smaller with advancing skill (see Table 4). One explanation is the care taken by experienced fallers to place a falling tree in an exact trajectory to avoid surrounding trees and reach a safe and convenient resting point. The effort requires concentration on the cut to the last possible moment. Yet, within the professional skill category, there was also an observed difference between the two fallers. Although the difference appears small, the mean time in seconds to “get in the clear” for the older and more experienced first faller was significantly longer than the time for the second professional faller ($p<0.05$). The repeated difference in behavior was noticeable, too, in direct observation. The difference suggests the second professional faller was exposed to increased risk by remaining too often, too long near the stump of a falling tree, where most serious injuries for fallers occur. Data in Table 2 indicate the second professional faller did not take the action to get in the clear as the tree fell in 15% of the tree events.

Taking this example as a notable difference, a power analysis was conducted to determine the sample size required for beginning students to detect a 2-second difference for the action to “get in the clear,” assuming a range of variance among the felled trees similar to the standard deviations shown for action times in Table 6. The result indicated 10 tree events for each faller would need to be observed to detect a statistically significant difference (power 0.8, 95% confidence level). Under the same conditions, to detect the change among a group of fallers, following training or an intervention, for example, 10 fallers would need to be observed. In some instances, however, student fallers exhibited wider variation in behavior on each tree, and a sample size of 20 trees, or 20 students could be required to detect significant differences.

5.5. Interrater Reliability

An interrater reliability test with two independent coders was conducted for view time in different directions to determine if this coding – observing split-second changes in a dynamic scene from the eye of a camera – can produce reliable results that could be repeated in another study. The results were reassuringly positive, but also highlighted problems.

Reliability between two coders is computed with a formula for intraclass correlation (ICC), or is approximated with a simple Pearson correlation coefficient.[7-8] The ICC test was used here. The level of agreement between two coders is interpreted from ICC test values according to the following scale.[9]

0.0 to 0.1 = virtually none
0.1 to 0.4 = slight
0.41 to 0.6 = fair
0.61 to 0.8 = moderate
0.81 to 1 = substantial

The original selection of coded views was simplified to six directions following the test results. The original codes included views toward the tree, ahead, back, left, right, and the same directions up, plus down in any direction. The test made it clear that distinguishing up in any direction, except for “tree up,” was too difficult and should be collapsed to indicate the main direction only. Also, the distinct left-right views produced error and added no additional information, and was collapsed to “sides” only.

TABLE 8. Correlation Between Two Coders on Direction of View Times While Falling Trees

Direction of View	ICC	CI	p-value
All Views			
All n=692	0.981	0.978 - 0.984	<0.001
Students n=68	0.976	0.962–0.985	<0.001
Professional n=624	0.987	0.984-0.988	<0.001
Tree View			
All n=159	0.987	0.982-0.990	<0.001
Students n=12	0.936	0.795-0.981	<0.001
Professional n=147	0.970	0.959-0.978	<0.001
Tree Up View			
All n=152	0.966	0.953-0.975	<0.001
Students n=12	0.934	0.788-0.981	<0.001
Professional n=140	0.977	0.968-0.983	<0.001
Ahead View			
All n=153	0.946	0.927-0.961	<0.001
Students n=12	0.928	0.772-0.979	<0.001
Professional n=141	0.781	0.737-0.838	<0.001
Back View			
All n=97	0.413	0.233-0.565	<0.001
Students n=11	0.352	-0.281-0.772	0.131
Professional n=86	0.867	0.803-0.911	<0.001
Sides View			
All n=73	0.744	0.62-0.831	<0.001
Students n=10	0.696	0.161-0.915	0.009
Professional n=63	0.110	-0.139-0.347	0.193
Down View			
All n=58	0.628	0.443-0.762	<0.001
Students n=11	0.142	-.472-0.664	0.329
Professional n=47	0.844	.0736-0.910	<0.001

Views excluded when absent for both coders.
Abbreviations: n, number of views; ICC, intraclass correlation coefficient;
CI, confidence interval

The reliability test was conducted with data from the two beginning student fallers and the two professional fallers, with a total of 159 trees, making all together 954 (159 x 6) possible views for the coded sample. Not all views occurred on each tree, however, and the inclusion of those views that were absent for both coders artificially inflated the level of agreement. Consequently, all views with a time of zero for both coders were excluded from the final analysis.

The results showed substantial agreement between the coders overall, but high agreement for views of the tree, tree up, and ahead masked diminishing agreement for sides (moderate), down (moderate), and back (fair)(see Table 8). In some cases, disagreement occurred due to one coder not recognizing the view at all in the video data; in other cases, disagreement was due to one coder recognizing a “back” view, for example, where the other coder recognized the same interval as a “side” view, which compounded the disagreement.

Both coders found coding for the student fallers the most difficult, and ICC test results for each group confirms there was less agreement on the student fallers, particularly on “back” and “down,” which show virtually no agreement. Yet, for professional fallers, the “sides” view also shows virtually no agreement. Considering the many stances in relation to the tree, the pace of action, and the offset view of the camera from the eye of the faller, the high level of agreement for the main activities while falling – viewing the “tree, it’s trajectory “ahead,” and movement overhead with “tree up” – gave reasonable reassurance to continue coding direction of view for all of the video episodes.

6.0. DISCUSSION

Conducting point-of-view video observation of fallers at work in a remote location proved technically feasible. Quantifying the resulting video data to characterize safe work behaviors and distinguish patterns of behavior among fallers at different skill levels also showed promising results. The study results give a clear idea of the large difference in time to fall a tree between students and professional fallers, and specifies the effort needed to collect sufficient data from student fallers to evaluate performance. One issue made clear from viewing different sets of fallers is the need to standardize the logging environment to achieve comparable results, less susceptible to variation due to type of logging, terrain, and trees.

Data on times and counts for faller action steps and directions of view while falling suggested ways to quantify observed behaviors. One example of a meaningful quantitative difference was supplied related to the time interval for getting in the clear as the tree falls. In other cases, however, using quantities to characterize observed activities does not necessarily indicate an ideal value. How often the faller should look up and around in different circumstances needs to be interpreted by loggers and trainers according to issues they understand as important, according to the skill level of the faller.

A number of challenges and issues arose in the study that should be briefly discussed.

Equipment. The first camera was purchased directly from Viosport, the second camera through a dealer as it was no longer available directly from the manufacturer. The SD card in the second camera did not meet minimum requirements for video recording. Write speed must be at least 2.5 mb/sec. (20 mb/sec. is available for video cards). The second camera recorded short episodes fine during testing, but failed on the longer recordings in the field. The unit was sent twice for warranty repair. A new CPU was installed and instructions received to replace the SD card.

Video analysis software. The Transana software performed very well for all functions, and exported data in a convenient format for use in Excel and SPSS. The only drawback with Transana was it’s required use of Quicktime video player, a non-Windows program that produced problems when installed on a Window’s Vista operating system. Transana provides excellent customer support, however, and questions on use were answered promptly in an online forum. The qualitative analysis software Atlas.ti was investigated as an alternative, but the software, though excellent for text-based analysis, did not allow the creation of a transcript to provide a map for successive passes through video files, and was clumsy at creating and organizing coded video clips.

Methods. The original study proposal suggested following the analytic procedure of the Virginia Tech 100-Car Video Study,[10] which divided an extensive video database into 6-second epochs to derive a random sample of 10,000 epochs for coding to create a standard denominator for variables in the driving experience, and also spare the necessity of coding every second of recorded video data. This elegant method proved unnecessary. With only 196 tree events in the whole video database, it was possible to code and utilize all information from every event. With a larger video database, coding would eventually become too cumbersome and costly to code comprehensively, and in that case, the epoch procedure used in the Virginia Tech study appears to be the best way to produce useful results. The process would require software specifically designed for the procedure.

Eye glances. One limitation of the study was the inability to directly observe eye glances to evaluate awareness of the surrounding environment. The Virginia Tech 100-Car Video Study[10] mounted a camera on the rear-view mirror aimed directly at a driver's face, and used eye glances in its evaluation of causal factors in crash and near-crash events. The analysis suggested an eye glance away from the forward direction for 2 seconds or more was a hazard; but also suggested that eye glances of less than 2 seconds were actually protective, indicating heightened awareness. The experience of coding for direction of view for fallers verified that 2 seconds is a long time. Many glances of the fallers at work were much shorter, and only those glances where the head moved were recorded. Mounting a bicycle rear-view mirror to each hardhat was considered as a way to detect eye glances, but this idea was rejected as a potential hazard, and too obtrusive for the participant, making the recording too evident.

Hardhat hazard. Student fallers had no apparent difficulties or complaints with the camera-mounted hardhats. The two professional fallers, however, were both unhappy. Faller 1 wore the hardhat for only 1½ hours, and Faller 2 wore the hardhat for 4 hours before removing it. Their comments were recorded.

Faller 1: Complaint about restriction turning head. "Something I've learned with safety in 40 years of cutting, distraction is what ****s you up, and this is a distraction."

Faller 2: (Talking about chain problem after cutting a root wad and finding a big rock underneath it): "I should of got down and looked. I blame the hardhat."

Faller 1: "Course it is, you can't turn your head."

Faller 2: "Cause I'd have got down and turned my head, but I didn't want the hardhat falling off."

Such comments may indicate other sources of dissatisfaction, but certainly the professional fallers work at a very rapid pace amidst heavy brush and branches, performing very hazardous work; the small length of cord down the back of the hardhat, and possibly the slight weight of the camera on one side, could have obstructed movement to some degree. Currently, Viosport does not make a cordless camera unit like the POV.1. An improved design should also consider balancing the weight. Some fallers work with ear, eye, or face protection on their hardhats, so the additional equipment is probably not an insurmountable issue. Finally, it may be necessary to mount the camera on the faller's own hardhat to assure familiarity. This option was rejected for the current study, due to the permanent damage that would result from drilling holes to permanently mount the camera fixture.

Institutional Review Board approval. The use of video observation in scientific studies is fairly common now, and an institutional review board is likely to be accustomed to the medium. With specific informed-consent language, the approval process for this study was more straightforward than anticipated. In the preparation phase, we obtained a model consent form for narrow use of video data from Dr. Tim Koschmann of Southern Illinois University School of Medicine. Narrow use means the data will be used for this one study only. A provision can be added that further use will be allowed by the subject following IRB review and approval for that one additional purpose.

Another model consent form was obtained from an ergonomic video observation study by CROET scientist Dr. Ryan Olson. The technical administrator of the Transana video analysis software, David Woods, added the practical point that audio recording is very useful for interpreting images and should not be neglected in the consent development and approval process. This proved to be valuable advice.

7.0. Conclusions

This study demonstrated the feasibility of putting a camera on a hardhat for point-of-view observation of work activities in a remote location. The recorded video episodes were clear and in most cases easy to interpret. The study also demonstrated the possibility of coding the video data and quantifying work behaviors essential to safety. Coding for faller action steps provided information on how fallers use specific procedures to work safely while falling trees. Attention to direction of view while falling attempted to quantify faller awareness as a critical aspect of safe work behavior in a hazardous environment.

The camera-mounted hardhat could be used again for a study of student fallers, due to the slower pace. No complaints were received. The type of forest is also a consideration. Less undergrowth will reduce the possiblity of entanglement. The camera-mounted hardhat may not be suitable for professional fallers in the current design, unless the faller is introduced to the equipment in advance and feels comfortable with it in the particular work conditions where it will be used.

The most interesting future use of the Fallers Point-of-View Video Observation Study data follows from the feedback of the study's logging safety consultant, suggesting that student fallers could benefit from observing over the shoulder of a professional faller at work. Secondary analysis does not capture the posture and tempo of the professional fallers that allows them to fall a tree in 1 minute and move on. Associated Oregon Loggers produces training DVDs and has the technical capacity for such a project. With IRB approval, a collaborative effort could produce training material using the unique video data obtained in this study.

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FINAL REPORT

PROJECT TITLE

Pilot 6: Further Skills Retention in Fishing Safety Training

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PROJECT DESCRIPTION

Commercial fishing continues to have one of the highest rates of occupational fatalities in the U.S. This project fits PNASH's goal of reducing occupational injury in the commercial fishing sector. It will also strengthen PNASH's partnerships and collaboration with the fishing industry, safety trainers and U.S. Coast Guard regulators. Commercial fishing is also often a family based small operation.

One basic question will be asked: what is the skills decay rate over an 18 to 24 month time period of the four survival skills originally taught as part of the federally required (46 CFR 28.270) Drill Conductor (DC) course? The NIOSH Alaska Pacific Regional Office has previously shown that fishermen who have taken DC training have a higher chance of survival than those that have not, but that this survival rate is reduced the chronologically further out fishermen are from their initial DC training. Currently there is no recurrency required in DC courses. By establishing the retention rate of the survival skills acquired in the DC training, an effective interval for refresher training may be developed by Coast Guard policy.

Four of the skills tested in this study are the same that are required to be taught to fishermen in the DC course. Previously these same fishermen were tested one and then again three months later in these four skills in Phase I of this project. The phase II project in this report re-tests the same skills that were taught 18 to 24 months previously, to measure skills retention rate over a longer period of time.

From Phase I of this project in 2007, we obtained data on skills decay at one and three month intervals. This helped determine intervals for emergency drills that are conducted by DCs. In this second proposed phase, the skills decay of the DCs themselves who are actually conducting the drills after being initially certified to do so, would be measured to ascertain the appropriate time interval for refresher training of the DCs.

This Phase II project examines the skills retention of up to 30 people trained and tested during the initial Phase 1 period. TA similar but modified questionnaire was used in Phase II as in the previous Phase 1 project, to collect qualitative data about fishermen's views on training and lowering risks.

PROJECT AIMS

1. Commercial fishermen were used as subjects in order to measure their skills retention in 4 distinct survival skills they were taught in the previous 18 to 24 month period. 28 of the original 30 were retested and data collected and analyzed. - **Met**
2. The skills retention data was given to the U.S. Coast Guard for feedback on their policy on refresher training for the Drill Conductor skills training required under 46 CFR 28.270 during the Advance Proposed Rulemaking public comment period which was open on this topic in 2008 during the period of this project. - **Met**
3. Further input to a follow on Coast Guard Proposed Rulemaking to take place in 2010 will be sent on the

Phase II results. This will take place **after this project is closed but followed up on by AMSEA staff.**

4 Qualitative one-on-one interviews took place with 28 test subjects to determine what fishermen's perspectives were on training and on lowering risk in commercial fishing. - **Met**

METHODS

From Phase I of this project in 2007, we obtained data on retention (skills decay) of required skills that are taught to Alaskan commercial fishermen. These skills were then tested at one and three month intervals. In Phase II of the study, completed in 2009, 28 fishermen who were trained and tested during the initial Phase 1 period were tested once again after a further 18 to 24 month interval to measure further deterioration of skills. The Phase II group had only been trained in 4 of the 16 skills required in the complete U.S. Coast Guard required Drill Conductor workshop.

Each of the 4 skills was broken into steps that were assigned a value of importance that added up to 100 points (and thus 100%). For example, in donning an immersion suit, if the subject completed donning in 60 seconds they were given 10 points, since donning a suit quickly could make the difference in survival, whereas ensuring that the subject's feet reached clearly to the bottom of the suit was only given 5 points since survivability was not as dependent on this step being completed. The subjects did not participate in this study unless they could demonstrate that they could perform the skills to 100% competency on initial training.

Skills for the decay over both Phase 1 and Phase 2 is illustrated in two ways:

- Plotting the % total score [(total score for 4 skills/baseline)*100] by the number of months post-training.
- Plotting the % change in score from baseline [% score at test month – baseline % score] by number of months post-training. These values are negative because the change in score represent a loss from baseline (perfect score).

For the purpose of constructing these figures, 21 was used as the number of months post training because it was the midpoint between the time period (18 – 21) over which the Phase 2 post-testing was conducted.

The relationship between skills retention and both age and education was determined using the Pearson correlation coefficient. Differences in skills retention between skippers and crew were examined using an unpaired t-test. Both of these statistical tests are the same as used for the Phase 1 (2007) study.

In addition, qualitative questions were asked of the tested subjects to compare sub groups of test subjects, test knowledge and perceptions of risk of subjects and other questions that might be of use to safety trainers working with commercial fishermen.

RESULTS

Question # 1: What is the rate of skills decay from initial training (100%) at through both Phase 1 and Phase 2 for the group without previous training?

The descriptive statistics for the total population are located in Table 1 and include mean, standard deviation, median, minimum, and maximum.

Table 1. Descriptive Statistics for Skills Retention Scores (%)

test month	score (%)					
	n	mean	sd	median	minimum	maximum
total score						
Pre-test	32	64	9	67	31	79
Post 1	32	86	12	90	49	98
Post 3	30	87	10	91	58	99
Post 21	29	76	11	75	50	100
change from baseline[a]						
Post 1	32	-14	12	-10	-51	-2
Post 3	30	-13	10	-9	-42	-1
Post 21	29	-24	11	-25	-50	0

[a]The negative values indicate a decrease in score from baseline.

The percent scores for skills testing at 1, 3, and 21 months is shown in Figure 1 with error bars of ± one standard deviation (SD). The baseline percent score (100%) is included in the figure as well. The mean percent score essentially did not change between the 1 month and 3 month post test (86 and 87%, respectively). Of note is that the minimums score at month 3 was higher than month 1 (49% and 58%, respectively). After 21 months the percent scores dropped to a mean of 76%. With additional points between 3 and 21 months it would be possible to find a line to fit the data.

Figure 1. MeanTotal Score (%) for Four Skills at 1, 3, and 21 Months after Initial Training

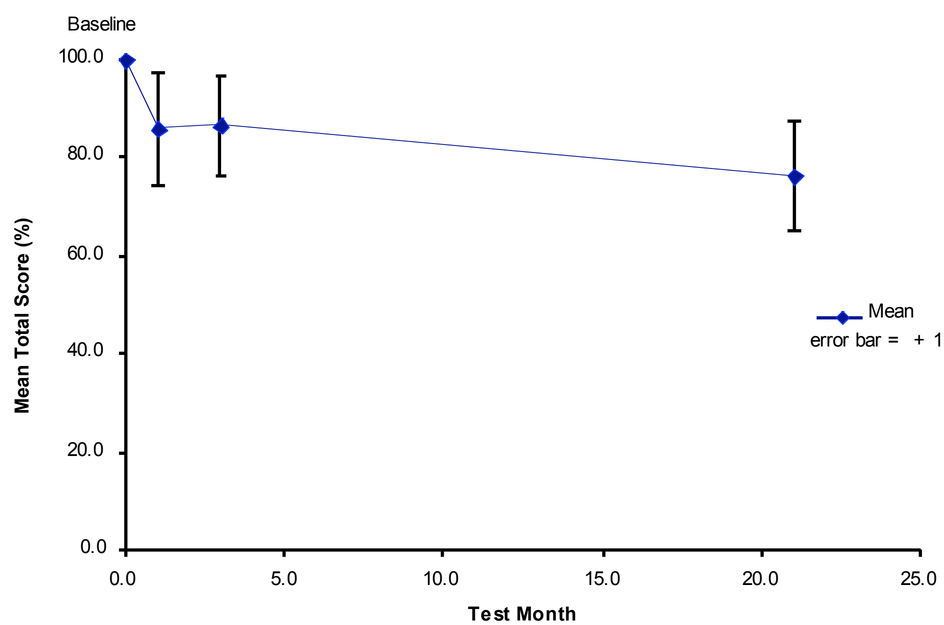
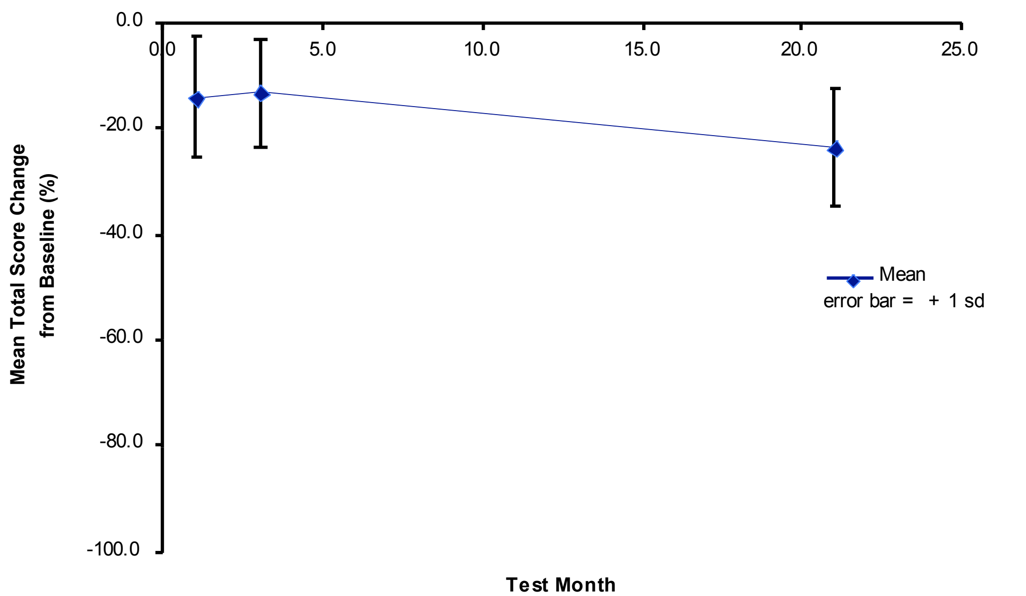


Figure 2 illustrates the skills loss showing the change (%) score from baseline (100%) at each of the three time points that posttests were conducted. The mean values are express as negative (score % - baseline %) because they represent a loss in skills retained. The error bars show ± one standard deviation (SD).

Figure 2. Mean Total Score Change (%) From Basline for Four Survival Skills at 1, 2, and 21 Months after Training



Question # 2: Is there a correlation between age of the subject at baseline (the 2007 interview) and skills retention at 18 to 24 months?

At 18 to 24 months, there is a slight positive correlation (r = 0.276) between age and skills retention. As age increased, skills retention increased. The Pearson correlation p-value = 0.155 (N=28) is not significant.

Question # 3: Is there a correlation between years in school at baseline (2007 interview) and skills retention at 18 to 24 months?

At 18 to 24 months, there is virtually no correlation (r = -0.196) between years in school and skills retention. The Pearson correlation p-value = 0.317 (n=28) is not significant.

Question #4: Is there a difference between skippers and crew in skills retention at 18 to 24 months?

No, the mean scores of 78.7 ± 10.7 (std dev) for skippers and 74.6 ± 11.4 (st dev) for the crew members are not significantly different. T-test p-value = 0.338.

RESULTS OF QUALITATIVE INTERVIEW QUESTIONS.

Can you list the four main emergencies that are required to be practiced during monthly emergency drills?

Only 4 out of 29 fishermen (14%) interviewed could name all 4 of the main emergencies that are required to be practiced during monthly emergency drills. 15 of the 29 (52%) could name 3 or more of the emergencies.

What do you think is the best way to retain emergency skills?

Twenty-nine out of 29 (100%) felt that practicing was the best way to retain skills as opposed to learning by reading or watching a DVD or watching others.

If you were offered refresher safety training would you take it?

Twenty-seven of 29 (93%) said they would take refresher training if offered. One participant responded “maybe” and one “no”.

List any barriers you think may exist to fishermen taking refresher safety training.

Sixteen of 28 (57%) respondents said that “not enough time” was a barrier. Six of the 28 (21%) responded that it was “ego, overconfidence, pride, laziness, ‘know it all’ attitude, lack of motivation or forgetfulness” that was the main barrier. 5 of the 28 responded that the timing of the training would be a barrier. Only one subject responded that the cost of training was a barrier.

Have you changed your safety practices as a result of safety training?

Eighteen of 29 (62%) responded that their safety practices had changed as a result of safety training.

What do you think is the best way to change fishermen’s behavior positively to reduce casualties?

Twenty-three of 28 (82%) who responded noted that education and training were the most important ways to change behavior. 4 of 28 (14%) responded that general awareness efforts of the risks were the most important.

Are there any other comments you would like to make that would help us understand how to lower risks in commercial fishing?

Eight of 18 (44%) of the responses noted some aspects of safety training being most important to lowering the risks in commercial fishing. 4 of 18 (22%) noted the importance of media efforts on risk awareness as being most important. 3 of 18 (17%) noted the need for some type of requirements.3 of the 18 others noted sobriety, fatigue and more affordable survival equipment was important to lowering the risks.

DISCUSSION

The commercial fishermen in this study worked in Alaska waters and were largely from the Seattle, WA and Sitka, AK. areas. They were largely family run businesses in vessels from 28 to 58 feet in length. This size makes up the great majority of fishing vessels in the U.S. One basic question asked in the study was what was the skills decay rate over an 18 to 24 month time period of the four survival skills originally taught as part of the federally required (46 CFR 28.270) Drill Conductor (DC) course. These skills such as proper donning and storage of immersion suits, demonstrating the Heat Escape Lessening Position (HELP) and components of a MAYDAY are skills which casualty reports have demonstrated are critical in an emergency at sea.

The skills retention data in Phase I was provided to the U.S. Coast Guard in 2008 in response to a Federal Advanced Notice of Proposed Rulemaking. This Advanced Notice solicited input on the need for safety refresher training for commercial fishermen. Currently there is no refresher training required in DC courses.

In 2010, the Coast Guard will seek additional comment on DC refresher training in a Notice of Proposed Rulemaking. The data from this Phase II study will be valuable input for the Coast Guard in determining what the interval of refresher training should be. The longer range of time between initial training and retesting in Phase II, will give the Coast Guard a measurement of skills decay and the will be provided this data for the Rulemaking.

Quantitative aspects of this study demonstrated that there was not a significant change in retention rate due to age, status as crewmember or captain, or education background.

The qualitative interview survey portion of this research gave perspectives on a wide variety of issues. It is significant that only 14% of subjects could name the four required emergency situations that had to be practiced once a month. This would indicate more education is needed in this area by the Coast Guard and safety trainers.

100% of the subjects felt that practicing skills was the most effective way to learn and 93% said they would take refresher training if it was offered. 57% said that “having enough time” to participate in training would be the largest barrier to taking training, and 21% mentioned personal negative attitudes that would be the biggest barrier. The latter response underscores the frankness by which subjects answered questions. Cost of refresher training was only seen as a barrier by one person.

When subjects were asked what was the most effective way to change behavior in safety practices, 82% responded it would be education and training efforts. 62% responded that training had already resulted in positively changing some of their work practices. 44% responded that safety training was the most important tool in fishing safety, compared to 22% who noted the importance of media efforts on “raising awareness” as being most important, and 17% noted the need for some type of unspecified “requirements”. As a result of these responses, it can be seen that there is strong support from fishermen for training efforts to play an important role in safety.

CONCLUSION/FUTURE DIRECTION

This project is a good example of research helping policy makers in decision making. The results of this study are important to commercial fishing vessel safety trainers as well. A skills decay rate from 100% competency to 76.5% in a time period of 18 to 24 months from initial training demonstrates a high rate of decay for survival skills in an industry that has the highest fatality rate in the U.S.

A further direction for research would be to find out what an optimum interval of refresher training would be by providing periodic refresher training of skills and measuring retention rates.