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NORA Symposium 2003

Working Partnerships: Applying Research To Practice

June 23-24, 2003

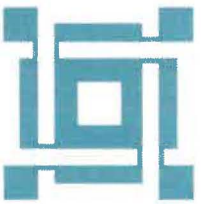
Hilton Crystal City Hotel
Arlington, VA

CDC Workplace Safety and Health

NIOSH

APHA

NORA Symposium 2003



Working Partnerships: Applying Research To Practice

June 23-24, 2003

NORA Symposium 2003

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DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

National Institute for
Occupational Safety and Health
Centers for Disease Control
and Prevention (CDC)
200 Independence Avenue, SW
Washington, DC 20201

Message from the Director, National Institute for Occupational Safety and Health

Welcome to—and thank you for attending—the 2003 NORA Symposium! 2003 marks the seventh year of the National Occupational Research Agenda. This year, the Symposium will showcase some exciting research findings, educational products and interventions from the 21 priority areas of the National Occupational Research Agenda.

The 2003 Symposium will offer potential solutions and promising avenues of research to meet the many of the challenges that the occupational safety and health community faces in the 21st century. While NIOSH is pleased to be the primary sponsor of the 2003 Symposium, I would like to thank our co-sponsor, the American Public Health Association (APHA) for helping us with the Symposium. Most importantly, I would also like to thank the many scientific presenters at the 2003 NORA Symposium.

Over the past seven years, the NORA partners have made much progress in advancing etiologic and interventional research, in developing excellent educational products and in establishing valuable partnerships. NORA's success is in large part due to the collaboration between the National Institute for Occupational Safety and Health with its partners from industry, labor, government, academia and the occupational safety and health professions.

A special feature of the 2003 Symposium is a session on assessment of the effectiveness of the National Occupational Research Agenda since its inception in 1996. This year marks the seventh year of the Agenda and it is time for all of us to join together and discuss how best to evaluate NORA's effectiveness in eliminating work-related injuries and illnesses in American workers and how best to chart NORA's course for its next decade which begins in 2006.

I wish each of you a successful 2003 NORA Symposium!

John Howard
Director, NIOSH

Introduction

American Public Health Association
800 I Street, NW • Washington, DC 20001-3710
(202) 777-APHA • Fax: (202) 777-2534 • comments@apha.org • www.apha.org
Georges C. Benjamin, MD, FACP
Executive Director

May 30, 2003

Dear Friends,

Welcome to NORA Symposium 2003: Working Partnerships – Applying Research to Practice. The American Public Health Association is delighted to join the National Institute for Occupational Safety and Health as cosponsor of this year's meeting celebrating the achievements in occupational research.

Safe, healthy workplaces are established on a strong foundation of science accomplished through active involvement of employers, workers and the scientific community. Developing partnerships in conducting research and applying that research to public health practice is essential to reaching this shared goal.

Sincerely,

Georges C. Benjamin, MD, FACP
Executive Director

Advancing the Public's Health Since 18

CONGRATULATIONS TO THE WINNERS!

The National Occupational Research Agenda (NORA)

2003 Partnering Award for Worker Health and Safety

BJC Health Care

BJC Occupational Health Nurse Council

Washington University School of Medicine

West Virginia University College of Engineering and Mineral Resources

Arjo, Inc.

EZ Way, Inc.

National Institute for Occupational Safety and Health

for

Evaluation of a Best Practices
Back Injury Prevention Program in Nursing Homes

NORA
Symposium 2003

Acknowledgements

The organizers would like to thank the following individuals and organizations who helped make this NORA Symposium 2003 possible:

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Lore Jackson Lee, NIOSH
Debra Lipps, NIOSH
Max Lum, NIOSH
Kathleen Rest, NIOSH
Jane Roemer, NIOSH
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John Sestito, NIOSH
Ray Sinclair, NIOSH
Greg Wagner, NIOSH
Mary Lynn Woebkenberg, NIOSH

Fran Atkinson, APHA
David Fouse, APHA
Elaine Lynch, APHA

Gary Greenburg, Duke University
Rosmary Sokas, University of Illinois

NORA Liaison Committee

Symposium Agenda

Monday, June 23, 2003

11:00	Registration and Coffee *(Authors Set-up Posters)*
1:00	Introduction and Welcome John Howard, MD, MPH – NIOSH Director Georges Benjamin, MD, FACP – Executive Director, APHA Julie L. Gerberding, MD, MPH – CDC Director
1:45	Keynote Address Nancy Krieger, PhD – Harvard School of Public Health, "*Health Disparities and Workers' Health: An Ecosocial Perspective*"
2:30	Break
2:45	NORA Partnering Award Past and Present Update from the 1999 Winners: The Asphalt Partnership Update from the 2001 Winners: The Oregon Dermatitis Partnership Presentation of the 2003 NORA Award by Dr. Bonnie Rogers, Chair NORA Liaison Committee Remarks by the 2003 Winners: The Back Injury Prevention Partnership
3:45	By These Hands: A Photographic Essay - David Parker, MD
4:15	NORA: Looking Back and Looking Forward Moderator: Kathleen Rest, PhD, MPA <u>Reviewing NORA</u>: Bonnie Rogers, DrPH, COHN-S, LNCC, FAAN – University of North Carolina William B. Bunn, MD, JD, MPH – Navistar International Transportation Corporation Franklin Mirer, PhD – United Auto Workers <u>Discussion</u>: Alan Moshell, MD – National Institute of Arthritis and Musculoskeletal and Skin Diseases Tom Leamon, PhD – Liberty Mutual Insurance Company Michael A. Silverstein, MD, MPH – Dept. of Labor and Industries, Washington State
5:30 – 7:30	Poster Viewing

NORA Symposium 2003

Symposium Agenda

Tuesday, June 24, 2003

7:30	Registration and Refreshments
9:00	Plenary Session: Journalism & Science: Complex Issues in a Sound Bite World Bud Ward – Freelance Writer, Morris A. Ward, Inc. Andy Miller – Health-Care Reporter for the Atlanta Journal-Constitution
10:00	Break
10:15	Concurrent Sessions: Poster Briefs Session 1: Dermatitis; Lung Disease; Reproductive Disorders Session 2: Injuries; Musculoskeletal Disorders; Infectious Diseases Session 3: Intervention Effectiveness; Special Populations at Risk Session 4: Exposure Assessment; Mixed Exposures; Hearing loss
12:15	Lunch (on your own)
1:30	Concurrent Sessions: Paper Presentations Session 5: Traumatic Injuries; Musculoskeletal Disorders Session 6: Exposure Assessment; Mixed Exposures Session 7: Emerging Technologies; Control Technology & PPE Session 8: Cancer Research; Risk Assessment; Fertility & Pregnancy Abnormalities
3:00	Break
3:30	Concurrent Sessions: Paper Presentations Session 9: Asthma & COPD; Allergic & Irritant Dermatitis Session 10: Special Populations at Risk; Health Services Research Session 11: Organization of Work; Social & Economic Consequences Session 12: Intervention Effectiveness; Surveillance Research Methods
5:30	Adjourn

Breakout Session 1

Paper Number: 1
The abstract paper was withdrawn.

Paper Number: 2
Immune Responsiveness to Squaric Acid Dibutylester in Human Subjects
E.D. Baron (1), A. R. Swick A. R. (1), C.A. Ryan (2), G.F. Gerberick (2), S.S. Tinkle (3), S.T. Nedorost (1), K.D. Cooper (1), S.R. Stevens (1)
(1) University Hospitals of Cleveland/Case Western Reserve University, (2) Proctor and Gamble Co, (3) National Institute for Occupational Safety and Health

Paper Number: 3
Pesticide Patch Test Series in Panama for the Assessment of Allergic Contact Dermatitis Among Banana Plantation Workers
Homero Penagos (1,2), Clemens Rueper (3), Timo Partanen (3), Catharina Wesseling (3)
(1) Department of Occupational Dermatology, Social Security Bureau of Panama, David, Panama. (2) Environmental Sciences Institute, University of Chiriqui, Panama. (3) Central American Institute for Studies on Toxic Substances, Heredia, Costa Rica

Paper Number: 4
Structure Activity Relationship for Skin Sensitization Using the Local Lymph Node Assay Data.
Adam Fedorowicz (1), Harshinder Singh (1,2), Eugene Demchuk (1,3)
(1) National Institute for Occupational Safety and Health, Morgantown, WV, (2) Department of Statistics, West Virginia University, Morgantown, WV, (3) School of Pharmacy, West Virginia University, Morgantown, WV

Paper Number: 5
Development of Colorimetric Indicators: A New Technique to Determine Glutaraldehyde and Alkaline Glutaraldehyde Contamination
E. Vo
National Institute for Occupational Safety and Health, National Personal Protective Technology Laboratory, Technology Branch

Paper Number: 6
Experimental Contact Dermatitis Research Group: A Successful NORA-AID Activity.
G.F. Gerberic (1), B.D. Lushniak (2)
(1) Procter and Gamble Company, (2) National Institute for Occupational Safety and Health

Paper Number: 7
Chronic Occupational Beryllium Disease With Cutaneous And Pulmonary Findings
James S. Taylor, MD and Joshua Berlin, MD

Paper Number: 8
Work-Related Lung Disease Surveillance Report 2002: Asthma and COPD Highlights
M. Attfield, K.M. Bang, R.M, Castellan, M. Filios, C.J. Rotunda, J. M. Wood
National Institute for Occupational Safety and Health

Paper Number: 9
A Simple Method for Evaluating Sample Size in the Houston ATAC (Air Toxics and Asthma in Children) Study.
D. Lai (1), S. Maberti (1), S. Abramson (2), L. Freimans (1), N. Hanania (2), C. Lusk (1), M. Morandi (1), M. Sockrider (2), T. Stock (1), C. Umeh (1), and G.L. Delclos (1)
(1) Southwest Center for Occupational and Environmental Health, The University of Texas School of Public Health and (2) Baylor College of Medicine, Houston, Texas.

Paper Number: 10
Preventing Occupational Respiratory Disease: A Lesson From Coal Mining
M.D. Attfield, E.L. Petsonk, G.R. Wagner
Division of Respiratory Disease Studies, NIOSH

Paper Number: 11
The Functional Capability Chart: A New Tool for the Monitoring of Lung Function in Asthma Care
F. Hayati (1), P.B. Boggs (2), D. Wheeler (3)
(1) Doctoral Candidate, Auburn University, Industrial Systems & Engineering, The Asthma 2000 Group, (2) Senior Fellow, The Asthma 2000 Group, The Asthma-Allergy Clinic, Shreveport, Louisiana, (3) Statistical Process Control, Inc. Knoxville, Tennessee

Paper Number: 12
Often-Unrecognized Spirometer Problems That Elevate Test Results
Mary C. Townsend, Dr.P.H. (1,2), John L. Hankinson, Ph.D.(3)
(1) M.C. Townsend Associates, Pittsburgh, PA, (2) University of Pittsburgh Graduate School of Public Health (Adjunct), Pittsburgh, PA, (3) Hankinson Consulting Inc., Valdosta, GA

Paper Number: 13
Paternal Occupational Exposure to 2, 3, 7, 8 – Tetrachlorodibenzo-p-dioxin Birthweight and Birth Defects
C.C. Lawson, T.M. Schnorr, E.A. Whelan, J.A. Deddens, D.A. Dankovic, L.A. Piacitelli, M.H. Sweeney, L.B. Connally
National Institute for Occupational Safety and Health

Paper Number: 14
Reported Parental Occupational Exposures and Birth Defects
A. Correa (1), C. Lawson (2), C. Louik (3), S. Lin (4), C. Druschell (4), P. Langlois (5), P. Romitti (6), J. Reefhuis (1), E. Whelan (2), Schnorr (2).
(1) National Center on Birth Defects and Developmental Disabilities, (2) National Institute for Occupational Safety and Health, (3) Boston University, (4) New York Department of Health, (5) Texas Department of Health, (6) University of Iowa

Paper Number: 15
A Cross-Sectional Study of Umbilical Cord Blood Lead Levels and Selected Soceoeconomic Risk Factors
R.C. Frates (1), A.I. Carson (1), D. Lane (2), G.L. Declos (1)
(1) Southwest Center for Occupational and Environmental Health, The University of Texas School of Public Health, Houston, Texas; (2) Department of Psychology, Rice University, Houston, Texas.

Paper Number: 16
A Social Marketing Approach in Male Occupational Reproductive Hazards Communication
Nancy Muturi, Ph.D. Communication Fellow, CDC/NIOSH and Vern Anderson, Ph.D. Chief, Information Resources Branch, CDC/NIOSH
National Institute for Occupational Safety and Health, Education and Information Division, Information Resources Branch

Breakout Session 2

Paper Number: 17
Addressing Ergonomic Disorders Amongst Librarians
E. Abdel-Moty (1,2), E. Diaz (2), T. Khalil (1,2), R. Rosomoff (2), S. Asfour (1,2)
(1) University of Miami Department of Industrial Engineering, (2) University of Miami Comprehensive Pain and Rehabilitation Center

Paper Number: 18
Effectiveness of Anti-Vibration Gloves
RG Dong (1), T.W. McDowell (1), D.E. Welcome (1), S. Rakheja (2), W.P. Smutz (1), C. Warren (1), C. Warren (1), J.Z. Wu (1), A.W. Schopper (1)
(1) Engineering & Control Technology Branch, National Institute for Occupational Safety and Health
(2) Dept. of Mechanical Engineering, Concordia University

Paper Number: 19
Risks of Musculoskeletal Disorders in California Winegrape Trellis Systems
F. Fathaliah (1), J. Miles (1), J. Meyers, J. Faucett (1), Janowitz (1), E. Garcia (1), A. Kato (2), and D. Reiter (1)
(1) University of California Agricultural Ergonomics Research Center, (2) Zenith National Insurance Corp.

Paper Number: 20
NIOSH Shipyard Ergonomics Project
S.D. Hudock, L.E. Reed
National Institute for Occupational Safety and Health

Paper Number: 21
Shoulder Symptoms in Apprentice Construction Workers
Linda A. Merlino (1), John C. Roscrance (2), Dan Anton (1), Thomas M. Cook (1)
1Department of Occupational and Environmental Health College of Public Health, The Univeristy of Iowa, Iowa City, Iowa (1) Environ mental & Radiological Health Sciences, Colorado State University, 1681 Campus Delivery, Fort Collins, Colorado (2)

Paper Number: 22
Carpal Tunnel Syndrome among Apprentice Construction Workers
J. Rosecrance (1), D. Anton (2), L. Merlino (2), T. Cook (2)
(1) Environmental & Radiological Health Sciences, Colorado State University, 1681 Campus Delivery, Fort Collins, Colorado , (2) Department of Occupational and Environmental Health, College of Public Health, The University of Iowa, Iowa City, Iowa

Paper Number: 23
The Influence Of A Roofing Task On Unilateral Balance
L.R. Wade, W. Weimar, J. Davis, B. Carnahan
Auburn University

Paper Number: 24
Traumatic Injury Potential to Seat-Belted Operator During a Rearward Overturn of A ROPS-Equipped Farm Tractor
Jinhua Guan, Hongwei Hsiao, Richard S. Current, John R. Powers, Douglas E. Ammons, Douglas M. Cantis and James S. Spahr
Division of Safety Research, National Institute for Occupational Safety and Health

Paper Number: 25
Hand Injuries Associated with Hand Tools Used in Mining
Douglas F. Scott
National Institute for Occupational Safety and Health

Paper Number: 26
A NIOSH Machine Risk Reduction Workshop
J. Etherton (1), T. Heidoiing (1), B. Main (2), D. Cloutier (3), and W. Christensen (4)
(1) National Institute for Occupational Safety and Health, (2) Designsafe, Inc., (3) Cloutier Consulting, (4) Christensen Consulting for Safety Excellence

Paper Number: 27
Current Status of Warning-Systems in Forest Harvesting Equipment
N.T. Dorris and J. A. Davis
Auburn University

Paper Number: 28
Ergonomics in Construction: An Intervention with Concrete Laborers
Jennifer A. Hess, DC (1), Steven Hecker, MPH, MSPH (1), Marc Weinstein, PhD (1), Mindy Lunger, PT (2)
(1) University of Oregon, Labor Education and Research Center, (2) University of Oregon Physical Therapy Clinic

Paper Number: 29
Relative Change in Hand Size Over Time: Implications for Glove-Size Schemes and Labeling for End-Users
J.S. Spahr (1), TY Kau (1), J.V. Zwiener (1), R.L. Whisler (1), H.X. Hsiao (1)
(1) National Institute for Occupational Safety and Health

Paper Number: 30
Threshold Shifts in Tactile Perception at the Fingertips Induced by Exposure to Simulated Power Tool Iimpacts and Continuous Vibration
D.R. Peterson (1), A.J. Brammer (1), M.G Cherniack (1)
(1) Biodynamics Laboratory, University of Connecticut Health Center

Paper Number: 31
Disaster Response: Safety and Health Training for Construction Workers
J.L. Gittleman, D. Ellenberger and C. Trahan
Center to Protect Workers' Rights

Paper Number: 32
A Systems Approach to the Socioeconomic Impacts of Workplace Injuries
Thomas W. Camm, PhD, PE and Jami Girard Dwyer, PE
Spokane Research Laboratory, National Institute for Occupational Safety and Health

Paper Number: 33
The National Study to Prevent Blood Exposures in Paramedics: Protecting the Nation's First Responders
Sara Baden, MPH (1), Jack K. Leiss, PhD, MPH (1), Jennifer M. Ratcliffe, PhD, MPH (1), Jean G. Orelien, MStat (1), Jennifer A. Tierney, BA (1), Winifred L. Boal, MPH (2), Nicole D. Hawkins, MPH (1), Janine Jagger, PhD, MPH (3)
(1) Statistics and Public Health Research Division, Analytical Sciences, Inc., 2605 Meridian Parkway, Suite 200, Durham, NC 27713. (2) Surveillance Branch, Division of Surveillance, Hazard Evaluations, and Field Studies, National Institute for Occupational Safety and Health, 4676 Columbia Parkway, R-21, Cincinnati, OH 45226. (3) International Health Care Worker Safety Center, University of Virginia, 1224 W. Main Street, Suite 400, Charlottesville, VA 22903

Paper Number: 34
Sharps Injuries among Hospital Workers in Massachusetts
Laramie AK, Davis LK
Massachusetts Department of Public Health Occupational Health Surveillance

Breakout Session 3

Paper Number: 35
Evaluation of Compliance with the Exposure Control Matrix in Automotive Body Shops
S.A. Sarpy, R. Rando, Hites, L, Z. Fridge, M. Zyphur
Tulane University

Paper Number: 36
OSHA Violence Prevention Guidelines: Effectiveness in the Mental Health Setting
J.A. Lipscomb (1), K. McPhaul (2), New York State Office of Mental Health Multi-Union Health and Safety Committee (2)
(1) University of Maryland, Baltimore, MD (2) NYS OMH Muti-Union Health and Safety Committee, Albany NY

Paper Number: 37
Intervention to Prevent, Reduce, and Manage Resident Violence Towards Nursing Home Staff Nursing Assistants
E.L. Fitzwater, D.M. Gates, S. Telineto
University of Cincinnati, College of Nursing

Paper Number: 38
Violence Against Caregivers:An Intervention Study
D. Gates (1), E. Fitzwater, (1), Succop, P. (1)
University of Cincinnati

Paper Number: 39
Fostering Intervention Effectiveness Research through a NORA - NSC Partnership
J. Thomas (1), R. Sinclair (2), L. Goldenhar (3), M.L. Lin (1)
National Safety Council (1), National Institute for Occupational Safety and Health (2), Institute for Health Policy & Health Services Research (3)

Paper Number: 40
Information Dissemination as an Intervention in Occupational Safety and Health: Evaluating its Effectiveness at NIOSH
Nancy Muturi, PhD, Communication Fellow, CDC/NIOSH and Vern Anderson, PhD, Chief, Information Resources Branch, CDC/NIOSH
National Institute for Occupational Safety and Health, Education and Information Division, Information Resources Branch

Paper Number: 41
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M. J. Burke, S.A. Sarpy, K. Smith-Crowe, S. Chan, G Islam, R. Salvador
Tulane University

Paper Number: 42
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T. Heidotting, C. Stephenson, L. Boldt, H. Linn, F. Varley, P. Keane
National Institute for Occupational Safety and Health

Paper Number: 43
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S.S. Que Hee, R.N. Phalen, H. Zainal
Department of Environmental Health Sciences and UCLA Center for Occupational and Environmental Health, School of Public Health, University of California at Los Angeles

Paper Number: 44
Automated Breathing and Metabolic Simulator (ABMS) CO2 Test for Powered and Non-Powered Air-Purifying Respirators, Airline Respirators, and Gas Masks
N.L. Turner, E. Sinkule, S. Hota
National Personal Protective Technology Laboratory, National Institute for Occupational Safety and Health

Breakout Session 3

Paper Number: 45
The Effects of Job Complexity and Proactive Personality on Occupational Stress and Health
Steve M. Jex (1), Jennifer L. Burnfield (1), Eyal Grauer (1), Gary A. Adams (2), Emily Morgan (2)
(1) Bowling Green State University, (2) University of Wisconsin, Oshkosh

Paper Number: 46
A Pilot Study to Assess Safety Climate, Occupational Injuries, and Safety Practices among Hispanic and non-Hispanic Construction Workers.
S.A. Felknor, K.D. Burau, D. Olipant, R.F. Frankowski
The University of Texas Houston Health Science Center, School of Public Health

Paper Number: 47
Occupational Health Surveillance of Low Income Minority and Immigrant Workers through Community Health Centers
Kerry Souza and Letitia Davis
Massachusetts Department of Public Health

Paper Number: 48
Farm Exposure to Individual Pesticides and Glioma in Men.
A.M. Ruder (1), M.A. Waters (1), M.A. Butler (1), T. Carreon (1), G.M. Calvert (1), K.E. Davis-King (1), P.A. Schulte (1), W.T. Sanderson (1), E.M. Ward (1), L.B. Connally (1), E.F. Heineman (2), J.S. Mandel (3), R.F. Morton (4), D.J. Reding (5), K.D. Rosenman (6), G. Talaska (7)
(1) National Institute for Occupational Safety and Health, Cincinnati, OH 45226 (2) National Cancer Institute, Rockville, MD 20852 (3) University of Minnesota, Minneapolis, MN 55455 (4) Mercy Medical Center, Des Moines, IA 50314 (5) Marshfield Foundation, Marshfield, WI 54449 (6) Michigan State University, East Lansing, MI 48824 (7) University of Cincinnati, Cincinnati 45267

Paper Number: 49
Farm Exposure to Pesticides and Glioma in Women
A.M. Ruder (1), M.A. Waters (1), M.A. Butler (1), T. Carreon (1), G.M. Calvert (1), K.E. Davis-King (1), P.A. Schulte (1), W.T. Sanderson (1), E.M. Ward (1), L.B. Connally (1), E.F. Heineman (2), J.S. Mandel (3), R.F. Morton (4), D.J. Reding (5), K.D. Rosenman (6), G. Talaska (7)
(1) National Institute for Occupational Safety and Health, (2) National Cancer Institute, (3) University of Minnesota, (4) Mercy Medical Center, (5) Marshfield Foundation, (6) Michigan State University, (7) University of Cincinnati

Paper Number: 50
Polymorphisms in GSTM1, GSTT1, GSTP1, and NAT2 and Susceptibility to Primary Intracranial Brain Gliomas
M.A. Butler (1), A.M. Ruder (1), A.K. Daly (2), M.A. Waters (1), T. Carreün (1), and P.A. Schulte (1)
(1)National Institute for Occupational Safety and Health, Cincinnati, OH 45226; (2)University of Newcastle Medical School, Newcastle upon Tyne, UK

Paper Number: 51
Communication Statregies for the Young Worker
R.M. Nester, M. Lutz
Occupational Safety and Health Administration

Paper Number: 52
Working Adolescents and Young Adults: Job Stress, Emotional Labor, and Cardiovascular Risk
S.T. Fitzgerald (1), A.B. deCastro (1), J.A. Haythornthwaite (2)
(1) The Johns Hopkins Bloomberg School of Public Health, (2) The Johns Hopkins School of Medicine

Paper Number: 53
The Impact Of Diabetes On Work Performance
E.G. Phillips (1), C.A. Mancuso (1), S. Morales (1)
(1) Weill Medical College of Cornell University, New York, New York

Breakout Session 4

Paper Number: 54
Occupational And Non-Occupational Exposures To PM2.5 Among Outdoor And Indoor Workers In Two Mexican Cities
Horacio J. Tovalin (1), Salvador Blanco (2), and Maria T. Morandi (1)
(1) University of Texas-Houston, School of Public Health, and (2) Centro Nacional de Capacitacion e Investigacion Ambiental (CENICA)-Mexico City, Mexico.

Paper Number: 55
A Study of Heat Strain Among Mine Rescue Workers
F.D. Harley, P.D. Hintz
National Institute for Occupational Safety and Health

Paper Number: 56
The abstract paper was withdrawn.

Paper Number: 57
Pharmacologic Protection From Single and Repeated Noise Exposure in Rats
Eric D. Lynch, Rende Gu, Carol Pierce, Jonathan Kil
Sound Pharmaceuticals, Inc., 4010 Stone Way North, Seattle WA 98103

Paper Number: 58
Qualitative Methods For Characterizing Worker Exposures in the Metalworking Fluid Environment
R.A. Lunsford, J.R. Pretty, K.K. Brown, R.A. Glaser, J.E. Arnold, S. Beck
National Institute for Occupational Safety and Health

Paper Number: 59
Urinary PAH and Its Metabolites as Molecular Biomarkers of Asphalt Fume Exposure Characterized by Microflow LC Coupled to Hybrid Quadrupole Time-of-Flight Mass Spectrometry
Jin J. Wang, Daniel M. Lewis, Brandon Law, Samuel Stone, Travis Goldsmith, Amy Moseley, Janet Simpson, Ali Afshari, and David Frazer
National Institute for Occupational Safety and Health, Health Effects Laboratory Division

Paper Number: 60
Investigation and Follow-up of a Hypersensitivity Pneumonitis Outbreak Using a New Exposure Assessment Tool
Dennis O'Brien
International Union, UAW

Paper Number: 61
A Simple Method for Evaluating Sample Size in the Houston ATAC (Air Toxics and Asthma in Children) Study.
D. Lai (1), S. Maberti (1), S. Abramson (2), M. Afshar (1), N. Hanania (2), C. Lusk (1), M. Morandi (1), M. Sockrider (2), T. Stock (1), C. Umeh (1) and G.L. Delclos (1)
(1) Southwest Center for Occupational and Environmental Health, The University of Texas School of Public Health and (2) Baylor College of Medicine, Houston, TX 77030
This project has been funded by the Mickey Leland National Urban Air Toxics Research Center.

Paper Number: 62
Measuring Physical Risk Factors of Musculoskeletal Disorders During Computer Work
J.T. Dennerlein (1), P.W. Johnson (2)
(1) Deparment of Environmental Health, Harvard School of Public Health (2) Department of Environmental Health, University of Washington, Seattle WA

Paper Number: 63
The Validity and Reliability of the University of South Florida Environmental Assessment Questionnaire
Robert R. Haight, MD, MSPH., Matthew A. Vuskovich, MD, MSPH., Stuart M. Brooks, MD
Department of Occupational and Environmental Medicine, The University of South Florida College of Medicine and College of Public Health, Tampa, Florida

Paper Number: 64

Breakout Session 4

Hexavalent Chromium and Lung Cancer in the Chromate Industry: A Quantitative Risk Assessment
Robert M. Park, James F. Bena, Leslie T. Stayner, Randall J. Smith, Herman J. Gibb, Peter S.J. Lees
National Insitute for Occupational Safety and Health

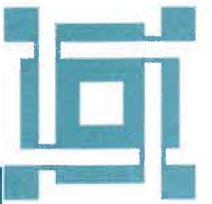
Paper Number: 65
Development and Field Testing of a Local Positioning System Using GPS and Near-Real-Time Monitors for Exposure Assessment in the Outdoor Environment
J.L. Hornsby-Myers (1), L. Lee (1), M. Flemmer (1), R. Gali (2),S. Soderholm (1)
(1) National Institute for Occupational Safety and Health (2) West virginia University

Paper Number: 66
A Philosophy for Developing Job Exposure Matrices to Reduce Exposure Misclassification
P.A. Stewart (1), P.S.J. Lees (2)
(1) Division of Cancer Epidemiology and Genetics, National Cancer Institute, (2) Bloomberg School of Public Hygiene, Johns Hopkins University

Paper Number: 67
The Cortisol Response to Awakening: A Potential Biomarker for Occupational Stress
D. Landen, C. Burchfiel, L. McWilliams, D.B. Miller
National Institute for Occupational Safety and Health

Paper Number: 68
Development of a Chlorinated Solvent Exposure Data Base for Use in Case-control Studies
M.A. Waters (1), P.A. Stewart, A. Ruder (1)
(1) National Institute for Occupational Safety and Health, (2) National Cancer Institute.

Paper Number: 69
California Occupational Pesticide Illness Tracking Using Laboratory Reporting: Preliminary Findings
Christine Geiser, PhD (1), Rupali Das, MD, MPH (2) and Laura Ellerbe, MS (1)
(1) Public Health Institute, Occupational Health Branch, California Department of Health Services, 1515 Clay Street, Suite 1901, Oakland, CA 94612, (2) Occupational Health Branch, California Department of Health Services, 1515 Clay Street, Suite 1901, Oakland, CA 94612



Breakout Session 5

Paper Number: 70
Evaluation of Jolting and Jarring and Its Effects among Operators of Mobile Equipment
N.K. Kittusamy (1), F. Biggs (1), A.G. Mayton (2),C.C. Jobes (2), and T.R. Waters (3)
(1) National Institute for Occupational Safety and Health—Spokane Research Laboratory, (2) National Institute for Occupational Safety and Health—Pittsburgh Research Laboratory, (3) National Institute for Occupational Safety and Health—Division of Applied Research and Technology

Paper Number: 71
Assessing PPE Protection - Development of a Safety Eyewear Coverage Coefficient
J.R. Harris, R. Whisler
National Institute for Occupational Safety and Health

Paper Number: 72
Occupational Injuries and Illnesses Among Emergency Medical Services Providers.
B.J. Maguire (1), KL Hunting (2), T.L. Guidotti (2), G.S. Smith (3)
(1) Department of Emergency Health Services, University of Maryland, Baltimore County, MD; (2) The Department of Environmental and Occupational Health, The George Washington University, Washington, DC; and, (3) The Center for Safety Research, Liberty Mutual Research Center for Safety and Health, Hopkinton, MA.

Paper Number: 73
Prevention of Injuries-Nursing Homes and Hospitals
A. Garg (1), K. Hegmann (2)
(1) University of Wisconsin-Milwaukee, (2) University of Utah

Paper Number: 74
Priority Outcomes for Research in Work-Related Musculoskeletal Disorders: Qualitative and Quantitative Analysis
Glenn Pransky (1,2), Katy Benjamin (2), Carolyn Hill-Fotouhi (2), Jay Himmelstein (2), Jeff Katz (3)
(1) Liberty Mutual Center for Disability Research, (2) University of Massachusetts Medical School, (3) Harvard University

Breakout Session 6

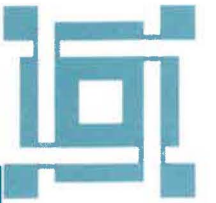
Paper Number: 75
Relative Contributions of Particulate and Vapor-Phase Semi-Volatile Organic Fractions to Inflammatory and Cytotoxic Effects of Fresh Engine Emissions
Joe Mauderly(1), Jean Clare Seagrave(1), Jacob McDonald(1), and Ingvar Eide(2)
(1) Lovelace Respiratory Research Institute, Albuquerque, NM,(2) Statoil Research Center, Trondheim, Norway

Paper Number: 76
Assessment of Mixed Exposures in a Population-Based Study on Occupational Asthma
M. Kogevinas (1), J.P. Zock (1), H. Kromhout (1, 2) J.M. Antó (1), J. Sunyer (1), and D. Jarvis (3) for the Occupational Asthma working group of the ECRHS.
(1) Municipal Institute of Medical Research (IMIM), Barcelona, Spain, (2) University of Utrecht, Utrecht, The Netherlands, (3) Guy's and St Thomas's Medical and Dental School, London, U.K.

Paper Number: 77
Pollution Prevention and Worker Toxic Exposures: A Method
D.D. Sivin
International Union, UAW

Paper Number: 78
Urinary 1-Hydroxypyrene and Polycyclic Aromatic Hydrocarbon Exposure Among Asphalt Paving Workers
McClean MD (1), Rinehart RD (2), Ngo L (1), Eisen EA (1), Kelsey KT (1), Wiencke JK (3), Herrick RF (1)
(1) Harvard School of Public Health, (2) Occupational Safety and Health Administration, (3) University of California - San Francisco

Paper Number: 79
Investigating Principles of Workroom Exposure
C.E. Feigley (1), J. Khan (2), E. Lee (1), M. Ahmed (2), S. Tamanna (2), R.O. Semeniuc (1), J.J. Jenkins (1)
(1) Department of Environmental Health Sciences, Arnold School of Public Health, Rm. 311, University of South Carolina, Columbia, SC 29208, (2) Department of Mechanical Engineering, University of South Carolina



Breakout Session 7

Paper Number: 80
NIOSH Control Technology Research for Mining Hazards
J.A. Breslin
National Institute for Occupational Safety and Health

Paper Number: 81
The Work Zone Analysis System: A Tool For Quantifying Worker Interaction With Mobile Equipment in Dangerous Work Zones
W.H. Schiffbauer, G.L. Mowrey
NIOSH PRL

Paper Number: 82
Integrating Occupational Safety and Health - Pollution Prevention in Hospitals: An Intervention Study
Margaret Quinn, ScD, Anila Bello, MS, Thomas Fuller, MS, Catherine Galligan, MS
Department of Work Environment, University of Massachusetts Lowell

Paper Number: 83
Protecting Emergency Responders - Lessons Learned from Terrorist Attacks
Brian Jackson, D.J. Peterson, James Bartis, Tom LaTourrette, Irene Brahmakulam, Ari Houser, Jerry Sollinger
The RAND Corporation

Paper Number: 84
Lessons Learned in Adapting OSHA Training Institute Course Content to the Web
M.H. Hodges (1), S. Tillett (2)
(1) Georgia Institute of Technology, (2) George Meany Center for Labor Studies-National Labor College.

Breakout Session 8

Paper Number: 85
NAT2 Slow Acetylation and Bladder Cancer in Workers Exposed to Benzidine
T. Carreón (1,2), A.M. Ruder (1), P.A. Schulte (1), R. B. Hayes (3), N. Rothman (3), G.K. LeMasters (2), M.A. Waters (1), D.J. Grant (4), R. Boissy (4), D.A. Bell (4), F.F. Kadlubar (5), G.P. Hemstreet (6), S. Yin (7)
(1) National Institute for Occupational Safety and Health, (2) University of Cincinnati, (3) National Cancer Institute, (4) National Institute of Environmental Health Sciences, (5) National Center for Toxicological Research, (6) University of Oklahoma, (7) Chinese Academy of Preventive Medicine

Paper Number: 86
Male Reproductive Effects From Occupational Exposure to Boron
F. Wei (1), W.A. Robbins (2), G Wu (1), B.L. Chang (2), J. Hu (3), L. Xun (2), N. Kennedy (2) and Boron Epidemiology Research Group (1,2)
(1)China National Environmental Monitoring Center, (2)University of California, Los Angeles, (3)Chinese Institute of Health Education

Paper Number: 87
Applying New Biotechnologies to the Study of Occupational Cancer: A NORA Cancer Research Methods Workshop
M. Toraason (1), A. Blair (2), N. Rothman (2), A. Ruder (1), R.E. Savage (1), P. Schulte (1), M.T. Smith (3), E.M. Ward (4), A. Weston(1).
(1)National Institute for Occupational Safety and Health, (2)National Cancer Institute, (3)University of California, Berkeley, (4)American Cancer Society.

Paper Number: 88
Development of Pharmacokinetic and Non-invasive Biomonitoring Approaches to determine Dosimetry and Assess Risk in Potentially Sensitive Sub-populations Following Exposure to Individual Chemicals and Mixtures
Charles Timchalk, Yuehe Lin, Ahmed Kousba and Torka Poet
Battelle, Pacific Northwest Division

Paper Number: 89
Circadian Rhythm Disruption: A Chronic Occupational Hazard Among Flight Attendants'
B. Grajewski (1), E.A. Whelan (1), M.M. Nguyen (1), L.C. Kwan (1), R.J. Cole(2), M.J. Hein (1)
(1)National Institute for Occupational Safety and Health, Cincinnati, OH 45226, (2) Synchrony Applied Health Sciences, Del Mar, CA 92014

Breakout Session 9

Paper Number: 90
Respiratory Health Effects at an Automobile Assembly Plant
S.K. Hammond (1), E. Gold (2), R. Baker (1), J. Balmes (1,3), P. Quinlan (3), W. Smith (2), R. Pandya (1,3)
(1) Univewrsity of California, Berkeley, (2) University of California, Davis, (3) University of California, San Francixco

Paper Number: 91
Reliability And Validity Of An Asthma Questionnaire For Healthcare Workers
G.L. Delclos(1), A. Arif (2), L.A. Aday (1), K. Bartholomew (1), A. Carson (1), D. Lai (1), C. Lusk (1), T. Stock (1), E. Symanski (1), L.W. Whitehead (1)
(1) The University of Texas School of Public Health, Houston, Texas, and (2) Department of Health Services Research, Texas Tech University Health Sciences Center, Lubbock, Texas. Supported by grant number 1R01OH003945 01A1 from CDC/ NIOSH.

Paper Number: 92
Creating Effective Partnerships in Occupational Safety and Health
S.J. Johnson (1), J. Armstrong (2)
(1) United Auto Workers, International Union, (2) New United Motor Manufacturing, Incorporated

Paper Number: 93
Investigation Of Health Effects Due To Handling Of Irradiated Mail
Stephen Mallinger (1), Glenn Lamson (2), Patrick Hearty (2)
(1) Office of Compliance, Office of the General Counsel, Occupational Safety and Health Admin., (2) Salt Lake Technical Center, Occupational Safety and Health Admin.

Paper Number: 94
Evaluation of the Dermal Absorption of Common Solvents
Karla D. Thrall, Karl K. Weitz, and Angela D. Woodstock
Battelle, Pacific Northwest Division, Richland WA, USA

Paper Number: 95
Dermal Exposure Research Program
S.C. Soderholm, H.W. Ahlers, M.F. Boeniger, B.D. Lushniak
National Institute for Occupational Safety and Health

Breakout Session 10

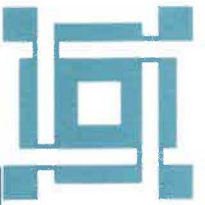
Paper Number: 96
Injury Surveillance in Migrant Farmworker Families
S.P. Cooper (1), K. Burau (2), E.M. Shipp (1,2), R. Frankowski (2), N. MacNaughton (2), C. Hanis (2), A.M. Sweeney (1), L. Freimanis (2), D. Oliphant (1,2), N. Weller (3)
(1) Texas A&M School of Rural Public Health, (2) The University of Texas School of Public Health, (3) Harvill E. Weller & Associates

Paper Number: 97
Occurrence of Scabies across the Country in VA Healthcare Facilities: An Initial Look
G.A. Roselle (1,2,3), L.H. Danko (1,2), S.M. Kralovic (1,2,3,4)
(1)VA Central Office Infectious Diseases Program Office, (2)Cincinnati VA Medical Center, (3)Division of Infectious Diseases, University of Cincinnati School of Medicine, (4)Division of Epidemiology and Biostatistics, University of Cincinnati School of Medicine

Paper Number: 98
Predictors Of Successful Work Role Functioning Following Carpal Tunnel Release Surgery
B.C. Amick (1), J.N. Katz (2), J.M. Ossmann (1)
(1)University of Texas Health Sciences Center-Houston, School of Public Health, (2) Brigham and Women's Hospital; Harvard Medical School

Paper Number: 99
Health Care Savings from a Partnership Approach to Occupational Medicine
S.L. Long (1), W.B. Bunn (2)
(1) Stephen Long, M.D., M.P.H., Medical Director, IC Corporation, 751 South Harkrider, Conway, AR 72032
(2) William B. Bunn, III, M.D., J.D., M.P.H., Vice-president Health, Safety, and Productivity, International Truck and Engine Corporation, 4201 Winfield Road, P.O. Box 1488, Warrenville, IL 60555

Paper Number: 100
Characteristics and Relative Risk of Occupational Fatalities of Hispanic Construction Workers
J.W. Platner and X. Dong
The Center to Protect Workers' Rights



Breakout Session 11

Paper Number: 101
The Impact of Demanding Work Schedules in a Nationally Representative Cohort of Working Adults
Allard E. Dembe (1), J. Bianca Erickson (2), Rachel Gross (2), Steven M. Banks (1), Robert Reville (3)
(1) University of Massachusetts Medical School, (2) Applied Epidemiology, Inc., and (3) RAND Institute for Civil Justice

Paper Number: 102
Diagnosing and Treating Abusive Behavior in the Medical Workplace - Creating Healthy, Abuse-free Environments.
D.J. Anderson (1), C. Cassirer, ScD, MPH (2)
(1)Park Nicollet Excelsior Center for Healthy Organizations, (2)Carlson School of Management, University of Minnesota

Paper Number: 103
A Comparison Of Time Loss Injury Rates Between Employer And Employee Choice States
R.W. Watson
Arbor Occupational Medicine

Paper Number: 104
Characteristics of Work Scheduling and Work-Related Injuries in Construction
Sue Dong
The Center to Protect Workers' Rights

Paper Number: 105
Evaluation of Hearing Conservation Program Effectiveness - A Case study of How Safety and Health Policy and Standards are Translated into Workplace Practice
M.M. Prince (1), M.L. Colligan (1), C.M. Stephenson (1), B.J. Bischoff (2)
(1) National Institute for Occupational Safety and Health, (2) Crowe, Chizek and Company LLP

Breakout Session 12

Paper Number: 106
Fall-Safe Partnership: Results of Organizational Intervention Research to Prevent Construction Falls
P.B. Becker, ScD. (1), M.D. Fullen (1), M. Akladios, PhD (1)
(1) West Virginia University Safety and Health Extension, (2) The Center to Protect Workers Rights, (3) National Institute for Occupational Safety and Health, (4) The Construction Safety Council, and (5) St.Paul Insurance Company

Paper Number: 107
Reporting Systems For Fatal Occupational Injuries: A Comparison Of The United States Of America And The European Union
F.G. Benavides (1), G.L. Delclos (2), S.P. Cooper (3), J. Benach (1)
(1) Occupational Health Research Unit, Department of Health and Experimental Sciences, Pompeu Fabra University, Barcelona, Spain, (2)Southwest Center for Occupational and Environmental Health, The University of Texas School of Public Health, Houston, Texas, U.S.A., and (3) Department of Epidemiology, Texas A&M University School of Rural Public Health, College Station, Texas, U.S.A.

Paper Number: 108
Active Injury Surveillance in Residential Construction
Hester J. Lipscomb (1), John M. Dement (1), James Nolan (2), Dennis Patterson (2), Wilfred Cameron (3)
(1) Division of Occupational and Environmental Medicine, Duke University Medical Center, (2) Carpnters District Council of Greater St. Louis, and (3) Center to Protect Workers Rights

Paper Number: 109
A Randomised Controlled Trial of Participative Ergonomics for Manual tasks (PerforM)
R. Burgess-Limerick (1), R. Egeskov (2), C. Pollock (3), Straker(3)
(1) The University of Queensland, (2) Department of Industrial Relations Queensland, (3) Curtin University of Technology

Paper Number: 110
Coupling Safety And Profit In Dairy Farming: An Intervention In A High Hazard Industry
L.J. Chapman, A.T. Taveira, B. Karsh, K.G. Josefsson, C.M. Brunette
University of Wisconsin Biological Systems Engineering Department

Abstracts

Session: 1

Paper Number: 1

The abstract paper was withdrawn.

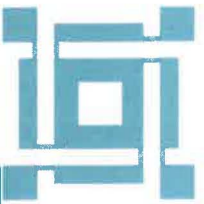
Session: 1 Paper Number: 2

Immune Responsiveness to Squaric Acid Dibutylester in Human Subjects

E.D. Baron (1), A. R. Swick A. R. (1), C.A. Ryan (2), G.F. Gerberick (2), S.S. Tinkle (3), S.T. Nedorost (1), K.D. Cooper (1), S.R. Stevens (1)

(1) University Hospitals of Cleveland/Case Western Reserve University, (2) Proctor and Gamble Co, (3) National Institute for Occupational Safety and Health

Understanding dose-response characteristics is essential in the prevention of allergic contact dermatitis. Squaric acid dibutyl ester (SADBE) is a known contact sensitizer, but dose-response data have not been reported. This study is aimed at determining the relationship between sensitization dose and contact hypersensitivity (CHS) response to SADBE in human volunteers and investigating the correlation of clinical response with T-cell proliferation in vitro. Thirty-six healthy volunteers were sensitized to either .025,.05,.1 or .5% SADBE on the buttock, followed two weeks later by elicitation on the arm using 5 graded doses from 0 to 1%. An additional control group of 10 subjects underwent elicitation without prior sensitization. 180 cc of blood was obtained immediately prior to sensitization and elicitation. In some subjects, blood was also obtained 4-10 months after elicitation. Results show that there is a direct relationship between sensitization dose and immune response. The SADBE dose capable of sensitizing 50% of the population was .05%. Although the T-cell proliferation assay was not sensitive enough to detect changes two weeks after sensitization, but prior to elicitation, post-elicitation analyses revealed that sufficient numbers of circulating reactive T cells are present to allow detection by in vitro methods. These results suggest that either time (4-10 months) or re-exposure is necessary for this expansion of reactive T-cell numbers.



Abstracts

Session: 1 Paper Number: 3

Pesticide Patch Test Series in Panama for the Assessment of Allergic Contact Dermatitis Among Banana Plantation Workers

Homero Penagos (1,2), Clemens Rueper (3), Timo Partanen (3), Catharina Wesseling (3)

(1) Department of Occupational Dermatology, Social Security Bureau of Panama, David, Panama. (2) Environmental Sciences Institute, University of Chiriqui, Panama. (3) Central American Institute for Studies on Toxic Substances, Heredia, Costa Rica

Background: It was usually agreed that, in order to make correct diagnosis leading to proper preventive action, agricultural workers with contact dermatitis should be pesticide patch-tested. Overall, patch testing for pesticides is uncommon.

Objective: The aim of this study is to explore the frequency of occurrence of ACD among a working population highly exposed to pesticides, by means of a pesticide patch test tray specific for this population of workers.

Methods: An inventory was made of the most frequently and recently used pesticides on the banana plantations studied in Panama.. The participants were first administered a structured interview at the worksites. A complete skin examination followed the interview. Finally, we use Standard Patch Test Series and Pesticide Patch Test Series (prepared at Universidad de Heredia, Costa Rica) in 37 banana workers and 23 controls.

Results: Among the 37 subjects with pesticide-related dermatosis diagnosed in the skin examination, the patch tests identified 15 cases (41%) with allergic contact dermatitis caused by dermal exposure to various pesticides (20 positive reactions). Three out of the 23 subjects with no findings in the skin examination had allergic reactions to pesticides (4 positive reactions). Carbaryl (5 cases) represented the most frequent pesticidal agent that triggered allergic skin reactions. Ethoprophos and tridemorph were identified as new sensiters.

Conclusion: Pesticide patch test trays can be developed successfully in Central America and should be used as an aid in assessing health problems in worker groups highly exposed to pesticides. The study identified a prevalence of 16% of sensitized workers.

Session: 1 Paper Number: 4

Structure Activity Relationship for Skin Sensitization Using the Local Lymph Node Assay Data

Adam Fedorowicz (1), Harshinder Singh (1,2), Eugene Demchuk (1,3)

(1) National Institute for Occupational Safety and Health, Morgantown, WV, (2) Department of Statistics, West Virginia University, Morgantown, WV, (3) School of Pharmacy, West Virginia University, Morgantown, WV

Allergic Contact Dermatitis (ACD) is a common cause of work-related skin illnesses and often develops as a result of repetitive skin exposures to a sensitizing chemical agent. A variety of experimental tests have been suggested to assess the skin sensitization potential. We applied a method of Quantitative Structure-Activity Relationship (QSAR) to relate the skin sensitization potential to measured and calculated physical-chemical properties of chemical compounds. Using statistical methods, each of these properties, called molecular descriptors, was tested for its propensity to predict the sensitization potential. A few of the most informative descriptors were subsequently selected to build a model of skin sensitization. In this work the murine Local Lymph Node Assay (LLNA) data were used. Generally, LLNA provides a standardized continuous scale suitable for quantitative assessment of skin sensitization. However, at present many LLNA results are still reported on a dichotomous scale, which is congruous to the scale of guinea pig tests. Therefore, in this study only a dichotomous version of the LLNA data was used. Our results suggest that a comprehensive QSAR model of ACD can be constructed, although the relevance of identified descriptors to the continuous ACD QSAR has yet to be investigated.

Session: 1 Paper Number: 5

Development of Colorimetric Indicators: A New Technique to Determine Glutaraldehyde and Alkaline Glutaraldehyde Contamination

E. Vo

National Institute for Occupational Safety and Health, National Personal Protective Technology Laboratory, Technology Branch

The aim of the study was to investigate a new indicator sensor pad for detection of glutaraldehyde permeation of chemical protective gloves. The pad carries a reagent which responds to glutaraldehyde contaminant by producing a color change. Some commonly used glutaraldehyde and alkaline glutaraldehyde solutions, Metricide, Cetylcide-G, and 50% glutaraldehyde solution, were analyzed by solvent desorption and gas chromatography. All glutaraldehyde solutions exhibited >98% adsorption on the pads over the spiking range 0.05-5.0 mL. Recovery for each glutaraldehyde solution was calculated, ranging from 58-92% (RSD <=4.0%) for all glutaraldehyde solutions. Breakthrough times for two protective glove materials (PVC and polymerized alkene) were determined using the Thermo-Hand Method, and found to range from 76 to 150 min for Metricide, from 170 to 230 min for Cetylcide-G, and from 232 to 300 min for 50% glutaraldehyde. The quantitative mass of the glutaraldehyde solutions on the pads at the time of breakthrough detection ranged from 35-37, 37-39, and 38-40 mg/cm2 for Metricide, Cetylcide-G, and 50% glutaraldehyde, respectively. The new aldehyde indicator pad should find utility in detecting, collecting, and quantitative analyzing glutaraldehyde and alkaline glutaraldehyde permeation samples in the workplace.

Session: 1 Paper Number: 6

Experimental Contact Dermatitis Research Group: A Successful NORA-AID Activity

G.F. Gerberic (1), B.D. Lushniak (2)

(1) Procter and Gamble Company, (2) National Institute for Occupational Safety and Health

The inaugural Experimental Contact Dermatitis Research Group (ECDRG) meeting was held in Cincinnati, OH in 1999. The goal of the research group is to foster scientific exchange among scientists (from academia, government and industry), regulators and clinicians working in the field of contact dermatitis. This goal is consistent with NORA's Allergic and Irritant Dermatitis (AID) Team's mission that is to develop a broad-based, active and lasting group to catalyze research in AID. Thus, NORA's AID Team has and continues to support actively the ECDRG. Specifically, NIOSH has sponsored each of the three meetings held thus far. Dr. Paul Bergstresser and the University of Texas Southwestern Medical Center Skin Disease Research Center in Dallas, TX hosted the second meeting in 2000. In 2002, Dr. Kevin Cooper and Case Western Reserve University/ University Hospitals of Cleveland Skin Disease Research Center hosted the third meeting. Each of the three meetings have been extremely successful in achieving the goal of the ECDRG; bringing together individuals from diverse backgrounds to discuss the challenges facing experimentalist in the field of contact dermatitis. The future is bright with plans underway for the next ECDRG meeting for 2004 to be held in Washington, DC. NORA's AID Team will be taking the lead in organizing this meeting.

Session: 1 Paper Number: 7

Chronic Occupational Beryllium Disease With Cutaneous And Pulmonary Findings

James S. Taylor, MD and Joshua Berlin, MD

Chronic beryllium disease (CBD) is an important occupational health problem, which is a cell-mediated granulomatous hypersensitivity to beryllium. CBD is usually diagnosed by: (1) history of beryllium exposure (2) positive blood and/or bronchoalveolar lavage (BAL) beryllium (Be) lymphocyte proliferation test (LPT) as evidence of hypersensitivity to beryllium; a positive patch test to Be is not a current criterion, and (3) granulomas on lung biopsy.

Our purpose is to describe a case of CBD involving the skin, a now infrequently reported event, and to discuss the potential role of skin exposure in CBD.

A 29-yr old beryllium furnace operator for 3 years had a 4-month history of violaceous, lichenoid papules on his arms and legs; pulmonary symptoms were absent. For three years he worked at a factory operating a furnace that melted beryllium, copper, cobalt, zirconium and nickel. Skin biopsy showed epitheliod cell granulomas with focal caseation necrosis. PAS, GMS, Twort and AFB stains were negative. Because of his chronic exposure to Be, the factory routinely monitored pulmonary function tests. Although he had a significant decline in his diffusion lung capacity, a CT scan of the chest was normal. Bronchoscopy with BAL and transbronchial biopsies initially showed no evidence of granulomas or other signs of disease. Initial Blood and BAL Be LPT's were also negative but later became positive. Subsequent lung biopsy showed non-caseating granulomas and prednisone, 40 mg qod, prescribed for the lung disease, significantly cleared the skin lesions after one month.

There are five classes of beryllium skin disease: irritant and allergic contact dermatitis, chemical ulcers, ulcerating granulomas, and allergic dermal granulomas. Non-occupational allergic contact gingival reactions to beryllium occasionally occur from dental implants, and are diagnosed by clinical findings and positive patch tests to beryllium. Although the beryllium industry has made major improvements in respiratory protection and engineering controls, the rate of CBD has not declined. Evaluation of additional beryllium workers is needed to determine if cutaneous lesions and sensitization to beryllium causes or predicts pulmonary sensitization or CBD. The role of patch testing in occupational CBD needs clarification.

Session: 1 Paper Number: 8

Work-Related Lung Disease Surveillance Report 2002: Asthma and COPD Highlights

M. Attfield, K.M. Bang, R.M, Castellan, M. Filios, C.J. Rotunda, J. M. Wood

National Institute for Occupational Safety and Health

Introduction and Objectives: As part of its mission, the Division of Respiratory Disease Studies, NIOSH, disseminates information on the severity and extent of occupational lung diseases and related workplace exposures. Towards this end, the sixth of a series of Work-Related Lung Disease (WoRLD) Surveillance Reports has recently been completed. This report provides current and detailed information on various work-related respiratory diseases and associated exposures in the United States. It describes where these diseases are occurring (by industry and geographic location), who is affected (by race, gender, age, and occupation), how frequently they occur, and temporal trends. The current WoRLD Report includes sections on asthma and chronic obstructive pulmonary disease (COPD), diseases which together comprise a major NORA priority research area. Our presentation highlights key asthma and COPD findings from the 2002 WORLD Report.

Methods: We abstracted key findings from the 2002 WoRLD Report, including findings based on: (1) asthma cases ascertained by public health surveillance programs in four states (California, Massachusetts, Michigan, New Jersey) during the period 1993-1999; (2) 2000 National Health Interview Survey (NHIS) data on asthma and COPD; (3) National Center for Health Statistics multiple-cause-of-death data, restricted to U.S. residents aged 15 years and older, for asthma (1990-1999) and for COPD (1999).

Findings: Over 2,500 cases of work-related asthma were identified for the period 1993-1999 in the four states. About 80% represented asthma caused by occupational exposure, while 20% represented preexisting asthma aggravated by occupational exposure. Cases were most frequently attributed to the following agents: miscellaneous chemicals, cleaning materials, miscellaneous dusts, indoor air pollutants, pyrolysis products, and isocyanates. The three primary industries with the greatest number of asthma cases were: transportation equipment manufacturing (19%), health services (16%), and educational services (9%). Based on the NHIS data, "elementary and secondary schools and colleges" was the one current industry sector having a clearly elevated asthma prevalence among nonsmokers. Among the 11 usual industries with significantly elevated proportionate mortality for asthma, five were associated with healthcare, two with education, and two with agricultural industries. Similarly, among the 22 occupations with significantly elevated asthma mortality, healthcare-related jobs accounted for nine, and education jobs for four.

No clear patterns of COPD morbidity emerged from the NHIS data. However, national cause-of-death data revealed clear excesses of COPD mortality among miners, construction workers, transportation workers, and food service workers, among others. The mortality findings confirm, in part, results reported elsewhere, although the contribution of smoking to the excesses has not been evaluated here.

Overall, the findings provide information useful for identifying where work-related asthma and COPD may be occurring and for guiding targeted prevention programs.

Session: 1 Paper Number: 9

A Simple Method for Evaluating Sample Size in the Houston ATAC (Air Toxics and Asthma in Children) Study

D. Lai (1), S. Maberti (1), S. Abramson (2), L. Freimans (1), N. Hanania (2), C. Lusk (1), M. Morandi (1), M. Sockrider (2), T. Stock (1), C. Umeh (1), and G.L. Delclos (1)

(1) Southwest Center for Occupational and Environmental Health, The University of Texas School of Public Healthand (2) Baylor College of Medicine, Houston, Texas.

This project has been funded by the Mickey Leland National Urban Air Toxics Research Center.

Background: The effect of air toxics (non-criteria airborne pollutants) on asthma is unknown. Given that these compounds are ubiquitous both indoors and outdoors, and that many are established respiratory irritants and/or sensitizers, it is possible that variations in daily exposure can influence the variability of asthma. The Houston ATAC Study is a prospective pilot panel study investigating the association between exposure to aldehydes and asthma health outcomes (peak expiratory flow, FEV1, symptoms and expired nitric oxide) among persistent asthmatic middle school children, using a repeated measures design over a 12-month period. The study population centers on persistent asthmatic children on the assumption that they may manifest greater variability in asthma outcomes following exposure to airborne stimuli. Sample size calculation is a key element in any study design. Although several approaches exist, few take into consideration the autocorrelation of repeated measurements of one individual. We studied the effect of sample size and number of repeated measurements on statistical hypothesis testing.

Methods: Preliminary results from 10 subjects with 10 consecutive daily measurements were used for the analysis. The proposed method was based on the asymptotic distribution of the estimated coefficient in general linear models with autocorrelation error structure for the different outcomes of interest. The AR(1) covariance structure was introduced in order to take into account the correlation of the repeated measurements on the subjects.

Results: Model coefficients did not differ significantly from 0, probably due to the small sample size used in the calculations. However, the level of autocorrelation of each individual's measurements was very high, justifying the use of the autocorrelation structure. From the estimations, for a power of 0.80 and a=0.05, the required sample size would be 31 subjects sampled 40 times. The estimates of the ratios of the variance versus the coefficient (and therefore n) could improve by increasing the number of subjects and/or measurements. Given these estimates, we calculated the power obtained with different sample sizes. It was concluded that sampling 30 children would give reasonable power to detect the effect of aldehydes on FEV1 and PEF under the study assumptions.

Conclusions: The relationship between number of subjects, repeated measurements, and statistical power under linear mixed models is not trivial. Methods commonly used to compute sample size generally assume that all subjects have an identical value in the covariate at each time, which is not the case for the studied measurements. The proposed methodology allows correcting for the autocorrelation of the measurements as well as different covariance between and within subjects. Implementation of this methodology should allow for the design of more efficient studies and more powerful hypothesis testing.

Session: 1 Paper Number: 10

Preventing Occupational Respiratory Disease: A Lesson From Coal Mining

M.D. Attfield, E.L. Petsonk, G.R. Wagner

Division of Respiratory Disease Studies, NIOSH

The fact that coal miners can develop lung disease from their work exposures has been known for nearly 200 years. However, focused action to reduce dust levels, and thus lower disease risk, in western countries has occurred only over the last 35 years. Recent surveillance data from the U.S. indicate that the dust standard has been instrumental in bringing about a substantial reduction in the burden of coal workers' pneumoconiosis (CWP).

Historically, CWP was regarded as the major disease of concern among coal miners. For this reason, the logical basis of preventive measures in the U.S. is founded on eliminating this disease. But careful epidemiological investigation in a number of countries has now conclusively demonstrated that chronic obstructive pulmonary disease (COPD) as well as CWP can arise from coal mine dust exposure. Current surveillance data show that coal mining has the highest proportionate mortality ratio (PMR) for COPD among all industries, and that mining machine operators have the fourth highest PMR for COPD among occupations.

Because of the historical focus on CWP, current mandated medical monitoring in the U.S. for coal miners still relies exclusively on the chest x-ray. Although recommendations have been made, nothing has been done since 1969 to implement medical monitoring for diseases other than CWP. The mandated program provides no specific preventive interventions for miners who develop COPD but have normal chest x-ray readings. This contrasts with the right of miners with CWP on chest x-ray to work in a low dust job without a reduction in wages and have their dust exposures monitored frequently. The current approach, therefore, can identify and act on only part of the disease burden.

NIOSH is developing, improving, and evaluating approaches for medical monitoring of workers exposed to respiratory hazards. For example, NIOSH is conducting a large study in partnership with industry and labor groups to develop optimum medical monitoring practices for asthma among isocyanate-exposed workers. With both asthma and COPD there are common issues with quality control for spirometric testing and with the potential for high false positive and false negative rates arising from variability in the data. Among other things, reliable methods to assess temporal decline in longitudinal data need to be developed, along with sensitive but specific ways to identify promptly the start of excess decline in occupationally exposed individuals. Empirical evidence that medical monitoring and individualized intervention can effectively prevent disabling COPD would also be extremely valuable.

The challenge of workplace exposure, COPD, and disease prevention is not limited to coal miners. Given recent estimates that between 1.5 to 3.5 million persons in the U.S. have COPD attributable to occupation, there is an imperative need for research into causation and approaches to prevention of this disease.

Session: 1 Paper Number: 11

The Functional Capability Chart: A New Tool for the Monitoring of Lung Function in Asthma Care

F. Hayati (1), P.B. Boggs (2), D. Wheeler (3)

(1) Doctoral Candidate, Auburn University, Industrial Systems & Engineering, The Asthma 2000 Group
(2) Senior Fellow, The Asthma 2000 Group, The Asthma-Allergy Clinic, Shreveport, Louisiana
(3) Statistical Process Control, Inc. Knoxville, Tennessee

Broad Importance of the Research Problem: The monitoring of lung function, PEFR and FEV1, although recommended in national and international guidelines as integral to the care process of patients with moderate-to-severe asthma, remains underutilized by both the physicians and patients. The reasons for such underutilization are (1) current methods are incapable of predicting either an exacerbation or the risk of an exacerbation, (2) there are no rules governing what constitutes a significant change in the lung function leaving such interpretation to the individual physician or patient, (3) current monitoring guidelines provide very little insight into the care process, and (4) the traditional lung function charting methodology has become the paradigm.

Purpose or Objective of the Study: The purpose of this study was to introduce, apply, and validate the Functional Capability Chart in the monitoring of lung function in patients with asthma. Functional capability is the range within which future lung function values expected to fall if the current care system remains unchanged or unperturbed. The predictive characteristic of functional capability chart provides powerful insight to effect the care plan.

Summary of Methods:
In each of the clinical cases daily peak expiratory flow rates are measured and recorded by the patients. The serial values are then charted as a functional capability chart. The analysis and interpretation of the chart is used as the basis of communicating with the patients and developing a care process. The Shewhart Control Chart theories and Statistical Process Control (SPC) charting concepts are used in the development of Functional Capability Chart.

Summary of the Findings:
The Functional Capability Chart:

- Provides a clear, patient-specific, statistically derived signals that a change in the lung function has occurred.
- Identifies the type of variation (special cause or common cause) in the care system therefore focusing the clinical decision making.
- Identifies the patients at-risk for severe asthma.
- Provides a range of functional capability.
- Identifies factors that cause an improved change or deterioration in the lung function.
- A powerful communication tool between the patient and the physician.

How the findings advance the particular research field?

The research has provided a powerful tool in the monitoring of asthma that is not currently used. Such monitoring can become an integral component of workplace monitoring. Further, this research can be expanded to other lung function measurements such as expired nitric oxide.

How the findings can be used to improve workplace safety and health and related outcomes?

- Monitoring of asthmatic workers via functional capability charts away from work can give insight into their care process.
- Monitoring of asthmatic workers via functional capability charts in the work environment can detect any significant shifts in their care process.
- Functional capability charts can detect workers at risk for severe asthma.
- Functional capability charts can better anticipate care needs of the workers, provide those needs and better control their care process
- As the result of better care, workers can remain on the job and therefore improve productivity, reduce absenteeism and cost

Session: 1 Paper Number: 12

Often-Unrecognized Spirometer Problems That Elevate Test Results

Mary C. Townsend, Dr.P.H. (1,2), John L. Hankinson, Ph.D.(3)

(1) M.C. Townsend Associates, Pittsburgh, PA, (2) University of Pittsburgh Graduate School of Public Health (Adjunct), Pittsburgh, PA
(3) Hankinson Consulting Inc., Valdosta, GA

Importance: Both Asthma and Chronic Obstructive Pulmonary Disease (COPD) are serious chronic respiratory diseases of increasing public health significance. Screening and surveillance programs for these diseases often rely on spirometry tests to detect lung function impairment, monitor functional change over time, and assess the effects of inhaled therapeutic or provocative agents. It is recognized that most spirometry errors reduce test results, so that effective QA monitoring should minimize false positive interpretations due to inaccurate low test values. However, this paper addresses the often-unrecognized opposite problem: some spirometry errors elevate test results, potentially leading to false negative interpretations. These problems, caused by changes in flow-type spirometer sensors or calibrations that occur during testing, are often unrecognized, so they may not be detected by many existing spirometry QA programs.

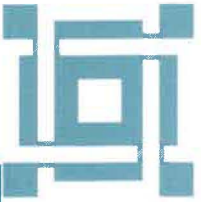
Objectives: The goals of this paper are: 1) to alert occupational health professionals to the potential for flow-type spirometer malfunctions during subject testing, even when using recently calibrated equipment; 2) to illustrate errors caused by inaccurate zeroing, contamination, or blockage of the sensor, so that users can recognize these problems when necessary; and 3) to demonstrate the errors' effects on screening and medical surveillance programs.

Methods: Industrial medical departments, occupational medicine clinics, and hospital pulmonary function laboratories submitted spirograms for technical quality review during NIOSH-approved spirometry courses or on a consulting basis. Review of the graphs found a number of elevated test results with anomalous spirograms recorded by several different recently calibrated flow-type spirometers. This paper presents examples of these problems and explains how they probably occurred.

Findings: Anomalous spirograms illustrate errors that seriously elevate test results, but are often unrecognized by spirometry users. Inaccurate zeroing of the sensor inflated one subject's FVC to 204% of predicted and probable mucus or vapor condensation on a screen pneumotach increased another subject's FVC to 144% of predicted. Zero flow errors and changes in sensors during subject testing probably caused 78% of 121 working men to record both FVC and FEV1 >100% of predicted in respirator medical clearance programs.

Significance: Spirometry Quality Assurance (QA) programs traditionally focus on problems with subject effort and performance of calibration checks. This paper describes often-unrecognized flow-type spirometer errors, illustrating patterns caused by sensor or calibration errors that may develop during testing. Unlike poor testing technique, which usually reduces spirometry results, these errors substantially elevate results, potentially leading to false negative interpretations.

Applications: Spirometry users conducting tests and/or interpreting results should be aware of spirometry's technique- and equipment-related pitfalls. QA reviews should be performed at least periodically on samples of recorded spirograms. Clusters of high test results or patterns of increasing/decreasing values should alert users to probable spirometer malfunction. QA programs for flow-type spirometers should check for zero flow and sensor-related errors, as well as poor testing technique and faulty calibration records. User recognition and correction of these errors will help assure the accuracy of spirometry tests in the workplace.



Session: 1 Paper Number: 13

Paternal Occupational Exposure to 2, 3, 7, 8 – Tetrachlorodibenzo-p-dioxin Birthweight and Birth Defects

C.C. Lawson, T.M. Schnorr, E.A. Whelan, J.A. Deddens, D.A. Dankovic, L.A. Piacitelli, M.H. Sweeney, L.B. Connally

National Institute for Occupational Safety and Health

Background: Agent Orange, a phenoxy herbicide, is a mixture of the herbicides 2,4-D [(2,4-dichlorophenoxy) acetic acid] and 2,4,5-T [(2,4,5-trichlorophenoxy)acetic acid]. Agent Orange was widely used as a defoliant in Vietnam and was contaminated with 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). Most of the general population is exposed to low levels of dioxins, primarily through dietary intake of animal fats.

Methods: Studies of occupational exposure to TCDD present the opportunity to assess the health effects of levels much higher than would be expected in the general population. We studied pregnancy outcomes among wives of male chemical workers who were highly exposed to chemicals contaminated with TCDD and among non-exposed neighborhood referents. Detailed information on reproductive, medical, lifestyle, and occupational factors was collected from current and former wives/partners via telephone interview. We estimated serum TCDD level at the time of conception using a pharmacokinetic model. The mean worker TCDD concentration was 254 parts per trillion (ppt), with a range of 3-16, 340 ppt. The mean referent concentration of 6 ppt was assigned to referent births and worker births conceived before exposure (pre-exposure births). A repeated measures analysis was used to assess the effect of TCDD on the birthweight of live, singleton, term births (> 37 weeks gestation).

Results: The mean birthweight was similar among referent births (n=604), pre-exposure worker births (n=259), and offspring born during or after exposure (n=292): 7.5 pounds (lbs), 7.4 lbs, and 7.6 lbs, respectively. There was no effect of continuous or categorical TCDD on birthweight when adjusted for infant sex, mother's education, parity, prenatal smoking, and gestational age. An analysis to estimate the potential direct exposure of wives during the time period of workers'
exposure yielded a non-significant increase of 0.29 lbs in the highest exposure group (TCDD >254 ppt) compared to referents (p=0.09), when adjusted for confounding variables. Mothers' reports of birth defects showed no evidence of an exposure relationship, though numbers were small.

Conclusion: These results do not support a causal relationship between paternal TCDD exposure and lowered birthweight. Because the estimated TCDD levels in this population were much higher than in other studies, the results provide evidence that paternal TCDD exposure does not increase the risk of low birthweight at levels above those observed in the general population. The study also offers reassurance to former workers and Vietnam veterans who may have been exposed to high levels of TCDD.

Session: 1 Paper Number: 14

Reported Parental Occupational Exposures and Birth Defects

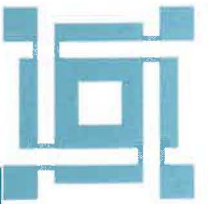
A. Correa (1), C. Lawson (2), C. Louik (3), S. Lin (4), C. Druschell (4), P. Langlois (5), P. Romitti (6), J. Reefhuis (1), E. Whelan (2), Schnorr (2).

(1) National Center on Birth Defects and Developmental Disabilities, (2) National Institute for Occupational Safety and Health, (3) Boston University, (4) New York Department of Health, (5) Texas Department of Health, (6) University of Iowa

There have been many published reports suggesting an etiologic role for various occupational exposures (anesthetic gases, solvents, metals) in the development of certain birth defects (limb defects, cardiac defects, neural tube defects). However, attempts to confirm these reports have yielded inconsistent results. In part, this may be due to difficulties in determining exposure status. Parental occupational exposures were usually classified using industry or occupational titles, which are only a proxy for actual exposure. Even where specific screening questions are used, results may be inaccurate. A previous study using industrial hygienist-assessed exposure as the gold standard found that the sensitivity of maternal self-report of agricultural chemicals was quite low (14%).

The National Birth Defects Prevention Study (NBDPS) collects information on occupational exposures both in the form of job history and as responses to five questions about specific types of exposures. This information can be extremely important in elucidating current questions about risks of maternal job exposures to the fetus. However, before associations between specific exposures and specific malformations are explored, it will be necessary to assure that exposure information is as accurate as possible. Therefore, in collaboration with researchers at NIOSH, we will use industrial hygienists to review parental reports of occupation in case groups of interest and assign exposure status to these cases for selected chemicals. If the selected chemicals overlap those for which the NBDPS inquires specifically, we will compare the self-reported data with the industrial hygiene assigned exposures.

This study has many advantages over previous studies of parental occupational exposure and birth defects, including a larger number of cases, greater diagnostic accuracy, the ability to control for confounders, and a short recall period. The multi-center nature of the study gives the opportunity to investigate a range of exposures that might not be possible in a study limited to only one state or metropolitan area. If analyses of these data show increased risks of certain birth defects with parental occupational exposures, then exposure limits can be reassessed.



Session: 1 Paper Number: 15

A Cross-Sectional Study of Umbilical Cord Blood Lead Levels and Selected Soceoeconomic Risk Factors

R.C. Frates (1), A.I. Carson (1), D. Lane (2), G.L. Declos (1)

(1) Southwest Center for Occupational and Environmental Health, The University of Texas School of Public Health, Houston, Texas; (2) Department of Psychology, Rice University, Houston, Texas.

Background: Almost one million U.S. children ages 1 to 5 years have blood lead levels (BLLs) >10 micrograms per deciliter, which can cause diminished hearing, stature, and intelligence. Children at greatest risk include racial or ethnic minorities, the poor, and living in older housing with deteriorating lead paint. Fewer than 20% of children at risk have BLL testing. Prenatal maternal occupational and environmental lead exposures may also be transmitted transplacentally to the fetus. Therefore, a method to detect these fetal exposures could allow estimation of fetal lead burden at an earlier time, which may be significant in mothers who are recent immigrants and may have sustained their occupational/environmental lead exposures prior to coming to the U.S.

Methods: The present study examined umbilical cord blood lead levels from 314 consecutively born term healthy neonates at two general hospitals in Harris County, Texas, one private and one public, to determine if cord blood lead levels (CBLL) are associated with some of the same socioeconomic risk factors as are elevated BLLs in children. Residual umbilical cord blood samples were collected from March through June 2002 and sent to a certified state laboratory for determination of whole blood lead concentrations. The limit of detection was down to and included 1 mcg/dl; the accuracy of the method was ±1 mcg/dl. Information on maternal age, race/ethnicity, parity, gravidity, birth weight, estimated gestational age and residential address was obtained from the labor and delivery logs. Housing characteristics were determined by linking residential address to county tax data on appraised market value of residence and year of construction.

Results: There was a significantly higher mean log lead level among neonates at the public hospital (n=192) compared to the private hospital (n=122), 0.95 ± 0.55 versus 0.54 ± 0.44 (p=0.03). CBLLs among Hispanics (n=215) were significantly higher than those among African-Americans (n = 77) (p=0.03). Interaction of hospital type and race/ethnicity was not significant, but mean log lead level among Hispanics attending the public hospital was significantly greater than that of Hispanics at the private hospital (p=0.001). The odds ratio for Hispanics at the public hospital having a CBLL > 2 mcg/dl was 5.56 (95% CI, 2.85 - 10.5).
Multiple regression analysis, with CBLL as the dependent variable, indicated that higher CBLLs were significantly associated with year of residence construction (p=0.006), the log of the appraised market value of the residence (p=0.01), but not with parity, birth weight or maternal age.

Conclusions: Since significantly elevated CBLLs have many of the same predictors as high BLLs, CBLL testing may allow earlier detection of lead poisoning, allowing earlier intervention before permanent damage is done.

Session: 1 Paper Number: 16

A Social Marketing Approach in Male Occupational Reproductive Hazards Communication

Nancy Muturi, Ph.D. Communication Fellow, CDC/NIOSH and Vern Anderson, Ph.D. Chief, Information Resources Branch, CDC/NIOSH

National Institute for Occupational Safety and Health, Education and Information Division, Information Resources Branch

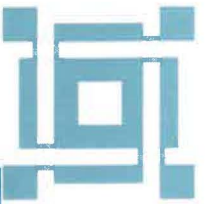
Reproductive health information and education for men and women is a basic human right that has been addressed by many organizations from different perspectives ranging from, information disseminating to provision of services. There are few organizations, however, that address occupational reproductive hazards that affect male workers and their families directly or indirectly who come into contact with these hazards on daily basis.

Male workers in metalworking industries (such as the automotive sector and welding), for example, are constantly exposed to metals, gases, and chemicals that have been identified as hazardous to the male reproductive system. Although animal studies indicate that men and women are equally affected by chemicals and other biological hazards, male reproductive health has not received as much attention - especially in terms of communicating information about hazards. Also, men rarely seek information or get routine checkups unless they have experienced illness.

Reproductive health problems resulting from exposure to hazardous substances have included low sperm count, abnormal sperm shape, altered sperm transfer, altered hormones and sexual function, impotence, and various disorders affecting offspring. Toxicants might also affect other phases of the reproductive system including the genetic integrity of the sperm cell, neuroendocrine function, and sexual function. Exposure can occur through inhalation, oral ingestion, or skin contact. Workers may also expose their families when they transport these substances to their automobiles or homes on clothing or work tools.

Scientific research has focused on identifying and examining these hazards; however, little has been done in terms of effective communication about results of these studies and risks workers face. Unfortunately, most scientific research has focused on examining these hazards while little has been done in terms of effective risk communication to the male workers who face the hazards on daily basis. Though identifying these hazards is necessary, it may not be sufficient in preventing the workers from short or long-term reproductive health problems if they do not have access or comprehend the information about the risks involved. Once a study is conducted it is important for researchers to disseminate the results and in a manner that will help the workers effectively use that information to protect themselves and others from occupational reproductive hazards.

In this presentation, we propose use of a social marketing approach for awareness, education and behavior change among male workers in relation to their reproductive health in relation to their health and wellbeing. Social marketing focuses on influencing consumer behavior (worker behavior in this case) by emphasizing the four P's of marketing - product, price, place and promotion. Product is the health information, ideas or practices that have been determined to affect the health of the consumer; price could mean the psychological cost of adopting a



practice or behavior; and place refers to any distribution channels that would reach the intended consume or client; and promotion could range from mass media, billboards, posters, to interpersonal or any other advertising.

Social marketing utilizes existing commercial or communication outlets, relying on the market analytical techniques: market research, product development, pricing accessibility, advertising and promotion. Social marketing encourages changes in behavior, which will benefit society as well as individuals either immediately or over a period of time. The goal should be long-term health benefits rather than the short-term goals in occupational safety and health communication. Market research or evaluation of the health information product is therefore necessary because it provides health communication specialists with tools to prevent potential problems and pitfalls and for understanding out thoughts and attitudes about a given issue that help prevent possible failures and position a health informatin product. This is precisely marketing's main contribution: systematic, research-based information about consumers (workers) that is indispensable for the success of interventions.

This presentation describes a process for (1) developing clear, direct, and appropriate messages for male workers about reproductive hazards, (2) disseminating the message, (3) evaluating worker access to and understanding of this message, and (4) prompting them to seek further information about repoductive hazards. Worker access to and comprehension of the message about risk is essential to preventing short- and long-term reproductive health problems.

Session: 2 Paper Number: 17

Addressing Ergonomic Disorders Amongst Librarians

E. Abdel-Moty (1,2), E. Diaz (2), T. Khalil (1,2), R. Rosomoff (2), S. Asfour (1,2)

(1) University of Miami Department of Industrial Engineering, (2) University of Miami Comprehensive Pain and Rehabilitation Center

Introduction: Poor ergonomic design of tasks, equipment and workplaces has resulted in a variety of musculoskeletal disorders including strains, sprains, pain, fatigue, numbness, and headaches. This study analyzed 47 workstations in a local university library with the objective of addressing and resolving the ergonomic risk factors potentially resulting in a systematic increase in reported health complaints in that workplace.

Methods. An ergonomic program was developed to evaluate 46 faculty and staff librarians (5 males and 41 females; average age 41.2). Ten participants (26%) reported a variety of work-related health problems such as carpal tunnel syndrome, low back pain, tendonitis, fibromyalgia, as well as neck, shoulder, and hand pain. The intervention involved administering questionnaires to all staff, measuring work areas, observing task performance individually, and implementing on-site modifications when needed.

Results: Problem-identification through direct observation showed a variety of ergonomic risk factors: a) personal factors: poor posture (87%), repetitive bending, turning, and twisting (65%), poor body mechanics (63%), overreaching (43%), and aspects of visual correction (17%); b) workplace factors: poor alignment of equipment such as computer monitor and keyboard (65%), inadequate workplace layout (57%), chair parameters (50%), and computer monitor height (17%). Once risk factors were identified, ergonomic interventions included: instructing in proper posture and body mechanics (100%), adjusting chair parameters (72%), relocating work items for efficiency and safety (70%), aligning computer elements (67%), instructing in stretching routines (26%), and re-introducing footrests (26%). Intervention also included recommending ergonomic products to resolve specific design issues: footrests (43%), proper keyboard and mouse trays (35%), floor mats (26%), copy holders (20%), new chairs (17%), as well as removal of middle drawer, longer telephone cord, telephone headset, electric stapler, and adding task light. Three participants were advised to seek medical management in order to address their chronic pain complaints (pain too severe). The most valuable component of this program proved to be safety education and increased awareness to sit properly, alternate sides, alternate sitting and standing, chair maneuverability, and general mechanics for daily activities. The program was concluded with a participatory seminar, an ongoing ergonomics-awareness e-mail campaign, and plans to orient/place new employees. Interventions resulted in immediate reduction in self-reported discomfort and pain and general feeling of improved efficiency. Staff continued to report better working conditions six months post intervention.

Discussion: Librarians' jobs require static postures to perform repetitive tasks including data entry, materials handling, upper extremity exertion, and working in constrained environments. The presence of desktop computers has added a host of ergonomic concerns amongst librarians. Ergonomic contributions helped reduce and/or eliminate subjective health complaints in this workplace. Providing adequate work tools and educating workers in safe work behaviors were essential. Staff was trained to identify stresses resulting from performing work tasks. Engineering changes were simple and inexpensive. This approach can be valuable in preparing an injured worker to return to work and/or insuring that workers perform safely on the job and in activities of daily living to avoid injury.

Abstracts

Session: 2 Paper Number: 18

Effectiveness of Anti-Vibration Gloves

RG, Dong (1), T.W. McDowell (1), D.E. Welcome (1), S. Rakheja (2), W.P. Smutz (1), C. Warren (1), C. Warren (1), J.Z. Wu (1), A.W. Schopper (1)

(1) Engineering & Control Technology Branch, National Institute for Occupational Safety and Health
(2) Dept. of Mechanical Engineering, Concordia University

Prolonged, extensive exposure to hand transmitted vibration is strongly associated with hand-arm vibration syndrome (HAVS). As personal protective devices, anti-vibration gloves have been used to help reduce the severity of vibration exposure. In the present study, the effectiveness of anti-vibration gloves is investigated through systematic examination of their vibration transmission characteristics. The study involved evaluations of many different experimental methodologies for assessing anti-vibration glove effectiveness and established a method for accurately measuring the vibration transmissibility of gloves at the palm of the hand. The study also evolved into many improved experimental procedures and data analysis methods. Further, a convenient and cost-effective method for predicting the tool specific vibration isolation effectiveness of anti-vibration gloves was developed and evaluated. The findings of this study indicate that only a few glove designs can reduce vibration transmitted to the palm of the hand, and the effectiveness of anti-vibration gloves is highly dependent upon the tool or the vibration spectrum. Moreover, the anti-vibration gloves yield considerably better vibration isolation when used with high frequency tools than that attained with low frequency tools. Owing to their dependency to the vibration spectrum, the assessment method requires repeatable vibration source. The glove effectiveness for a specific tool could be conveniently estimated from the vibration transmission function of the glove measured under broad-band vibration. The proposed assessment and prediction methods could aid in the selection of appropriate anti-vibration gloves for different tools and working conditions. The information and knowledge developed through this study may also be used to improve upon the relevant national and international standards.

Session: 2 Paper Number: 19

Risks of Musculoskeletal Disorders in California Winegrape Trellis Systems

F. Fathaliah (1), J. Miles (1), J. Meyers, J. Faucett (1), Janowitz (1), E. Garcia (1), A. Kato (2), and D. Reiter (1)

(1) University of California Agricultural Ergonomics Research Center, (2) Zenith National Insurance Corp.

The agricultural sector has been considered as one of the most hazardous among all industries in terms of work related injuries. The most commonly reported injuries are associated with Musculoskeletal Disorders (MSDs), with a work related MSD incidence rate of 80 per 1,000 workers in the winegrape industry alone. These injuries are attributed to MSDs of the lower back and upper extremities due to the highly forceful and repetitive hand intensive movements combined with frequent stooped postures observed during harvest and pruning operations. Field observations have documented extensive deviations of the wrist from the neutral position while pruning. These deviations are coupled with extremely repetitive cuts and high grip forces applied to the pruning shear. This combination has proven to increase the risk of developing MSDs of the wrist such as Carpal Tunnel Syndrome (CTS). In addition, the frequent stooped postures combined with highly dynamic movements of the torso may result in increased risks of low back disorders. The purpose of this study is to determine if differences in the risk of developing musculoskeletal injuries exist based on exposure to various trellis systems while pruning and harvesting. Twenty two vineyard employees participated in two simulation studies where they performed, respectiverly, a pruning task and a harvesting task on five unique trellis systems most commonly used throughout the industry. The Lumbar Motion Monitor (LMM) and the Greenleaf Motion Analysis System (MAS) were used to capture the kinematics of the spine and wrist, respectively. The results of this study indicate that there is a relationship between trellis characteristics and trunk and hand/wrist kinematics. As expected, trellis height had a direct impact on the level of MSD risks to the back, wrist, and shoulder joints. Means for incorporating the results of the study into guidelines for designing trellis systems that help minimize the risks of MSDs to vineyard workers will be also discussed.

Session: 2 Paper Number: 20

NIOSH Shipyard Ergonomics Project

S.D. Hudock, L.E. Reed

National Institute for Occupational Safety and Health

Approximately 100,000 workers are employed in the domestic construction and repair of ships. This number has fallen dramatically over the past 20 years as military and commercial orders have decreased. Due to the downturn in employment, new hires in the shipyards are rare and an aging workforce must work harder to build a commercially-feasible final product. Cheap labor rates and subsidized industries overseas have made this task even more difficult.

The shipbuilding and ship repair industries historically have had high injury incidence rates. For the year 2001, the industry had an overall injury and illness incidence rate of 17.2 per 100 full-time employees, twice the rate of the construction industry at 7.9 and three times the rate of all private industry at 5.7 per 100 full-time employees. These high incidence rates were a concern to the industry principally because of increased worker compensation costs and decreased productivity; mitigation of these rates through analysis and modification of job tasks was thought to be a cost-effective means to address the associated costs of the injuries and illnesses. Initial interest in the project came through the Maritime Advisory Committee for Occupational Safety and Health, an OSHA advisory committee, and the National Shipbuilding Research Program, a consortium of the major domestic shipyards. Researchers at the National Institute for Occupational Safety and Health became involved, competed for, and received funding from the U.S. Navy to pursue this research.

One of the objectives of this study was to identify those job tasks within each shipyard occupation that were associated with the highest exposure to occupational risk factors. These job tasks were identified through a survey of OSHA injury logs, and discussions with labor and management safety personnel at eight participating shipyards. Over forty specific job tasks were videotaped and analyzed with respect to the presence and magnitude of the occupational risk factors, such as sustained or awkward postures, repetition, excessive force and vibration. The exposures to occupational risk factors were then quantified by the application of several different exposure assessment techniques, such as the NIOSH Revised Lifting Equation, the Rapid Upper Limb Assessment, and the 3-D Static Strength Prediction Program. Suggestions of possible ergonomic interventions to reduce the exposure to the risk factors were made to the participating shipyards. If the shipyards agreed to implement one or more interventions, funds were available to defray some of the cost of the intervention equipment.

Over the course of the project, a limited number of interventions were implemented within the shipyards, including the installation of lift tables to minimize manual material handling in shop and drydock areas. Where implemented, the interventions were extremely successful in reducing the exposure to occupational risk factors, and usually increased productivity within the workplace as well. It is thought the worker compensation costs will decrease as well over time. The focus on ergonomics within the industry brought about by this project has caused a number of shipyards, both study participants and other yards, to reevaluate their ergonomic programs. For example, the Shipbuilders Council of America, the association representing the small- to medium-size shipyards, is developing an ergonomic training video and best practices guide for their membership. Other yards are incorporating ergonomic redesign as part of their lean manufacturing programs. The results of this study will be presented to OSHA for their use in the development of an industry-specific ergonomic guideline if OSHA chooses to pursue that course. The final product for this study will be a Compendium of Shipyard Ergonomic Solutions that will compile best industry practices that address exposure to occupational risk factors and will be widely distributed within the industry.

Session: 2 Paper Number: 21

Shoulder Symptoms in Apprentice Construction Workers

Linda A. Merlino (1), John C. Roscrance (2), Dan Anton (1), Thomas M. Cook (1)

(1)Department of Occupational and Environmental Health College of Public Health, The Univeristy of Iowa, Iowa City, Iowa (2) Environ mental & Radiological Health Sciences, Colorado State University, 1681 Campus Delivery, Fort Collins, Colorado

Broad Importance of Research: Musculoskeletal disorders are a major cause of work related disability and lost time illnesses for many occupational groups. Construction workers have one of the highest incident rates of illness and injury as reported by the Bureau of Labor and Statistics. However, musculoskeletal symptoms and disorders in construction work have not been well documented, in part due to the somewhat irregular nature of construction work.

Objective of Study: This study determined the prevalence of self-reported shoulder symptoms among apprentice construction workers.

Summary of Methods: A symptom and job factors survey was self-administered to 995 construction apprentices in four trades (electricians, plumbers/pipefitters, sheet metal workers, and operating engineers). Prevalence was determined by the percent of positive responses to musculoskeletal symptom questions. Odds ratios and 95% confidence intervals were the measures of association between prevalent shoulder symptoms and demographic, and job factors and were determined by logistic regression.

Summary of Results: The apprentices were fairly young (mean age 27 years) and predominately male (93%) and had worked in their trade for an average of three years. Shoulder symptoms were self-reported by 27.8% of apprentice construction workers. Female gender and increasing number of years worked in the construction trade (p-trend = 0.02) were demographic factors positively associated with shoulder symptoms. Work factors positively associated with shoulder symptoms included: "Doing the same task over and over," "Working in the same position for long periods," and "Reaching overhead."

Advancement of Research Field: These findings identify shoulder symptoms as a significant problem in young construction workers at the beginning of their careers. Particular job factors have also been identified as associated with prevalent shoulder symptoms providing a focus for future studies into the problem.

Improvements in Workplace Safety and Health: Prevention strategies are needed early in the apprentice training program. Simple strategies such as moving closer to the work task rather than reaching overhead or diversifying tasks could be implemented to reduce symptoms of job-related shoulder pain.

Session: 2 Paper Number: 22

Carpal Tunnel Syndrome among Apprentice Construction Workers

J. Rosecrance (1), D. Anton (2), L. Merlino (2), T. Cook (2)

(1) Environmental & Radiological Health Sciences, Colorado State University, 1681 Campus Delivery, Fort Collins, Colorado
(2) Department of Occupational and Environmental Health, College of Public Health, The University of Iowa, Iowa City, Iowa

Broad Importance of Research: Carpal tunnel syndrome (CTS) is perhaps the most widely known work-related musculoskeletal disorder. Although CTS has been commonly associated with computer work, recent studies indicate that the prevalence of CTS is much higher among construction workers than office workers. To prevent work-related CTS in the construction industry we need to redesign tools and work methods that are better matched to the capabilities of the workers. However, little is known about what specific construction work tasks increase the risk of workers developing disorders such as CTS.

Objectives of the Study:
1. To determine the prevalence of CTS among apprentice construction workers.
2. To identify tasks in construction work that are associated with CTS.
3. To develop safety and health strategies to prevent CTS among construction workers.

Summary of Methods: More than one thousand construction apprentices from four construction trades (electricians, operating engineers, sheet metal workers, and plumbers / pipefitters) in seven states participated in the study. All CTS testing was performed at the apprentice's union hall. A case definition of CTS was based on symptoms reported on hand diagrams and nerve conduction studies across the carpal tunnel. Questionnaires, focus group meetings, and field observations were used to collect data characterizing the apprentice and their working tasks.

Summary of Findings: Of the 1,115 construction apprentices included in the data analysis, 91 (8.2%) met the case definition of CTS in at least one hand. Mean age and body mass index were higher among construction workers with CTS than those without CTS. When the operating engineering apprentices were classified by job task, those that were involved with more than 6 hours of daily hand tool use had a significantly higher prevalence (26.5%) of CTS than those classified as equipment operators or drivers not using hand tools (5.7% prevalence). The self-reported job task of working overhead was significantly associated with prevalent CTS. Eighty-eight percent of apprentices with CTS had never sought medical attention for their condition. Many workers with CTS indicated that they thought that their hand symptoms (numbness and tingling) were "just part of the job."

Advancement in Research Field: The results of this study indicate the need for developing strategies to prevent CTS among construction workers. This study has enabled us to identify the work tasks associated with CTS and has allowed us to develop a cohort to pursue a prospective investigation of the relative contribution of both occupational and non-occupational factors in the development of CTS.

Improvements in Workplace Safety and Health: The results of this study indicate that workplace safety and health strategies for CTS and other musculoskeletal disorders must begin early in the construction worker's career. As a result of this investigation, we are working with tool manufactures in the design of "ergonomic" hand tools for the construction industry and working with union and contractor organizations in the education of construction workers in ergonomic principals.

Session: 2 Paper Number: 23

The Influence Of A Roofing Task On Unilateral Balance

L.R. Wade, W. Weimar, J. Davis, B. Carnahan

Auburn University

A total of 8,786 fatal work injuries were reported in 2001, one half of these fatal fall incidents were a result of falls from a pitched roof setting, as indicated by the Bureau of Labor Statistics. The Bureau of Labor Statistics indicated nearly 4,000 serious injuries were associated with industry related falls from roofs in 2001. Previous roofing construction related research has focused on the changes on postural sway velocity as a result of decrements in one or more of the three major systems associated with balance (somatosensory, vestibular, and visual). Though all have been examined, less attention has been focused on the somatosensory systems and proprioception of the lower extremities.

Purpose: To research is to investigate the effect of exposure to a pitched roof setting on unilateral balance.

Hypothesis: It was hypothesized that exposure to an inclined surface would have a significant decrement on unilateral balance.

Methods: All subjects who volunteered as participants (n=25; males,) were tested under two conditions: flat and inclined. Each subject performed a ten-minute locomotion protocol, on a 12 x 15' inclined roof segment or a 12 x 15' flat segment, to determine if there was a difference in the ability to balance on a single leg following exposure. Each subject performed a pre - and post test protocol with random assignment to order of surface. Data were collected over four, ten-second trials, under eyes open and eyes closed conditions, for each leg. Performance was measured using the recordings made by the NeuroCom Balance Master System. Balance was recorded in sway velocity (degrees/second), where the value was representative of the change in center of gravity (COG) in the anterior, posterior, medial, or lateral directions. The angular change of the COG per unit time was summed and divided by ten-seconds to achieve an average sway velocity of the COG. This average value was recorded for each trial, under each condition, for each leg. The data were separated into four categories: pre/post, inclined/flat, left /right foot, eyes open/ closed, and then analyzed using a repeated measures ANOVA.

Results: The analysis concluded that there was a significant decrement on single leg balance as a result of exposure to inclination ($p>.05$).

Conclusion: The findings have practical implications when dealing with the construction industry. On a daily basis, roofers ascend and conduct roofing related tasks for prolonged periods of time. Following exposure to the pitched roof setting, roofers must move from the roof to scaffolding or a ladder to descend. These findings suggest that there is a significant decrement in unilateral balance due to exposure to inclination. Unilateral balance is critical in ascending and descending ladders and scaffolding on flat surfaces. Possible areas of future research that might impact unilateral balance could potentially involve roof jacks, work boot design, and work rest cycles.

Session: 2 Paper Number: 24

Traumatic Injury Potential to Seat-Belted Operator During a Rearward Overturn of A ROPS-Equipped Farm Tractor

Jinhua Guan, Hongwei Hsiao, Richard S. Current, John R. Powers, Douglas E. Ammons, Douglas M. Cantis and James S. Spahr

Division of Safety Research
National Institute for Occupational Safety and Health

Each year, an average of 120 American farm tractor vehicle operators die from tractor overturns. The use of rollover protective structure (ROPS), together with a seat belt, has been found to be the single most effective method of preventing overturn-related fatalities. However, non-fatal traumatic injuries may still occur during these events when a ROPS and seatbelt are appropriately used. Preliminary NIOSH anthropometric analyses indicate that the current operator protective volume, as defined in the ANSI/SAE Standard J2194, may be too small to prevent average-to-large sized people from being injured in a rollover incident. The present study examined the injury potential to a seat-belted operator during a rearward overturn in a ROPS-equipped farm tractor.

Three rearward overturn tests were conducted at the field test site of the NIOSH Pittsburgh Research Laboratory. These tests involved a Ford 4600 farm tractor running up a 60 deg ramp at an average speed of about 5 mph, as per ANSI/SAE Standard J2194. An instrumented crash-test manikin (Advanced Dynamic Anthromorphic Manikin or ADAM; equivalent to a 95th %tile male) was restrained to the tractor seat by a seat belt. Data collection included the manikin's head movement, upper neck load, and head injury criterion (HIC) measurements.

The results showed that the manikin's head moved outside the inclined plain (G1 G2 I2 I1 as defined in ANSI/ SAE J2194) of the operator protective volume and impacted the ground during each rearward overturn test. The time history analysis of axial neck loading ranged from 514 lbs to 925 lbs, which suggested injury modes ranging from neck pain to neck fracture with quadriplegia. The HIC measurements were below the level of brain damage or skull fracture.

To reduce the likelihood of severe injuries to the upper neck, modifications could be made to the protective components of the farm tractor. First, the back rest of the tractor seat may be raised so that the head movement will be kept within the operator protective volume during a rearward overturn. Second, a mesh structure may be installed on the roll bar to prevent the operator's head from impacting the ground. Third, the operator protective volume may be redefined on the basis of the most recent anthropometric data, range of joint movement data, and the manikin's kinematic data obtained in this study. In the next phase of the study, the effectiveness of these modifications in reducing injury potential will be investigated.

Session: 2 Paper Number: 25

Hand Injuries Associated with Hand Tools Used in Mining

Douglas F. Scott

National Institute for Occupational Safety and Health

Results from a review of 1997-2001 Mine Safety and Health Administration data showed that more than 5,500 hand tool injuries occurred in the mining industry. Non-powered hand tools accounted for the majority of injuries followed by machine maintenance and powered hand tools. One-hundred and eight-four underground metal miners were surveyed to determine the level of hand tool experience they had received and how many hours of hand tool training they had received on the job. Results showed that 14 % of the workers had no safety training in powered hand tools and 18 % had no training on non-powered hand tools. Based on this sample, an estimated 48,963 mine workers nationwide have no safety training on the use of powered hand tools, and 62,411 mine workers nationwide have no safety training on the use of non-powered hand tools. It is concluded that a NIOSH-funded safety program developed at training mine workers on safety procedures for use of powered and non-powered hand tools could be effective in reducing the high frequency of hand injuries associated with hand tool use in mining.

Session: 2 Paper Number: 26

A NIOSH Machine Risk Reduction Workshop

J. Etherton (1), T. Heidoiing (1), B. Main (2), D. Cloutier (3), and W. Christensen (4)

(1) National Institute for Occupational Safety and Health, (2) Designsafe, Inc., (3) Cloutier Consulting, (4) Christensen Consulting for Safety Excellence

The risk of injury from machinery in US workplaces is high. Between 1992 and 2000, there were, on average, 148 fatalities per year involving caught-in-running-machinery. For 1992-2000, there were, on average, 133,511 cases per year of nonfatal machine-related injury involving lost workdays. The majority of these (65%) were in the manufacturing industry.

A US task group recently developed a technical reference guideline, ANSI B11 TR3, "A Guide to Estimate, Evaluate, & Reduce Risks Associated with Machine Tools", that is intended to bring machine tool risk assessment practice in the US up to or above the level now required by ISO 14121, "Safety of Machinery - Principles of Risk Assessment". NIOSH conducted a workshop on the new US guideline as a first step in a research project to evaluate its effectiveness. Partners in this study include General Motors, Liberty Mutual Insurance, and the Association for Manufacturing Technology. The ANSI guideline emphasizes identifying tasks and hazards not previously considered, particularly those associated with maintenance and teamwork among line workers, engineers, and safety professionals.

The workshop trained labor and management participants from the automotive, industrial and consumer products, metal stamping, and medical devices industries on the TR3 process for reducing machine-related risk. Software tailored to the TR3 process was used to facilitate and document assessments. A multiple-choice knowledge test and Likert scale questionnaire were administered to the trainees before and after training. Test questions were taken from materials developed for the training. The attitude questions were designed to elicit responses about how confident trainees felt about applying risk concepts.

Gains were achieved in knowledge of risk reduction concepts for this pilot sample (n = 11). The mean percentage of correct responses increased from 65% (SD=4.6) in the pretest to 74% (SD=2.8) in the posttest. Comparisons of pre-training and post-training survey responses revealed increases in participant confidence of their ability to evaluate levels of risk associated with tasks from different machines (18% increase). Survey responses also revealed increases in participant confidence that their company was using a systematic approach towards preventing machine-related injury (9% increase).

Upon completion of the workshop, participants were able to explain key terms and concepts used in risk assessment, conduct a risk assessment using the software, and understand maintenance risk assessment applications. As the TR3 evaluation study proceeds, participating companies will focus on two matched machinery systems for study; one will have the TR3 risk assessment process applied, and the other will remain in use without utilizing the TR3 risk assessment process. At the end of one year, these two machinery systems will be evaluated for safety and productivity improvements. The numerous positive responses of workshop attendees indicate that the evaluation study will proceed to a successful conclusion.

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Abstracts

Session: 2 Paper Number: 27

Current Status of Warning-Systems in Forest Harvesting Equipment

N.T. Dorris and J. A. Davis

Auburn University

Introduction: Historically, logging has ranked among the most hazardous occupations in the United States, sharing this undesired distinction with commercial fishing, mining, and commercial truck driving. The most recent copy of the Worker Health Chartbook (NIOSH, 2000) reported that as recently as 1997, timber cutting (logging) experienced the highest fatality rate (128.7 fatalities/100,000 workers) in the nation for all occupations, compared to the national average (4.8/100,000). A NIOSH special alert has reported that many workers and employers in the logging industry are unaware of the risks associated with logging and are not following procedures in the OSHA standards for preventing injuries and fatalities (NIOSH, 1995). More recently, Bordas et. al. (2001) reported the observation of numerous unsafe behaviors in the woods as practiced by loggers. These authors concluded "unsafe behaviors may be due in part to a lack of awareness of the hazards," thus supporting the NIOSH position regarding a possible lack of hazard awareness.

Objective: The warning-systems associated with this class of machinery are the manufacturers' primary means of communicating with operators and other equipment users. Warnings can effectively impart the necessary precautionary information as well as alert users to unknown hazards. This paper presents the results of a cross-sectional study designed to investigate, document, and assess the current status of warning-systems associated with forest harvesting equipment typically used in the southern region of the United States. The most prominent components of these warning-systems are the on-product warning signs and labels. This study, however, examines the entire warning-system for this specific class of machinery including precautionary information relayed to users via operator manuals. Formal and informal safety training was excluded. This research was supported by a grant from the United States Forest Service.

Method: Forest harvesting equipment observed in this study includes grapple skidders, feller-bunchers, harvesters, loaders, forwarders, and whole tree chippers. Thirty different logging operations (within 100 miles of Auburn University) were visited. Researchers photographed and noted the location, presence, condition, and visibility of warning signs and labels on the equipment as well as supplementary warning-system components, e.g., operating manuals. The mode of degradation was also noted, e.g., scratched and/or worn, covered with oil, grease, or dirt, peeling, obstructed or faded. Additional information was collected from the equipment owner/ operators regarding maintenance and upkeep practices.

Preliminary Results: In the course of this study, 110 individual forest harvesting machines were observed containing a total of 1,603 on-product labels. Subjective criteria were developed to estimate the level of degradation of those signs and labels. Both damage/wear (permanent degradation) and cleanliness (temporary) were independently rated on a five-point Likert-type scale by three judges. Statistical analysis is being performed on the data to determine if there are any significant relationships between the type of equipment, age of equipment, or type of operation (i.e., stems vs. chips) and warning degradation.

	Damage Scores					Cleanliness Scores						
	1(low)	2	3	4	5(high)	1(low)	2	3	4	5(high)	Total	%
Feller and Feller-buncher	214	124	93	82	84	109	427	57	2	2	597	37.2%
Forwarder	5	29	9	7	2	3	38	8	1	2	52	3.2%
Loader	182	95	19	1	2	87	199	9	3	1	299	18.7%
Processor	3	5	0	0	1	0	8	1	0	0	9	0.6%
Chipper	28	27	4	2	6	12	47	8	0	0	67	4.2%
Skidder	151	156	84	74	114	95	379	86	14	5	579	36.1%
Total	583	436	209	166	209	306	1098	169	20	10	1603	100.0%

Preliminary Conclusions:
This is the first study to assess the condition of warnings in a real world environment (industrial operation). The harsh environment in which forest-harvesting equipment is used has caused considerable degradation of on-product warning labels and signs. In 209 cases the warnings were degraded (permanently) so severely that no user could have comprehended the message. Only 49 (45%) machines had the operators' manuals available on site.

Equipment manufacturers will benefit from this new information concerning the status and reliability of their current warning-system components as it regards the design of future warning-systems. The users of this equipment are not adequately maintaining the warning-systems. Loggers would directly benefit from an industry-wide campaign to encourage replacement of degraded or missing warning-system components. Future work is planned to test the impact of various levels of degradation on user comprehension.

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Session: 2 Paper Number: 28

Ergonomics in Construction: An Intervention with Concrete Laborers

Jennifer A. Hess, DC (1), Steven Hecker, MPH, MSPH (1), Marc Weinstein, PhD (1), Mindy Lunger, PT (2)

(1) University of Oregon, Labor Education and Research Center, (2) University of Oregon Physical Therapy Clinic

Construction workers are at significant risk of work-related musculoskeletal injury. Laborers in particular are injured 2.5 times more often than the general work force with 38 percent of these injuries due to strains and sprains. The placement of concrete in construction poses risks of musculoskeletal injury to laborers due to the weight of materials, awkward postures, schedule pressures, and harsh environmental conditions. The goals of this project were: 1) to introduce an ergonomic tool with the potential for decreasing exposure risk of low-back injury among concrete laborers, 2) to apply instruments that quantitatively assess exposure, and 3) to evaluate whether a participatory approach to the intervention would result in additional reduction in exposure risk.

The study focused on laborers manually moving the hose that delivers concrete from a pumper to a placement site, in a case where pouring from above was not possible. Researchers met with laborers to discuss their job duties and elicit ways of reducing exposure to injury. The idea of using skid plates, metal disks that go under the junctions between sections of hose was introduced. The hypothesis tested was that skid plates would prevent hose joints from catching on rebar matting and allow the hose to slide more easily, reducing the need for repetitive bending and excessive force to move the hose. Four laborers agreed to evaluation wearing the Lumbar Motion Monitor (LMM), a tri-axial electrogoniometer that records position, velocity and acceleration in three planes of movement. Force to move the hose was measured with a dynamometer, while lifting frequency was collected by timing workers in several 10-minute increments. Workers were measured during three comparable concrete pours: 1) baseline, before introducing the skid plates, 2) using unmodified skid plates, and 3) after worker field modifications of the skid plates.

During initial use of skid plates, flexion and right bending increased significantly while velocity and acceleration did not change. Workers then recommended securing the hose to the skid plates. After implementing this field-fix average twisting and maximum lateral velocity were significantly reduced. These factors, as well as load moment, have been associated with risk of occupationally related low-back disorders. Maximum frontal, sagittal and axial acceleration in the lumbar region were also significantly reduced after the field-fix. Applying Newton's second law F=MA, it follows that reducing acceleration should result in decreased moment in the low back. Estimate of low-back moments showed that maximum torque in the lumbar spine was significantly decreased. These findings suggest that use of tied-down skid plates during horizontal concrete hose movement decreased exposure risk for low back injury among construction laborers. Crew involvement led to modifications in skid plate use that made the tool more effective. To date most ergonomic field studies have relied upon observational assessment, survey data or other qualitative methods of analysis with limited ability to capture dynamic aspects of worker biomechanics. The LMM appears to show promise for quantitative assessment of intervention effectiveness in the field, making an important contribution to the advancement of field exposure assessment in construction ergonomics.

Session: 2 Paper Number: 29

Relative Change in Hand Size Over Time: Implications for Glove-Size Schemes and Labeling for End-Users

J.S. Spahr (1), TY Kau (1), J.V. Zwiener (1), R.L. Whisler (1), H.X. Hsiao (1)

(1) National Institute for Occupational Safety and Health

In 1996, the leading occupational injury treated in US hospital emergency departments was an acute hand injury. Hand injuries annually affect 30% of injured workers. Finger lacerations rank as the third highest cause of lost work days. Compensation insurance fund claims for finger and hand injuries (Calif. construction trades - direct cost only, 1998) averaged between $10,500 to $14,400 per claim respectively. Despite the high frequency, significant lost work days, and medical costs associated with these injuries, they are still etiologically poorly understood. Many of the injured workers were not wearing protective gloves at the time of injury. Appropriate glove selection and use-compliance at work is important to understand as glove use has been shown to both increase the risk of hand injury (around moving machinery parts) or reduce the risk of hand injury (handling rough material) depending on specific work place hazards and activities. This study examined one possible cause of compliance failure: the problem of appropriate glove size selection by analyzing the change in hand size over time, and it's relationship to glove-size labeling schemes.

Comparative analysis of anthropometric body segment length was conducted from equivalent United State data sources (US Military, NHANES, CAESAR). Male and female standing height, hand length, and hand circumference measures were compared at similar decade time points over the last 50 years (1950-2001). Anthropometric analysis indicates that both stature and hand size have increased in equal proportion over time. The ratio of hand length to stature has remained constant at approximately 11%, and circumference at approximately 11.5%. Male stature, however, has slowly increased from a mean of approximately 66 inches (1950) to the current mean height of approximately 70 inches. Over the same time period, mean hand length change is estimated to be approximately from 7.3 to 8 inches in males. The same general growth trends are demonstrated in females.

Allometry of body size varies over time by gender, race, and nationality. Some of the traditional dies used to construct sewn glove pattern components in the US date to hand-size schemes devised in Western Europe after the 1850s. There are no equivalent ANSI PPE design standards for uniform glove size standardization or labeling. Differing size classifications are used throughout the glove making industry. Gloves are made in limited quantities in limited size ranges. Information on determining glove fit is minimal and often qualitative. This analysis demonstrates how commercial glove-sizing schemes may slowly fall behind increasing dimensional body changes. Qualitatively based size labeling schemes will accommodate fewer workers over time if glove patterns are not changed. Results confirm the importance of using accurate anthropometric measurements to size and label gloves to better address comfort and fit. These same concerns apply to all other safety apparel design strategies.

Session: 2 Paper Number: 30

Threshold Shifts in Tactile Perception at the Fingertips Induced by Exposure to Simulated Power Tool Impacts and Continuous Vibration

D.R. Peterson (1), A.J. Brammer (1), M.G. Cherniack (1)

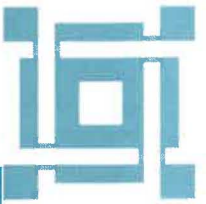
(1) Biodynamics Laboratory, University of Connecticut Health Center

Repetitive shock and vibration are routinely encountered with the use of powered and manual hand tools and have been associated with neurologic and neurovascular disorders of the hand. This study was designed to assess the extent and duration of temporary threshold shifts (TTS), produced by vibratory simulation, in three different mechanoreceptor populations that determine sensory function in the fingers. The objectives of the study are centered on three primary issues: 1) to investigate the effects of engineering design factors, such as vibration cycle time, on TTS, 2) to determine whether measurable TTS is sufficient to effect function and effect receptor function differentially, and 3) to correlate the results from laboratory simulations into practical field use and tool design.

To study the effects of temporal patterns that are characteristic of real tools, waveforms consisting of exponentially decaying sinusoidal signals have been synthesized to simulate impacts containing predominantly low or high carrier frequencies (125 or 1250 Hz). Repetition rates were varied from 4 to 32 impacts per second while holding the frequency-weighted acceleration of the generated stimulus at specific RMS values.1 In addition to impact simulations, waveforms that contain continuous vibration frequencies of 125 and 1250 Hz serve for comparisons with continuous vibration exposure. The stimulus was generated using an electro-dynamic vibration exciter driven by the synthesized waveform and was coupled to the hand-arm system by means of a handle containing acceleration and grip sensors. The repetition rate of the transient stimulus was chosen to both be representative of common power tools and fall within the range of frequencies at which the vibration perception threshold (VPT) is mediated by a single mechanoreceptor population.2 TTS in vibrotactile perception were determined at selected time intervals following termination of the stimulus over a 30-minute recovery period following an 8 minute exposure interval. Ten subjects, 5 having industrial experience with vibratory tools and 5 without industrial experience, were tested.

TTS occurred after exposure to relatively low acceleration (<= 2.0 m/s/s) at a lower carrier frequency (125 Hz), and small deficits seemed to persist after the recovery plateau had been attained. Shock type stimuli frequently produced less short-term physiologic change than continuous vibration under these experimental conditions. There appeared to be differential effects on mechanoreceptor populations. Substantial differences in response were observed between subjects, both in the magnitude of the TTS and in the form and rate of the recovery function. On average, there was little or no TTS at 4 Hz in response to any of these stimuli. Recovery commonly followed a logarithmic time dependence after the termination of exposure approaching the unadapted threshold recorded prior to the stimulus after about 20 min for TTS at 125 Hz, and 10 min for TTS at 31.5 Hz. The TTS at 31.5 Hz seems to be, on average, little affected by the nature of the stimuli in contrast to that at 125 Hz, which is substantially less for the slower repetition rate. The pattern of these results suggests that the primary influence on TTS is related to the frequency-weighting function, rather than to the procedure for summing shocks. The results have potential ramifications for tool design and for exposure measurement and control.

1. ISO 5349-1. International Organization for Standardization, Geneva 2001.
2. ISO 13091-1. International Organization for Standardization, Geneva 2001.



Session: 2 Paper Number: 31

Disaster Response: Safety and Health Training for Construction Workers

J.L. Gittleman, D. Ellenberger and C. Trahan

Center to Protect Workers' Rights

The catastrophe at the World Trade Center revealed that construction workers were not sufficiently trained in safety and health procedures given the magnitude of hazards at the site. The Center to Protect Workers' Rights (CPWR) has developed an interactive DVD curriculum designed to support safety and health training for construction workers. No educational package of this type currently exists in the U.S. Construction workers working in a catastrophic site need awareness of safety and health issues and potential risks of that environment. Lessons learned from the World Trade Center Disaster and Oklahoma City indicated construction workers were not sufficiently trained to protect their safety and health in several areas: hazard recognition, personal protective equipment, and decontamination.

The goal of this project was to develop a program that would convey critical information in a compelling manner and concise format. Interviews of construction workers across a wide spectrum of trades (e.g. ironworkers, asbestos workers, plumbers, bricklayers, crane operators) to obtain first-hand experiences from workers at disaster sites are included along with simulations for inspecting and wearing protective equipment. Regulatory requirements were abstracted to enhance understanding of legal standards. To ensure that the training program included necessary information, focus groups of the Building Trades Master Instructors provided comments on the draft modules in a workshop held Septmeber 12 and 13, 2002 in Washington, DC. These interviews and visual demonstrations are incorporated into the curriculum to allow workers to learn from peers in a non-lecture format.

The Building and Construction Trades Department, of the AFL-CIO represents millions of construction workers nationwide. The Building Trades has a training infrastructure through the OSHA 500 and Outreach Programs where approximately 50 Master Instructors train a force of approximately 3500 Outreach Trainers. The 3500 Outreach Trainers train workers in the OSHA 10-hour Hazard Awareness Program. This framework lends itself to reaching Building Trades members who may be needed to assist in the rescue, recovery, and cleanup phases of a catastrophe. We plan to have the training program housed in Building Trades Council offices, Training Centers, and Union Halls in America, allowing a quick delivery of the training program by local trainers.

This train the trainer approach is considered a starting point for a national dissemination strategy. We believe the most efficient and expeditious way to train Building Trades workers who may be called on in disaster situations is to have a worker curriculum readily available and instructors on hand to deliver it. The next phase of this project will be to disseminate the training to these instructors and evaluate it effectiveness.

Session: 2 Paper Number: 32

A Systems Approach to the Socioeconomic Impacts of Workplace Injuries

Thomas W. Camm, PhD, PE and Jami Girard Dwyer, PE

Spokane Research Laboratory, National Institute for Occupational Safety and Health

The goal of this research project is to determine the impacts of occupational injuries and fatalities in terms of both economic costs and social consequences. This will provide a new basis for targeting and evaluating the effectiveness of investments in prevention research.

Each day in the United States an average of 16 workers die from an injury at work, and an additional 9,000 workers sustain disabling injuries on the job. This amounts to well over 5,000 deaths and 3.2 million disabling injuries each year. Typically, the focus of attention in evaluating a workplace injury is the direct medical, employment and earnings consequences for the employer and the injured worker. However, the medical and labor market consequences are only a fraction of the ultimate consequences for the worker. Economic consequences may also extend to the worker's family, co-workers, employer, and community. In addition, researchers are finding substantial non-economic, social consequences of workplace injuries affecting both physical and psychological functioning.

The National Institute for Occupational Safety and Health estimates the economic burden of these injuries to be over $141 billion in direct and indirect costs annually, and the total federal investment in research to prevent occupational injuries and illnesses was $266 million dollars in 2000. There are many avenues of research/ prevention methods, engineering design, economics, human behavior, decision theory, organizational structure, intervention effectiveness, etc. that address various aspects of workplace injuries and fatalities and their consequences. Deciding which research should be funded, and which research will have the most effect, can be difficult. By applying a systems approach incorporating engineering, economics, psychology, and sociology, the impact of occupational injuries and fatalities can be better understood. Basing the research on the theory that the workers are part of an interconnected system of processes and relationships, the resulting investigation will provide an understanding of fatality and injury with a richness and subtlety that results from a multidisciplinary approach.

This multi-disciplinary approach provides a reliable new basis for targeting and evaluating the effectiveness of investments in prevention by studying the impacts on the interrelated system of the injured worker, coworkers, family, and the community, as well as the organizational structures that were the setting for the incident. This poster session presents an introduction to systems theory applied to traumatic injury and socioeconomic consequences research. Case studies from mining (one of the occupations with the highest national fatality and injury rate) are used as examples of applying this approach.

Session: 2 Paper Number: 33

The National Study to Prevent Blood Exposures in Paramedics: Protecting the Nation's First Responders

Sara Baden, MPH (1), Jack K. Leiss, PhD, MPH (1), Jennifer M. Ratcliffe, PhD, MPH (1), Jean G. Orelien, MStat (1), Jennifer A. Tierney, BA (1), Winifred L. Boal, MPH (2), Nicole D. Hawkins, MPH (1), Janine Jagger, PhD, MPH (3)

(1) Statistics and Public Health Research Division, Analytical Sciences, Inc., 2605 Meridian Parkway, Suite 200, Durham, NC 27713. (2) Surveillance Branch, Division of Surveillance, Hazard Evaluations, and Field Studies, National Institute for Occupational Safety and Health, 4676 Columbia Parkway, R-21, Cincinnati, OH 45226. (3) International Health Care Worker Safety Center, University of Virginia, 1224 W. Main Street, Suite 400, Charlottesville, VA 22903

This study presents results on occupational blood exposure from a national mail survey of paramedics, the first national study of occupational blood exposure in this population. Previous studies of local populations showed that paramedics are at risk for occupational blood exposure and infection from blood borne pathogens including hepatitis B virus (HBV), hepatitis C virus (HCV), and human immunodeficiency virus (HIV). The goal of the study is to reduce occupational exposure to blood borne pathogens among paramedics. The study has four primary aims:

1) Estimate the incidence of blood exposure;
2) Identify risk factors and quantify their effects for exposure to blood;
3) Estimate the use and availability of various exposure prevention measures; and
4) Identify potential strategies for prevention of occupational blood exposure.

Using a two-stage sampling scheme, 6,500 paramedics were selected from lists of licensed paramedics provided by ten state licensing agencies. Questionnaires were mailed to paramedics in California, Connecticut, Florida, Kentucky, Minnesota, North Carolina, Ohio, Pennsylvania, Tennessee, and Texas during fall 2002 through February 2003. Illinois was also selected, but was unable to provide paramedics' contact information because of privacy restrictions.

Paramedics were asked about current job status, use and availability of equipment and devices, safety procedures, and blood exposure incidents within the previous 12 months. For each incident reported, they were asked about route of exposure (needle or lancet stick; other sharp object stick; blood in eyes, nose, or mouth; bite; or blood on non-intact skin), body part exposed, safety devices or equipment that were being used, circumstances contributing to the exposure, and whether the incident was reported.

According to preliminary results, the most frequent exposures reported were mucocutaneous blood splashes to the eyes, nose, or mouth, and perhaps blood contact with non-intact skin. While almost 9% (unweighted) of paramedics reported a bite from a patient, in only 20% of such cases was the skin broken. Combative patients were frequently involved in exposure events. Detailed results on exposure rates, use of protective measures, and risk factors for exposure will be presented.

The questionnaire incorporated methodological advances in defining the work environment of paramedics as it relates to blood exposure. Because the survey included both exposed and unexposed paramedics, the results allow the identification of specific exposure risk factors. Data about the circumstances of exposure events are being used to estimate what fraction of exposures is preventable, and to identify promising areas for intervention.

Study results can be used to enhance blood exposure prevention programs for paramedics. Results will be applicable to a wide audience, including practicing paramedics, administrators of emergency medical services, and policy makers. Policy makers can use the results to evaluate the impact of OSHA's Bloodborne Pathogens Standard on preventing blood exposure in paramedics. Study findings will facilitate comparisons between occupational blood exposure in paramedics and other health care worker populations.

Session: 2 Paper Number: 34

Sharps Injuries among Hospital Workers in Massachusetts

Laramie AK, Davis LK

Massachusetts Department of Public Health Occupational Health Surveillance

Occupational exposures to bloodborne pathogens among health care workers are a significant public health concern. The Centers for Disease Control and Prevention (CDC) estimates that between 600,000 and 800,000 percutaneous injuries from contaminated sharp devices occur each year in healthcare, approximately half of which are sustained by hospital-based health care workers. Percutaneous injuries have been associated with occupational transmission of human immunodeficiency virus, hepatitis C and hepatitis B; risk of transmission ranges from 0.3% to 30%. The U.S. Public Health Service has recommended guidelines for post-exposure management of all workers who have sustained occupational exposures to bloodborne pathogens. The direct costs of follow-up testing and treatment range from $500 to $3,000 per injury.

Surveillance of sharps injuries sustained by health care workers is a key component of a comprehensive prevention strategy. While national data has been collected, little is known about sharps injuries among health care workers at the state level. Such data are important to inform prevention activities and promote action at the local level. The Massachusetts Department of Public Health (MDPH) promulgated regulations in 2001 requiring hospitals to report sharps injury data to MDPH. The Massachusetts Sharps Injury Surveillance System is intended to provide information regarding the magnitude of the problem in the state, to identify devices, procedures, departments most frequently associated with sharps injuries, as well as identify specific hospitals with successful sharps injury prevention programs and facilitate sharing of best practices among health care facilities.

Hospitals are required to record and report any occupational exposure to blood or other potentially infectious materials as a result of events that pierce the skin or mucous membranes. All health care workers in hospitals, and their satellite units, licensed by MDPH are included in the population under surveillance. Information from hospital sharps logs is provided to MDPH by employee health and infection control practitioners. Data are coded using standard lists developed by CDC's National Surveillance System for Hospital Health Care Workers. MDPH has provided hospitals with tools and training to assist them in developing effective sharps injury surveillance programs.

Data from the initial surveillance period October 1, 2001 - December 31, 2001 will be presented. Findings by occupation of the injured worker, clinical practice area in which the injury occurred, procedure performed and device involved will be described. Results will be stratified by hospital bed size into categories of small, medium and large hospitals. Experience in conducting follow-up with both high and low risk hospitals will be discussed.

Valuable information about devices involved in sharps injuries will be obtained from data submitted to MDPH. Device information will help hospitals evaluate and select devices for use and may lead to suggestions for changes in procedure and substitution of devices. Information regarding occupation and clinical practice area will be useful in developing specific work practice controls to prevent sharps injuries from occurring. Hospital specific data will enable MDPH to target specific facilities for follow-up. Findings will also generate hypotheses for further research regarding risk factors for sharps injuries and effective intervention strategies.

Session: 3 Paper Number: 35

Evaluation of Compliance with the Exposure Control Matrix in Automotive Body Shops

S.A. Sarpy, R. Rando, Hites, L, Z. Fridge, M. Zyphur

Tulane University

Workers in the automotive body industry have the potential for elevated exposures to a range of hazardous substances, including organic solvents, chromates, lead and isocyanates. The Exposure Control Matrix was proposed by the Environmental Protection Agency (EPA), Occupational Health and Safety Administration (OSHA), the National Institutes of Occupational Health and Safety (NIOSH) and members of the automotive refinish industry in an attempt to control these exposures. It is intended as a guide to facilitate compliance with manufacturers' recommendations for protecting workers against adverse health effects attributed to polyisocyanate exposures during spray painting in automotive body shops. The matrix includes recommendations on types of equipment, control technologies, respiratory protection training, hazard communication and improved work practices. The present study evaluated the extent of compliance with the recommendations made in the Exposure Control Matrix in the New Orleans metropolitan area automotive body shops.

There are approximately 200 automotive body shops in the New Orleans metropolitan area ranging from individual proprietorships to several large corporations. In this study, an interdisciplinary approach was used to measure compliance that integrated behavioral science and epidemiological methods with the traditional industrial hygiene approach. That is, using written surveys and interviews, current exposure reduction work practices were measured including the behaviors of the workers, managers, and shop owners as well as organizational and psychosocial factors that affect compliance with these risk reduction practices. Further, Industrial Hygiene walk throughs were conducted, which verified the types of equipment used in the shop, degree of the functionality of equipment used to control exposures, and areas that are in need of improvement. Finally, worker exposure to isocyanates was measured by collecting personal air samples during spray painting operations.

The results of the study provide descriptive information as well as a baseline regarding compliance with the recommendations of the Exposure Control Matrix in the metropolitan New Orleans area. Intervention effectiveness research of this nature remains a priority area for the National Occupational Research Agenda (NORA) of the CDC and NIOSH. The proposed study systematically evaluates the effectiveness of the Exposure Control Matrix as an intervention technique for the automotive body industry in reducing health risks and thereby enhancing safety for painters. This study also addresses several unanswered questions identified by the NORA including: (1) what are the barriers to the acceptance of new control technologies; (2) what are the individual factors that motivate the adoption of protective work practices; (3) what organizational factors predict success in prevention programs and how can programs be tailored to take these factors into account; and (4) why do managers and workers in some organizations implement occupational health and safety interventions when others do not. Answers to these questions will not only enhance the effectiveness of the Exposure Control Matrix as an intervention but also will promote its adoption and thereby reduce health risks in automotive body shops.

Session: 3 Paper Number: 36

OSHA Violence Prevention Guidelines: Effectiveness in the Mental Health Setting

J.A. Lipscomb (1), K. McPhaul (2), New York State Office of Mental Health Multi-Union Health and Safety Committee (2)

(1) University of Maryland, Baltimore, MD (2) NYS OMH Muti-Union Health and Safety Committee, Albany NY

Significance and Purpose: Workplace violence is a significant hazard in the healthcare sector. In 1999, 43% of all non-fatal assaults against workers resulting in lost workdays across all industries occurred in the health care sector. According to data collected as part of the Department of Justice National Crime Victimization Survey (NCVS), mental health professionals and custodial workers are at nearly four times the risk of assault relative to all health care workers. In 1996, the Occupational Safety & Health Administration (OSHA) published "Guidelines for Preventing Workplace Violence for Health Care and Social Service Workers." The 1996 Federal guidelines provide a framework for addressing the problem. The purpose of this intervention study was to evaluate the effectiveness of these guidelines in preventing violence in the in-patient mental health care setting. This presentation will focus on the practical important of these findings for future violence prevention efforts.

Methods: The New York State Office of Mental Health (OMH) Multi-Union Health and Safety Committee and the University of Maryland collaborated on this intervention effectiveness study. The basic elements of any proactive health and safety program, namely Management Commitment and Employee Involvement, Worksite Analysis, Hazard Prevention and Control, Training and Education provided the framework for the intervention. Two measurement tools were used to evaluate the effectiveness of the guidelines. First, a pre-intervention survey of perceived risk factors for assaults and assault experience in the past year was conducted in June 2001. A post-intervention survey will be conducted in June 2003. Secondly, OMH's Occupational Injury Reporting System (OIRS), an existing computerized data system that provides quarterly injury, lost time, and lost time severity rates on all reported occupational injuries, will be accessed and injury data compared for the calendar year prior to the intervention and the year following the intervention.

Results: The baseline survey data demonstrate that in-patient mental health care staff experience high rates of assault. Data also indicate that although many violence prevention measures have been in place for years, the formal introduction of the OSHA violence prevention guidelines presents the opportunity to identify additional risk factors and prevention strategies. At baseline survey, staff rating management commitment to violence prevention as "excellent or good" reported fewer staff assaults. A comparison of pre- and post-intervention OIRS data is underway and will be presented.

Conclusion: The OSHA guidelines provide an outline for developing a violence prevention program, but since they are "performance-based", it is up to stakeholders within the industry to do the painstaking work of implementing them in a manner that will yield results. Though the OSHA Guidelines were published in 1996, to our knowledge our current project with NY State OMH Multi-Union Health and Safety Committee is the first to evaluate the effectiveness of these guidelines. Management and direct care staff partnership in identifying and implementing violence prevention strategies is anticipated to improve overall workplace health and safety resulting in reduced staff assaults.

Session: 3 Paper Number: 37

Intervention to Prevent, Reduce, and Manage Resident Violence Towards Nursing Home Staff Nursing Assistants

E.L. Fitzwater, D.M. Gates, S. Telineto

University of Cincinnati, College of Nursing

Problems: Nursing Assistants (NA) working in nursing homes experience frequent harassment, threats, and assaults by nursing home residents. Studies indicate that NAs consider that these resident behaviors are violent and abusive yet NAs receive minimal training in prevention and management.

Methods: The investigators conducted a quasi-experimental study in three intervention and three comparison nursing homes to measure NA skills in preventing and managing violence by testing an intervention focused on increasing violence prevention skills. The intervention was based on Social Cognitive Theory (SCT) and included education and problem-solving sessions. Each subject participated in a videotaped simulation using a standardized patient format wherein an actress portrayed a nursing home resident in need of care. The subject NAs (N=138) were given identical instructions to provide care for the resident (actress) as would typically be performed. Each NA received a score on a criterion-referenced Violence Prevention Skill Checklist (VPC) that reflected whether or not the NA demonstrated the skill during the simulation experience. Raters trained to view the videotapes scored each NA skill performance in each simulation by using the VPC. Inter-rater reliability ranged from good to excellent.

Results: ANCOVA statistics indicate no significant differences between groups on 11 of the 12 pre-intervention VPC scores, indicating that the groups were equivalent in 11 of their VPC skills before the intervention. T-test for those subjects where pre and post intervention data points were available indicatesignificant differences between control and intervention groups on six of twelve VPC skills including: 1) maintaining a distance of 12 inches on approach to the resident ($p < .0002$), 2) calling the resident by name ($p < .04$), 3) introducing self to resident ($p < .03$), 4) telling the resident what the NA will do before touching the resident ($p < .002$), 5) appropriate blocking of assaultive attempt ($p < .002$), and 6) validating the resident's emotional state ($p < .03$). There was a significant difference between control and intervention homes for overall VPC skills use at post intervention ($p < .0001$).

Conclusions: NAs demonstrated serious deficits in violence prevention skills intended to manage violence directed towards them from nursing home residents even though 65% of the NAs reported they had received prior violence prevention training. NAs in intervention homes demonstrated significant increases in violence prevention skills acquisition and in their ability to apply the skills in a simulated clinical situation. This study provides evidence of the effectiveness of SCT in training NAs in using skills intended to manage violent behavior by nursing home residents. Simulation is supported as a sound method useful in evaluating clinical skills application. Study results underscore the need for more research focused on examining current training strategies for effectiveness and discovering additional skills useful in violence prevention. Since NAs provide 90% of the hands-on care in nursing homes, there is a clear need to assist these frontline workers frequently exposed to potential harm in their workplace. Providing NAs with evidence-based training enhances their abilities in managing violent behaviors and assists in maintaining their safety and the safety of nursing home residents.

Session: 3

Paper Number: 38

Violence Against Caregivers: An Intervention Study

D. Gates (1), E. Fitzwater, (1), Succop, P. (1)

University of Cincinnati

Problem: The worker most commonly assaulted in the workplace is the nursing assistant (NA) working in long-term care and the perpetrator most often is the patient. There are physical, emotional and economical costs related to violence in healthcare settings.

Purpose: The investigators conducted a quasi-experimental study to test the effectiveness of a violence prevention intervention, based on Social Cognitive Theory.

Methods: One hundred thirty eight NAs from 3 intervention and 3 comparison homes participated. A baseline questionnaire was used to obtain information on demographics, employment, and past violence experience. At pre and post intervention all subjects recorded the following information on an Assault log during 80 hours of work: time of assault, resident's diagnosis, type of assault, caregiving activity being performed, and whether an injury occurred. T-test was used to determine if significant changes in assaults occurred in the intervention group.

The mean number of assaults for the homes ranged from 1.57 to 8.42. A total of 624 assaults were experienced by 94 NAs; 44 NAs (29%) did not encounter any assaults. The mean number of assaults for NAs was 4.52 and 6.64 for NAs who were assaulted at least once. The number of assaults per caregiver during the 80 hours ranged from zero to 64. Thirty one injuries resulted from assaults (5%) during the 80 hours of work. On the baseline questionnaire 59% of the NAs reported that they are assaulted by residents once a week and 16% reported that they are assaulted by residents every day. Additional questionnaire findings regarding lifetime prevalence rates included: 1) 51% reported that they have been injured by a resident, 2) 38% reported that they have received medical attention for an injury from a resident, 3) 10% reported that they have been assaulted by a co-worker, and 4) 4.3% reported that they have been assaulted by a family member. There was not a significant decrease in the assaults for the three intervention homes. However, data analysis excluding the third intervention home showed a significant decrease in the incidence of assaults ($p<.05$).

Summary: The rate of assaults from residents was not surprising and supported findings from previous studies. However, the lifetime prevalence rates of injury and medical care related to assaults from residents were unexpectedly high. The assault rates from co-workers and resident's family members were astounding when compared to other work settings. Although the intervention was significant in its ability to decrease assaults in the first 2 intervention homes, the inability to do so at study completion is probably due to two factors. First, the intervention homes had a much lower assault incidence at baseline making it more difficult to show a significant decrease. Secondly, during the intervention for the third nursing home, two major events occurred that affected the intervention: an attempt to unionize NAs and an unexpected state licensing inspection. More research is needed to study the incidence of all types of violence experience by NAs, as well as interventions to decrease the incidence of violence in this work setting.

Session: 3 Paper Number: 39

Fostering Intervention Effectiveness Research through a NORA - NSC Partnership

J. Thomas (1), R. Sinclair (2), L. Goldenhar (3), M.L. Lin (1)

National Safety Council (1), National Institute for Occupational Safety and Health (2), Institute for Health Policy & Health Services Research (3)

One key to improving the health and safety of the workforce is discerning which interventions are most effective. Yet employers often measure the effectiveness of workplace interventions poorly or not at all. Interventions are selected and implemented with a singular expectation that they will either reduce morbidity and/or mortality (and thus be adopted) or not (and thus be summarily discontinued). Other outcomes are rarely considered. Factors such as the trial period for the intervention, the size of the trial sample, competing explanations of outcomes, and unintended consequences are either neglected or ignored. In addition, the resources that employers allocate for intervention effectiveness research are often very limited.

Both the NORA Intervention Effectiveness Research team and the National Safety Council's Research and Statistical Services Group have been striving to encourage the evaluation of workplace safety and health interventions. The NORA team has published a manual and an article on intervention effectiveness research. It has conducted workshops and seminars on research methods. The NSC Research Group has encouraged such research through competitions and publications that seek to highlight case studies in which safety interventions were systematically evaluated.

In recognition of the need to better equip the employers in conducting intervention evaluation and to encourage this practice, the NORA team and the NSC created a partnership and developed a one-day professional development seminar for employers. Based on the NORA team's guide, this seminar was designed to teach practical research skills for intervention evaluation. A pilot presentation of the course was conducted at the NSC's annual meeting in October 2002. Forty safety professionals attended the full-day workshop. An evaluation of the workshop was conducted, featuring a pretest, a post-test, and a four-month follow-up questionnaire. The results of that evaluation show a positive influence of the workshop on participant knowledge of, and attitudes toward, intervention effectiveness research.

The NORA-NSC partnership will continue as it explores ways to conduct a more extensive and rigorous trial of the one-day workshop. After revisions based on the pilot, the partners hope to test its effectiveness at building evaluation research capacity among NSC members throughout the country. The partnership will also explore other means to encourage this important component of a complete safety and health program.

This presentation will detail the results of the workshop evaluation and the plans for the future of this productive partnership.

Session: 3 Paper Number: 40

Information Dissemination as an Intervention in Occupational Safety and Health: Evaluating its Effectiveness at NIOSH

Nancy Muturi, PhD, Communication Fellow, CDC/NIOSH and Vern Anderson, PhD, Chief, Information Resources Branch, CDC/NIOSH

National Institute for Occupational Safety and Health,Education and Information Division, Information Resources Branch

Evaluation of the process and effectiveness of projects has become increasingly important in public health. This includes evaluating the effectiveness of the communication products and processes involved in disseminating occupational safety and health information to increase understanding for injury and disease prevention. Program evaluation has become necessary in helping these projects to gain direction for improving as they develop and to determine their effectiveness after they have had time to produce results. Schneider and colleagues point out that the process of evaluation and revision helps to ensure that health-related communication tools are effective in assisting the users to understand health issues and make informed choices.

The primary mission of the National Institute of Occupational Safety and Health (NIOSH) is to inform the public about various occupational health issues for the prevention of injuries and diseases. This is achieved through the development and transfer of information, providing recommendations to foster prevention of occupational injuries and disease. Each year the National Institute for Occupational Safety and Health (NIOSH) develops and disseminates about 35 primary "numbered" publications, along with one hundred or more annual "series" publications. The NIOSH publication inventory contains nearly 4,000 scientific and educational documents relevant to occupational safety and health issues.

In collaboration with four professional organizations (American Association of Occupational Health Nurses, American College of Occupational and Environmental Medicine, American Industrial Hygiene Association, and American Society of Safety Engineers), NIOSH has conducted a survey to evaluate their satisfaction of these publications and other communication products developed and disseminated through NIOSH since 1995. The goal of this evaluation survey is to obtain a statistically acceptable sample of user feedback that can be analyzed to identify improvements in our information products and means of delivery. The survey was designed to determine: (1) to what extent NIOSH publications are perceived as credible, useful sources of information about occupational safety and health issues, i.e., a product evaluation, (2) to what extent NIOSH is successful in distributing its occupational safety and health information products to the appropriate user audience, i.e., marketing evaluation; and, (3) to what extent (and in what ways) NIOSH publications have influenced workplace safety and health program practices, i.e., impact evaluation.

Data for this evaluation project were gathered in two phases: focus groups and questionnaire surveys. The information gathered from focus groups was used to formulate the 26-question survey administered to a sample of 1,200 randomly selected members of the four professional associations. Members of these associations were selected because of their knowledge and expertise in occupational health and safety and because of their familiarity with NIOSH publications. An electronic version of the questionnaire was developed giving respondents the option to fill it out electronically. This e-version is easily completed and can be electronically submitted along with an electronic copy of the Survey Response Card.

The purpose of this presentation is to report some of the findings of this evaluation project and how these findings will help in focusing NIOSH's communication products and distribution efforts as well as directing future communication efforts aimed at its stakeholders regarding their preferred publication format, design and delivery system

Session: 3 Paper Number:41

A Cumulative Study of the Effectiveness of Worker Health and Safety Training

M. J. Burke, S.A. Sarpy, K. Smith-Crowe, S. Chan, G. Islam, R. Salvador

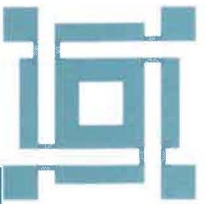
Tulane University

Presently, the literature on worker health and safety training has not been quantitatively integrated. This situation precludes a determination of the relative effectiveness of different types and methods of training with respect to modifying safety-related knowledge, behavior, and outcomes. Based on Burke and Sarpy's (2001) theoretical framework for studying the effects of worker health and safety training programs, this study addresses this deficiency by meta-analytically integrating the extant literature on workplace health and safety training.

Burke and Sarpy argued that the effectiveness of worker safety training can best be studied with respect to an integrative worker characteristic - safety performance - work context matrix that incorporates key individual and organizational variables. At the most general level, they posited that health and safety interventions are designed to impact three broad worker characteristics (i.e., declarative knowledge, procedural knowledge and skill, and motivation/values), which in turn are expected to differentially and directly affect two broad categories of safety performance (i.e., contextual performance and task performance). Worker characteristics are expected to be meaningfully, yet indirectly related to safety and health outcomes concerning accidents, illnesses, and injuries (and thus lower in magnitude in comparison to worker characteristic-safety performance relationships). Furthermore, worker characteristic-safety performance relationships are expected to vary according to two broad categories of work context variables (i.e., organizational climate and organizational risk factors).

This meta-analysis will test hypothesized relationships within Burke and Sarpy's integrative framework and, where feasible, test hypotheses concerning the relative effectiveness of different types of training/safety interventions. For the purposes of this meta-analysis, the "types" of safety training to be examined are: lecture, programmed instruction (including computer-based instruction), small group techniques, role playing, demonstrations/behavioral modeling, simulations (including hands-on training), and virtual reality training.

Based on keyword searches of PsycInfo, ABI Inform, PubMed, and the bibliographies of review articles and technical reports, we initially identified and gathered 607 training evaluation articles and technical reports for potential inclusion. These training evaluation studies were from a broad spectrum of disciplines including applied psychology, business, industrial hygiene, occupational medicine, epidemiology, environmental health, occupational safety, community health, and health education. Two hundred and ten articles were eliminated from further consideration, as they were non-empirical critiques or commentaries. A total of 397 articles and technical reports have been retained for coding and further analysis, including 80 safety training evaluation studies identified by Cohen and Colligan (1998).



We expect the results of this meta-analysis to contribute to our understanding of the relative effectiveness of safety training interventions and to the progressive development of an integrated worker characteristic - safety performance - work context framework. and (b) directing future research efforts with respect to areas where generalizable conclusions are tenuous or cannot be made.

As a result, this large-scale, cumulative evaluation should assist intervention effectiveness researchers in (a) identifying factors contributing to the success of occupational health and safety training efforts, and (b) directing future research efforts with respect to areas where generalizable conclusions are tenuous or cannot be made.

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Session: 3 Paper Number: 42

The Impact of Case Studies in Toolbox Safety Talks

T. Heidotting, C. Stephenson, L. Boldt, H. Linn, F. Varley, P. Keane

National Institute for Occupational Safety and Health

Broad Importance: Estimations that 74% of all work related injuries and illnesses in construction workers were sustained in the initial five years of employment attests to the need for early and effective safety training interventions (BLS, 1998). In addition, extensive reviews of the research have revealed a general consensus that safety training leads to enhanced worker knowledge regarding workplace safety practices (Cohen and Colligan, 1998).

One widely used approach to safety and health training in construction and mining is in the form of toolbox safety talks. These safety talks are brief (10 to 20 minute) discussions attended by a small group of employees (5 to 10 individuals) and can be conducted inexpensively. The discussions are typically facilitated by the foreman or a designated safety trainer and address a specific workplace safety topic.

Although use of toolbox safety talks seems to be increasing and they have the potential to provide industry with an affordable method of training, little research has evaluated their efficacy or ideal content and delivery.

Purpose of Study: This study is evaluating the inclusion of case studies (narratives) derived from work fatality investigation reports on the impact of toolbox safety training for construction and mining workers. The use of case studies in instruction has been widely used in professional training contexts including business, medicine, teaching, and law and has demonstrated favorable results.

The narrative based toolbox talks are being compared to conventional (facts only) instructional materials with respect to worker knowledge gains, changes in safety attitudes and intentions, and changes in workplace safety practices. The Training Intervention Effectiveness Research (TIER) model provided a framework for the study. This presentation will describe findings that have been obtained through formative efforts in developing the study materials, as well as preliminary findings from utilization field work currently underway.

Methodology: Participants in this study include construction workers and miners at various sites throughout the midwest and western states. Data analyses will examine differences between treatment work groups that receive eight weeks of narrative instruction compared to control work groups that receive eight weeks of conventional, didactic instruction. Variables of interest include differences in knowledge gains, attitudes towards safety, changes in behavioral intentions with regard to workplace safety, and observable differences in worksite culture, practices, or policies after training.

Findings: Preliminary findings will be discussed with regard to differences between treatment and control groups in knowledge gains, changes in safety attitudes, and behavioral observations. Feedback from workers as to their satisfaction with the training will also be discussed. Lessons learned from collecting data in these industries will be highlighted.

Applications of the Findings: Findings from this study will help to guide the development of future training materials by identifying the characteristics of effective toolbox safety training and the conditions that favor effective delivery of that training. Upon completion of the study, recommendations will be made to assist interested stakeholders in developing effective toolbox lessons. Such resources are especially needed by small businesses.

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Session: 3 Paper Number: 43

Field and Laboratory Glove Permeation Studies with Pesticide Formulations

S.S. Que Hee, R.N. Phalen, H. Zainal

Department of Environmental Health Sciences and UCLA Center for Occupational and Environmental Health, School of Public Health, University of California at Los Angeles

While the standard ASTM method for permeation has been a useful screening method to rank-order the protectiveness of gloves when challenged with chemicals, there is still need to develop more realistic screening protocols for both laboratory and the field that involve whole glove studies. The results of such protocols also require comparison with those from the standard ASTM method.

In the present study, aqueous emulsions of Captan, Benomyl, and Folpet wettable powder formulations at their highest field spraying concentrations were evaluated separately by the ASTM method using isopropanol as collection solvent for benomyl and folpet, and hexane for captan. The collection side was analyzed for pesticide by either capillary gas chromatography-electron capture (GC-ECD) or capillary gas chromatography-mass spectrometry (GC-MS). Benomyl was analyzed as the pentafluorobenzyl derivative of carbendazim. Folpet was monitored as its on-column pyrolysis product phthalimide. The challenged and inner glove surfaces were examined by attenuated total reflectance Fourier transform infrared (ATR-FTIR) analysis also to assess if this technique had the sensitivity and selectivity to detect surface residues of pesticides. All of the pesticides permeated slightly by 8 hours (less than 100 ng/cm2/min calculated on a time weighted average basis) but more than 250 ng/cm2. Pesticide was definitely detected on the dried surface of the challenge side, but not of the collection side by ATR-FTIR.

Since benomyl tended to decompose to the animal carcinogen carbendazim in water and folpet required strict column temperature control conditions to prevent on-column pyrolysis, captan which did not decompose in water or on-column was selected for further method development with a portable ATR-FTIR, the TravelIR. The optimized method involved solvent casting on nitrile glove material, and resulted in least quantifiable limits of 1.9 microgram/cm2 (working linear range 3.7-34 microgram/cm2) for the inner surface, and 0.20 microgram/cm2 (working linear range 0.75-29 microgram/cm2) for the outer surface at a wavelength of 1735 wave numbers at 128 scans per analysis. This sensitivity is adequate to detect beneath the ASTM flux threshold of 250 ng/cm2. Thus, at least for captan, the sensitivity and selectivity of quantitation for ATR-FTIR are sufficient for use as a feasible field screening technique.

Experiments are still in progress using moving and stationary mechanical hands with whole gloves to evaluate the permeation of aqueous captan emulsions, with those results to be reported at the Conference.

This research was supported through the UCLA Center for Occupational Safety and Health, and NIOSH RO1 03754A and ASPH/NIOSH S1891-21/21.

Session: 3 Paper Number: 44

Automated Breathing and Metabolic Simulator (ABMS) CO2 Test for Powered and Non-Powered Air-Purifying Respirators, Airline Respirators, and Gas Masks

N.L. Turner, E. Sinkule, S. Hota

National Personal Protective Technology Laboratory, National Institute for Occupational Safety and Health

It has been estimated that several million workers are required to wear respirators. Elevated inhaled carbon dioxide concentration is an inherent aspect of respirator wear. The physiological effects of breathing 3 - 4% inhaled CO2 are hyperventilation and headache. Previous data suggest that CO2 concentrations in nonNIOSH-approved surgical helmets exceed the NIOSH REL of 0.5% and that CO2 levels exceed the NIOSH STEL of 3% in a prototype powered air-purifying respirator operating with the blower turned off. There is currently no NIOSH certification test for CO2 concentrations in air-purifying respirators.

For this study the Automated Breathing and Metabolic Simulator (ABMS), which simulates human metabolism, minute ventilation, and breathing waveforms, was used to characterize average inhaled CO2 in a variety of NIOSH-approved air-purifying respirators. An ABMS CO2 test protocol was developed to test 11 powered air-purifying respirators (PAPR's), 20 airline respirators (SAR's), six gas masks, 27 P-100 air-purifying respirators (APR's), and 26 filtering-facepiece N95 respirators (N95's). The ABMS CO2 protocol consisted of the following levels of O2 consumption, CO2 production, and minute ventilation performed consecutively for a minimum of five minutes each: 0.5, 0.4, and10 L/min STPD; 1.0, 0.8, and 25 L/min STPD; 1.5, 1.3, and 38 L/min STPD; 2.0, 1.9, and 62 L/min STPD; 2.5, 2.5, and 70 L/min STPD; and 3.0, 3.1, and 80 L/min STPD, respectively. The mean across all PAPR models for average inhaled CO2 and O2 ranged from 0.2% and 20.7%, respectively, for the lowest metabolic rate to 0.9% and 20.0%, respectively, for the greatest metabolic rate. The mean across all SAR's for average inhaled CO2 and O2 ranged from 0.5% and 20.3%, respectively, for the lowest metabolic rate to 0.4% and 20.5%, respectively, for the greatest metabolic rate. The mean across all gas masks and APR's for average inhaled CO2 and O2 ranged from 2.6% and 17.5%, respectively, for the lowest metabolic rate to 0.7% and 20.4%, respectively, for the greatest metabolic rate. The mean across all N95's for average inhaled CO2 and O2 ranged from 3.5% and 16.8%, respectively, for the lowest metabolic rate to 2.7% and 18.6%, respectively, for the greatest metabolic rate. These data demonstrate the wide range of average inhaled CO2 concentrations across respirator types and the utility of the ABMS in conducting CO2 testing.

Session: 3 Paper Number: 45

The Effects of Job Complexity and Proactive Personality on Occupational Stress and Health

Steve M. Jex (1), Jennifer L. Burnfield (1), Eyal Grauer (1), Gary A. Adams (2), Emily Morgan (2)

(1) Bowling Green State University, (2) University of Wisconsin, Oshkosh

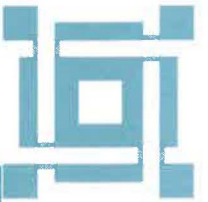
The impact of the "organization of work" on occupational health has received little research attention. Although extensive literature has linked job characteristics (e.g., low autonomy) to occupational stress and stress-mediated health outcomes, this research is primarily based on self-report data examining a limited range of work context and outcome variables. Further, little is known about employee characteristics that buffer work context effects on occupational health.

This study addresses these limitations by examining the interaction effects between work context and employee characteristics on occupational health. The objectives were to examine: (1) whether proactive personality moderates relations between stressors (role conflict and ambiguity, interpersonal conflict, and organizational constraints) and strains (general health, work-family conflict (WTF), family-work conflict (FTW), job and life satisfaction) and (2) whether work context (interpersonal complexity and mental demands) impacts any buffering effects.

Participants (N=188, 57% female) working 42.6 hours/week on average completed a questionnaire. Composite job complexity measures (interpersonal complexity, mental demands) were created from archival data (O*NET) based on participant's job title.

Proactive personality moderated several stressor-strain relationships. The nature of these effects differed depending on the type and level of complexity. The trend was for individuals high on proactive personality to respond negatively to stress regardless of complexity level, particularly for interpersonal complexity. Conversely, individuals low on proactive personality tended to react more favorably to stressors under low job complexity. This pattern of results was slightly less consistent for mental demands. For example, under high mental demands low proactive personality buffered the effects of constraints on FTW, but high proactive personality increased general health as interpersonal conflict increased.

These findings advance research on the organization of work and occupational health by suggesting that high proactive personality does not serve as a general buffer against the effects of stressors. Our results suggest that low proactive personality may be more functional, particularly for individuals holding low-complexity jobs. When jobs are low in scope, non-proactive employees may be better off because they cannot alter the stressors they encounter. Perhaps the active, problem-focused coping methods that highly proactive individuals tend to use may be thwarted when complexity is low.



In practical terms, organizations may consider selecting individuals low in proactive personality for low-complexity jobs. We do not suggest that organizations should ignore workplace stressors, stop trying to alleviate them, nor should they forego enriching jobs. Indeed, our results suggest that increasing mental demands may be beneficial for those with high proactive personality under some conditions (e.g., high interpersonal conflict). However, sometimes stressors are not easily alleviated and jobs cannot easily be changed. In such situations, selecting individuals who are not highly proactive may be a viable strategy.

These findings can improve workplace health by considering the role that a combination of work context and employee characteristics may have on job redesign interventions. Overall our results highlight the importance of considering the differential effects job redesign efforts may have on employee health-based on the employee's personality. Primary prevention strategies may not be universally effective without taking these factors into consideration.

Session: 3 Paper Number: 46

A Pilot Study to Assess Safety Climate, Occupational Injuries, and Safety Practices among Hispanic and non-Hispanic Construction Workers.

S.A. Felknor, K.D. Burau, D. Olipant, R.F. Frankowski

The University of Texas Houston Health Science Center, School of Public Health

Significance: The construction industry is considered one of the most dangerous in the industrialized world, and the Hispanic construction workforce is increasing at a pace twice that of the general US population. These workers are often at greater risk for workplace injuries, and they are more likely to experience traumatic and/or fatal injuries than their non-Hispanic co-workers. Effective injury prevention strategies are often hampered due to lack of reliable data, particularly with respect to the differences between Hispanic and non-Hispanic workers. The role of safety climate and its association with workplace injuries and safety practices has been well documented in the health and safety literature. Safety climate has not been well characterized in the construction industry and more work is needed to evaluate differences between Hispanic and non-Hispanic workers. A scientifically valid survey instrument designed to assess these constructs can provide needed data to the construction industry so that culturally sensitive prevention programs can be developed to reduce the human and economic costs of premature death and lost-time due to injury.

Purpose: A pilot study was designed to develop and validate a survey instrument to assess safety climate, occupational injuries, and safety practices among construction workers; and to assess the feasibility of accessing different construction worker populations. The survey was developed in English and in Spanish to accommodate the bilingual workforce.

Methods: A cross-sectional survey was designed based on previously validated scales in other occupational settings. The initial survey was further refined through focus groups and literature review. Safety climate was assessed through seven different scales that included: worker training, work environment, personal protective equipment, safety program, management commitment to safety, job-task demands, and open communication. The number of injuries experienced and reported was also included in the questionnaire, along with compliance with safety practices. The survey was translated and back translated into Spanish and English, and pre-tested for appropriate reading level and translation. The final questionnaire was pilot tested among a convenience sample of 50 construction workers at different sites in Houston, Texas.

Results: The survey yielded 49 complete and usable questionnaires. With the exception of management commitment to safety, all of the safety climate scales and the level of compliance with industry safety practices were below the desirable range, suggesting that there is need for improvement in these areas. Differences in these scales between Hispanic and non-Hispanic workers are being evaluated. The number of work injuries was assessed and significant under-reporting of injuries exists. The overall under-reporting rate of injuries among all respondents was 72%; Hispanic workers had an 82% under-reporting rate compared to 62% for their non-Hispanic co-workers.

Implications: The results of this study suggest that there are important differences between Hispanic and non-Hispanic construction workers that need to be investigated further. A better characterization of safety climate, occupational injuries, and safety practices in the construction industry will help guide effective and culturally sensitive practices.

Session: 3 Paper Number: 47

Occupational Health Surveillance of Low Income Minority and Immigrant Workers through Community Health Centers

Kerry Souza and Letitia Davis

Massachusetts Department of Public Health

Low-income minority and immigrant workers are believed to be over-represented in hazardous occupations and have poor access to health care and occupational health information. However, data describing the occupational health experience of these workers is lacking in many occupational health surveillance systems. The Massachusetts Department of Public Health (MDPH) is conducting a surveillance research project to evaluate the feasibility of collecting occupational health information through community health centers (CHCs) in order to document the health and safety experience of low-income, minority populations. The project also aims to promote prevention of workplace injury and illness through CHC-based intervention activities.

A central component of this project is the administration of a survey about work and occupational health experience to employed CHC patients. The survey, administered in English, Spanish, Portuguese, Vietnamese, Kmher and Cape Verdean Creole, collects information about: occupation and industry; working hours; health and safety training at work; language in which safety information was delivered; perceived hazards on the job; experience of injury or illness at work in the last year; knowledge of OSHA and workers' compensation; and demographics including English language ability. The survey is conducted in CHC waiting rooms using a standardized survey instrument, bilingual interviewers and incentives to respondents. Approximately 1400 completed surveys are anticipated. This presentation will focus mainly on the survey project.

This presentation will provide an overview of survey findings. It will include descriptive statistics on occupation and industry; number of jobs and hours worked; health and safety training; experience of injuries and illnesses; and knowledge of occupational health resources. Findings will be stratified by gender, ethnicity, occupation, immigrant status, length of time in U.S and union membership. Language in which health and safety training was provided will be compared to language spoken. Experience of injury or illness on the job will include rates of injuries and illnesses among this sample, respondents' experience with receiving wages while injured, and respondents' accounts of reporting injuries and seeking care. Implications for ongoing use of CHCs for surveillance will also be discussed.

This surveillance research project will provide an important snapshot of workers' occupational health and safety experiences across a broad spectrum of industries and occupations. Survey findings will help fill a gap in knowledge about immigrant workers and their workplaces and inform prevention efforts by public health agencies and non-profit organizations. Survey findings may also generate hypotheses for future research into factors that may contribute to increased risk for occupational injury and illness among low-income minority and immigrant workers. Overall conclusions of the surveillance research project will give insight into the potential to work with CHCs to improve surveillance and prevention of occupational injuries and illnesses among low-income minority and immigrant workers.

Session: 3 Paper Number: 48

Farm Exposure to Individual Pesticides and Glioma in Men.

A.M. Ruder (1), M.A. Waters (1), M.A. Butler (1), T. Carreon (1), G.M. Calvert (1), K.E. Davis-King (1), P.A. Schulte (1), W.T. Sanderson (1), E.M. Ward (1), L.B. Connally (1), E.F. Heineman (2), J.S. Mandel (3), R.F. Morton (4), D.J. Reding (5), K.D. Rosenman (6), G. Talaska (7)

(1) National Institute for Occupational Safety and Health, Cincinnati, OH 45226 (2) National Cancer Institute, Rockville, MD 20852 (3) University of Minnesota, Minneapolis, MN 55455 (4) Mercy Medical Center, Des Moines, IA 50314 (5) Marshfield Foundation, Marshfield, WI 54449 (6) Michigan State University, East Lansing, MI 48824 (7) University of Cincinnati, Cincinnati 45267

An excess incidence of brain cancer in farmers has been noted in several studies. The Brain Cancer Collaborative Study Group conducted the Upper Midwest Health Study to evaluate associations between rural exposures and brain cancers among adult (18-80) male and female rural residents in Iowa, Michigan, Minnesota and Wisconsin, where brain cancer incidence is significantly elevated. Histologically confirmed intracranial glioma cases (458 men) diagnosed January 1, 1995, through January 31, 1997, were identified from hospitals, medical practices, and cancer registries. Controls (648 men) were stratified samples of licensed drivers (ages 18-64) and Health Care Finance Administration enrollees (ages 65-80) residing in rural counties of each state. In-person interviews with participants or proxies collected farm, occupational, and other exposure information. Participants who lived on a farm where a pesticide was used were classified as exposed to that pesticide; those who reported personally handling a pesticide on the farm were classified as users. A NIOSH reference database, with over 800 trade names whose active ingredients have been identified was used to convert pesticide trade name responses to generics. The frequency of farm use of generics was used to identify pesticides to which >=100 participants (men and women) reported exposure. Multivariate logistic regressions controlled for farm residence and for age since controls were older. Those exposed to or using farm pesticides were compared with the 128 controls and 125 cases who had no farm, home and garden, or occupational pesticide exposure. Exposure to any farm pesticide was associated with lower glioma risk: adjusted odds ratio [OR] 0.54, 95% confidence interval [CI], 0.36-0.83. There was no association between farm residents' exposure to alachlor, cyanazine, diazinon, dicamba, glyphosate, metolachlor, pendimethalin, or trifluralin, and glioma risk. There were negative statistically significant associations between glioma risk and farm residents' exposure to 2,4-D, atrazine, DDT, and malathion. Use of any farm pesticide also was associated with lower glioma risk: OR 0.51, CI, 0.33-0.80. Personal use of pesticides on the farm was significantly lower among cases than controls for 2,4-D, alachlor, atrazine, cyanazine DDT, dicamba, malathion, and metolachlor. Results for analyses excluding proxy respondents (47% of cases) did not differ significantly. Evidence has been shown for pesticides crossing the blood-brain barrier and for pesticide central nervous system neurotoxicity. However the evidence for pesticide carcinogenicity in the brain is not strong. In our study, no positive association of farm pesticide exposure or use and glioma risk was found. Other farm exposures, which will be analyzed in future papers, may explain the excess brain cancer risk seen in previous studies of rural residents.

Session: 3 Paper Number: 49

Farm Exposure to Pesticides and Glioma in Women

A.M. Ruder (1), M.A. Waters (1), M.A. Butler (1), T. Carreon (1), G.M. Calvert (1), K.E. Davis-King (1), P.A. Schulte (1), W.T. Sanderson (1), E.M. Ward (1), L.B. Connally (1), E.F. Heineman (2), J.S. Mandel (3), R.F. Morton (4), D.J. Reding (5), K.D. Rosenman (6), G. Talaska (7)

(1) National Institute for Occupational Safety and Health, (2) National Cancer Institute, (3) University of Minnesota, (4) Mercy Medical Center, (5) Marshfield Foundation, (6) Michigan State University, (7) University of Cincinnati

An excess incidence of brain cancer in male farmers has been noted in several studies, but few studies have focused on women. This study evaluated the association between pesticide exposure and brain cancer among adult (18-80) female rural residents in Iowa, Michigan, Minnesota and Wisconsin, states where brain cancer incidence is significantly elevated. Since it has been suggested that hormonal factors play a role in the development of brain tumors, the effect of pesticides reported as endocrine disruptors was also evaluated. Histologically confirmed intracranial glioma cases (n=341) were identified from hospitals and medical practices. Controls (n=528) were stratified samples of rural residents who were licensed drivers (ages 18-64) and Health Care Finance Administration enrollees (ages 65-80). In-person interviews collected farm, occupational and other exposure information. Participants exposed to pesticides resided on farms where pesticides were used; participants who used pesticides personally handled them. A National Institute for Occupational Safety and Health database was used to convert pesticide trade name responses to generics. Pesticides to which 100 participants (either gender) reported exposure were identified. Logistic regression models adjusted for farm residence and age, using as reference group 156 cases and 201 controls who had no farm, home and garden, or occupational pesticide exposure. No association with glioma was observed for exposure to or use of arsenical pesticides, botanical pesticides, carbamates, chloroacetanilides, dinitroanilines, dinitrophenols, inorganic pesticides, organochlorines, organothiophosphates, phenoxy pesticides, triazines, or urea-based pesticides. A negative statistically significant association was observed for farm residents' exposure to organophosphates and glioma, but not for personal use. No association was observed between farm residence, exposure to or use of 2,4-D, atrazine, cyanazine, diazinon, dicamba, glyphosate, malathion, metolachlor, pendimethalin, or trifluralin, and glioma risk. Pesticides with reported estrogenic activities, such as DDT and alachlor, did not affect the risk of glioma. Women were less likely than men to have applied pesticides, but more likely to have laundered pesticide-contaminated clothes. Results were not affected by exclusion of proxy responses (43% cases, 3% controls). This is the first population-based case-control study of glioma among rural residents to evaluate the effect of pesticide exposure and work practices in women. No evidence for association of pesticide use and glioma risk was found. Other farm exposures, yet to be analyzed, may explain the excess brain cancer among rural residents.

Session: 3 Paper Number: 50

Polymorphisms in GSTM1, GSTT1, GSTP1, and NAT2 and Susceptibility to Primary Intracranial Brain Gliomas

M.A. Butler (1), A.M. Ruder (1), A.K. Daly (2), M.A. Waters (1), T. CarreÌn (1), and P.A. Schulte (1)

(1)National Institute for Occupational Safety and Health, Cincinnati, OH 45226; (2)University of Newcastle Medical School, Newcastle upon Tyne, UK

Enzymes encoded by GSTM1, GSTT1, GSTP1, and NAT2 are important in the biotransformation of a variety of carcinogens and polymorphisms in these genes have been identified as risk factors for numerous environmentally and occupationally induced cancers. In order to evaluate GSTM1, GSTT1, GSTP1, and NAT2 polymorphisms as risk factors in primary intracranial gliomas and explore their interactions with exposure, we determined their prevalence in participants in the Upper Midwest Health Study. This population-based case-control study was designed to identify risk factors for gliomas in rural residents in four upper midwestern states with high glioma incidence. Glioma cases (n=799) were identified from hospitals, private medical practices, and cancer registries. Controls (n=1176) were stratified samples of licensed drivers and HCFA enrollees. Questionnaires were administered to participants to identify occupational and environmental exposures. Blood was obtained from 325 case and 579 control participants. DNA was prepared from whole blood using solvent extraction procedures, and RFLP/PCR and gel electrophoresis procedures were used to characterize polymorphisms. We characterized GSTM1 (wild type and *0/*0), GSTT1 (wild type and *0/*0), GSTP1 *A, *B, *C, and *D, and NAT2 *4, *5A, *5B, *5C, *5E, *6, *7, *14, *12A, *12B, and *12C alleles. There were no statistically significant associations between polymorphisms and increased risk of glioma: GSTM1 *0/*0, present in 50.7% of controls and 50.6% of cases (odds ratio [OR] 1.00, 95% confidence interval [CI] 0.76-1.31); GSTT1 *0/*0, present in 14.6% of controls and 17.2% of cases (OR 1.22, CI 0.84-1.77); GSTP1 *B and *C 105val/105val present in 12.9% of controls and 11.5% of cases (OR 0.88, CI 0.58-1.34); NAT2 rapid acetylation status observed in 42.7% of controls and 48.1% of cases (OR 1.25, 95% CI 0.95-1.64). In addition, there were no statistically significant associations between specific polymorphisms and histopathologic subtypes. To determine if the polymorphisms were risk factors only under specific exposure conditions, participants were stratified by smoking status: ever (162 cases, 330 controls), never (163 cases, 249 controls); and by living on farm status: never (141 cases, 199 controls), ever but pesticides never used (71 cases, 130 controls), and ever and pesticides ever used (113 cases, 250 controls). Unadjusted odds ratio for polymorphism frequencies did not differ significantly between cases and controls in any of the subgroups. A multivariate logistic regression including all four polymorphisms plus farm status found a borderline increased risk for glioma associated with NAT2 rapid acetylator and a non-statistically significant increased risk associated with GSTT1 *0/*0. Future analyses will include additional occupational exposures.

Session: 3 Paper Number: 51

Communication Statregies for the Young Worker

R.M. Nester, M. Lutz

Occupational Safety and Health Administration

Importance of Research Area: A key determinant of an outreach program for any population is a keen awareness and incorporation of the target population's communication and learning styles into the delivery of the intended message. This is extremely important when designing approaches impacting the future safety and health of the intended audience. In particular, the educational, developmental and experiential attributes of the adolescent challenge the message designer.

In fact, the young worker is a special population of interest to whom the Occupational Safety and Health Administration (OSHA) is focusing attention through a myriad of program initiatives. This worker population is exposed to the same hazards, resulting in the same illnesses and injuries as seen in the adult worker population. However, the young worker's rates of occupational illnesses and injuries are substantially higher than their adult counterparts. Also, research indicates that youth learn differently than the adult learner; they respond differently to communication strategies. The same educational, developmental and experiential attributes of the adolescent that challenge the message designer can also adversely impact the occupational outcomes of this population. The resulting outcomes may be dramatically different from the intent of the message.

Study Purpose / Methods: OSHA conducted several focus groups with the purpose of describing a more acceptable media and outreach campaign designed to address the safety and health issues of the young worker. Three focus groups each were conducted in Boston and Phoenix. Each group of young workers was composed of participants of varying educational status and work experience. Participants were provided mock examples of campaign strategies and requested to comment on each. Each session was audio-taped and transcribed. Data were analyzed for trends.

Summary of Findings: Findings mirrored other research efforts. The young worker is open to peer endorsement of problem areas, celebrity endorsement is seen as biased. "Catchy" slogans were viewed as patronizing. The young worker's preference for learning is web-based activities designed to challenge and teach; interactive, true to life vignettes focusing on the common elements of daily life are critical to lend meaning to the message. Life impact is of great importance.

Application of Findings: These findings support previous research efforts in the field of communication strategies designed toward youth. As OSHA's efforts continue to expand, education through positive communication will be a paramount concern for the young worker population. Therefore, it is important to understand the learning response of the young worker. These findings provide guidance for the shaping of current and future OSHA endeavors to institute change in the perceived value of safety and health as a young worker cultural phenomena.

Session: 3 Paper Number: 52

Working Adolescents and Young Adults: Job Stress, Emotional Labor, and Cardiovascular Risk

S.T. Fitzgerald (1), A.B. deCastro (1), J.A. Haythornthwaite (2)

(1) The Johns Hopkins Bloomberg School of Public Health, (2) The Johns Hopkins School of Medicine

America's youth often join the labor market in low-level, frontline, interactive service jobs. For some, these are part-time efforts during continued education and serve as a transition to permanent, higher level employment. For others, service jobs become their careers. Service jobs often challenge the individual's interpersonal skills, and work interactions can range from dealing with angry or rude customers to satisfying a supervisor's expectations for productivity. Recent discussions of job stress and emotional labor are particularly relevant to young workers in the service industries. In addition to the immediate effects of job stress on emotional well-being, the long-term risk for cardiovascular disease may be elevated for urban youth exposed to job stress and emotional labor. We have followed 249 young working urban adults (63% African American; 71% female) after graduation from high school into adulthood and tracked employment (73% employed service or retail sectors), job stress and emotional well-being, and cardiovascular risk. Our work suggests that job stress in young adults may have identifiable social-emotional antecedents early in life. Over a 5-year period, high levels of anger in high school predict perceptions of low job control in adulthood, a key component of job stress.

Additionally, greater social problem-solving skills and better school performance predicted better co-worker relations in young adulthood. These findings lead us to investigate work characteristics that may elicit anger in young adult workers. In adulthood, low levels of job control and high levels of job dissatisfaction were strongly and consistently associated with work-related anger, with job dissatisfaction showing a strong relationship with anger directed towards customers. The strong link between job dissatisfaction and work-related anger suggests that unhappiness with one's job, in younger service sector workers, may signal interpersonal difficulties and hostile emotions that may increase heart disease risk. We have found that ambulatory measures of heart rate are elevated in white workers who report high levels of demand and low levels of control over their work. Similarly, these same workers showed higher levels of LDL-C and a tendency for lower levels of HDL-C. Although our sample shows expected low rates of CVD risk due to their age, these findings support the need for continued longitudinal studies of the impact of work characteristics on physical and emotional well-being. In addition to the focus on job control as an index of job stress, our work has expanded to consider the role of emotional labor as a more appropriate index of job stress among service workers. Our group has refined a measure of emotional labor and found that two key concepts comprise emotional labor - surface acting (presenting one's emotions consistent with an employer's expectations) and deep acting (internalizing the expected emotions). Our preliminary analyses suggest that young adults who experience high levels of negative mood, including anger, are more likely to experience depressive symptoms when working in situations where both types of emotional labor - surface and deep acting - are high. Interventions designed to assist adolescents and young adults who chronically experience anger and workplace stress may be warranted.

Session: 3 Paper Number: 53

The Impact Of Diabetes On Work Performance

E.G. Phillips (1), C.A. Mancuso (1), S. Morales (1)

(1) Weill Medical College of Cornell University, New York, New York.

Background: Work disability affects large numbers of patients with diabetes in the United States. The purpose of this study is to identify the psychosocial, occupational, and disease severity characteristics that are associated with work limitations in patients with diabetes mellitus(DM).

Methods: Patients from an urban primary care practice who spoke English, were >=18 years of age, employed, and treated with insulin or oral medications were enrolled in this cross-sectional study. Patients completed an in-person interview including the validated Work Limitations Questionnaire (WLQ), a 25-item questionnaire that measures the degree to which health problems impact four sub-groups of work tasks: time management, mental-interpersonal demands, physical demands and output demands. Scores for each sub-group range from 0-100 (high scores = more limitations). Additional survey questions addressed social support, physical function, comorbidity and perceptions about DM and work. Data regarding diabetes severity were obtained by chart review.

Results: 118 patients mean age 50 years (+/-10), 53% women, 54% Black, 17% White and 16% Hispanic were enrolled. The mean duration of DM was 7.6 years (+/- 8), with a mean HgbA1C of 8.1. 91% of patients had Type II DM with 66% having mild disease defined as no end organ involvement, no hospitalizations for severe hyperglycemia & not juvenile onset. For all patients, mean scores were worse for the time management (17;+/-23.3) and mental-interpersonal sub-scales (13.1;+/- 17.6). In multivariate analysis, the following factors were associated with more limitations in time management; younger age, more education, more depressive symptoms, poor physical function, more manual labor, and requiring insulin. Regarding mental-interpersonal demands younger age, more depressive symptoms, poor physical function, low social support, more manual labor, and more comorbidy were associated with more limitations. Interestingly diabetes severity was not a predictor of work limitations. All comparisons were significant at a $p < .05$.

Conclusion: Patients with diabetes mellitus experience limitiaions in the workplace, especially regarding the time management and mental-interpersonal demands of their jobs. Younger age, more depressive symptoms, poor physical function, and a physically demanding job, but not diabetes severity were associated with these limitations. Strategies to reduce work disability are necessary if patients with diabetes are to remain productive in society.

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Abstracts

Session: 4 Paper Number: 54

Occupational And Non-Occupational Exposures To PM2.5 Among Outdoor And Indoor Workers In Two Mexican Cities

Horacio J. Tovalin (1), Salvador Blanco (2), and Maria T. Morandi (1)

(1) University of Texas-Houston, School of Public Health, and (2) Centro Nacional de Capacitacion e Investigacion Ambiental (CENICA)-Mexico City, Mexico.

Supported by grants CDC/NIOSH T42/CCT610417 and NIH/Fogarty International Center 5 D43TW00644.

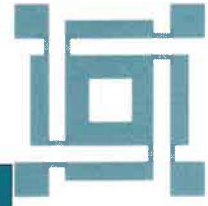
Background: Daily concentrations of ambient airborne particulate matter (PM) in a range of sizes - including TSP, PM10, and PM2.5 - have been associated with adverse cardiopulmonary outcomes in multiple cities. There is limited information on outdoor worker exposures to PM, who could be at increased risk, especially in highly polluted urban areas.

The objectives of this study were to measure PM2.5 personal exposures for a group of bus drivers, taxi drivers and street vendors and to compare these measurements to those of indoor office workers residing in Mexico City, a high pollution urban area, and in Puebla, a lower pollution city.

Methods: The study population consisted of 16 outdoor workers in Mexico City and 9 in Puebla, 15 indoor workers in Mexico City and 6 in Puebla. Two consecutive (one during the work-shift and the other off-work) PM2.5 personal samples were collected at a flow rate of 4 l/min on Teflon filters fitted to SKC personal impactors. Workers also completed a daily time-activity log. All filter samples were weighed at the Centro Nacional de Investigación y Capacitación Ambiental, following USEPA protocols. PM10 concentrations measured at central monitoring sites close to each study area were used with the time-activity information to estimate personal exposures to PM10.

Results: Outdoor worker shifts ranged from 10 to 14 hours in Mexico City and 11 to 18 hours in Puebla; indoor office worker shifts were 8 hours. Occupational exposures to PM2.5 were highest for taxi drivers in the northwest (NW) area of Mexico City (mean±SD: 244.60±242.92 mg/m3, n=5) and lowest for taxi drivers in the southeast (SE) (141.30±88.92mg/m3, n=9). NW indoor office workers had higher occupational exposures (145.37±35.73mg/m3, n=9) than those in Puebla (74.26±24.32/m3, n=6). Street vendors in Mexico City had mean PM2.5 exposures of 210.42±63.82/m3 (n=4).

Average non-occupational exposures to PM2.5 were higher for taxi drivers in Mexico City-NW (130.26±70.62mg/m3) and lower for SE taxi drivers (107.11±69.15 mg/m3). Indoor workers? non-occupational exposures were relatively similar for both cities (NW: 57.42±11.10mg/m3; SE: 60.15±21.29mg/m3; Puebla: 65.30±14.98mg/m3) . Total mean PM2.5 exposures were highest for Mexico City-NW taxi drivers (150.20±13.32mg/m3), intermediate for Puebla bus drivers (133.67±24.79mg/m3) and Mexico City street vendors (129.71±20.97mg/m3), and lowest for Mexico City-SE taxi drivers (115.08±55.96mg/m3). Among indoor workers, total mean PM2.5 exposures were higher in Mexico City (81.73 to 89.88 mg/m3) than in Puebla (67.08mg/m3).



Measured exposures to PM2.5 were 2-fold greater than estimated PM10 exposures for the outdoor workers, and 5-fold greater for indoor workers. Since PM2.5 represents a fraction of PM10, these results suggest that outdoor PM concentrations measured at fixed ambient monitors are not representative of exposure, even for outdoor workers.

Conclusion: Outdoor workers experience higher exposures to PM than indoor workers, with non-occupational exposures being lower than occupational exposures. This pattern differs from non-occupationally exposed population exposures, which are typically dominated by indoor concentrations. Concentrations monitored at fixed ambient locations underestimate personal exposures for outdoor workers. These results have implications for the design of epidemiology studies investigating relationships between exposure to ambient PM and cardiopulmonary effects.

Session: 4 Paper Number: 55

A Study of Heat Strain Among Mine Rescue Workers

F.D. Harley, P.D. Hintz

National Institute for Occupational Safety and Health

Broad Importance: Mine Rescue workers are the front line for emergency response when catastrophic events strike underground mines. Mine rescue teams can face dynamic and extreme environments as they work to rescue trapped miners and restore mine workings to operational status. Rescue operations can require teams to work under self-contained breathing apparatus (SCBA) for up to two hours in dangerous environments. No specific guidance regarding safe operational durations in hot environments has been provided to mine rescue workers in the United States. In October 2002, two mine rescue team members suffered fatal exposures to hot environments in an underground gold mine.

Purpose of Study: This study attempts to quantify the heat strain exposures of mine rescue workers engaged in underground operations in hot environments. The relative contributions of the mine environment, metabolic activity, breathing apparatus, and body mass of the individual will be assessed to identify administrative and engineering controls to reduce the risk associated with mine rescue operations in hot environments.

Methodology: Mine rescue workers were monitored during training exercises in hot underground mines in Idaho and Nevada. Environmental parameters of air velocity, dry bulb temperature, passive wet bulb temperature, globe temperature and rock temperature were measured. Physiological parameters of core body temperature and heart rate were collected in one-minute increments throughout the exercise utilizing thermometry pills. Observations of activities performed were made to assess relative metabolic rates between individuals.

Findings: Ten percent of the participants reached the NIOSH limit of 39 C during the observations. Over 40% of the participants experienced core temperatures in excess of 38.5 C, the ACGIH action level. Over 70% of the participants exceeded 38.0 C, a level associated with diminished judgment and reaction times. Excess heat retention was associated with high peak heart rates and slow recovery rates.

The rate of heat gain observed was predictable. Work time duration limits can be proposed based on ambient conditions, availability of rest periods and initial condition of the mine rescuer. Engineering controls to reduce heat have been identified for further study

Applications of the Findings: A model for prescribing limitations for durations of exposures for mine rescue work is being developed. Validation of the model will require additional monitoring of teams in a variety of exposures.

Administrative tools utilizing ambulatory heart rate monitors can allow teams to regulate their rest periods based on peak and recovery heart rates. An engineering control to provide the ability to hydrate during wearing of the closed circuit SCBA is being evaluated. The impact on acceptable durations of exposure is being assessed.

Abstracts

Session: 4

Paper Number: 56

The abstract paper was withdrawn.

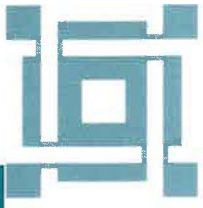
Session: 4 Paper Number: 57

Pharmacologic Protection From Single and Repeated Noise Exposure in Rats

Eric D. Lynch, Rende Gu, Carol Pierce, Jonathan Kil

Sound Pharmaceuticals, Inc., 4010 Stone Way North, Seattle WA 98103

Noise induced hearing loss (NIHL) represents a significant cost and burden to industrialized societies. In an effort to test and develop pharmacologically protective agents we performed single and repeated noise exposures on 8-week old Fischer-344 female rats (110dB-115dB, 4-16kHz noise for 4 hours). In the cochlea, noise evokes the formation of reactive oxygen species including the formation of "super-radicals", such as peroxynitrite. Ebselen, a mimic of glutathione peroxidase and an effective scavenger of peroxynitrite is a neuroprotectant under clinical investigation. In our studies, rats were dosed with 4-16mg/kg Ebselen by oral and intraperitoneal routes of administration before and after noise. Control rats were dosed similarly with vehicle only. ABR thresholds were measured using both click (4-16kHz) and pure tone (4, 8, 12, 16kHz) stimuli. Permanent threshold shifts were evaluated at 3-4 weeks following noise exposure. Morphologic evaluation of individual whole mounted cochleae stained with DAPI to detect cell nuclei and FITC-phalloidin to assay F-actin were performed. On average, three times more outer hair cells were lost in control animals versus Ebselen treated animals in this acute noise exposure model. Physiologic data from ABR analysis indicated that Ebselen provided protection from PTS following single ($p<0.01$) and repeated noise exposure ($p<0.05$). These data demonstrate that systemically administered Ebselen can protect hair cells from repeated exposures to noise. These data also indicate that the severity of the PTS is highly associated with OHC loss. Development of clinically relevant oral formulations of "Otoprotectants" for the prevention of noise induced hearing loss is a feasible means to augment current hearing protection strategies.



Session: 4

Paper Number: 58

Qualitative Methods For Characterizing Worker Exposures in the Metalworking Fluid Environment

R.A. Lunsford, J.R. Pretty, K.K. Brown, R.A. Glaser, J.E. Arnold, S. Beck

National Institute for Occupational Safety and Health

Manufacturing processes involving the shaping or machining of metal often use metalworking fluids (MWFs) to assist in removal of debris and for cooling, lubrication, and protection of freshly exposed metal surfaces. Worker exposure to MWF aerosol has been associated with an increased risk for nonmalignant respiratory disease and skin diseases. In 1998, NIOSH published a recommended exposure limit (REL) for MWF aerosol of 0.4 mg per cubic meter of air for thoracic particulate mass (or 0.5 mg per cubic meter for total particulate mass).

NIOSH Method 5524 was developed to provide quantitative measurement directly related to the NIOSH REL and a fundamental qualitative characterization of worker exposures to MWF aerosol, i.e., the differentiation between total sample mass and extracted mass. Thus far in field studies, all MWFs, as supplied by their manufacturers, have been fully extractable. Unextracted material in field samples may be attributable to non-MWF sources and subject to other health evaluation criteria. Examples from field studies of welding fume exposures are presented to show the benefits of having both measures of exposure.

NIOSH researchers are currently investigating the application of gas chromatography-mass spectrometry (GC-MS) and liquid chromatography-mass spectrometry (LC-MS) for the qualitative analysis of MWFs. GC-MS is a well established technique for identifying thermally stable volatile and semivolatile components of complex mixtures. Recent improvements in the sensitivity and ruggedness of liquid chromatography-mass spectrometry (LC-MS) instrumentation make it a promising tool for the identification of many thermally labile and nonvolatile compounds.

The various MWFs commercially available may comprise hundreds of substances, including cationic and anionic surfactants; alkaline compounds, such as alkanolamines; polar neutrals, such as nonionic emulsifiers; acidic compounds, including fatty acids and phenols; and nonpolar compounds, such as mineral oils and chlorinated paraffins. Solid phase extraction and multimodal liquid chromatographic methods are being evaluated for their ability to fractionate MWF samples by chemical class. Class fractions and unfractionated MWF samples are analyzed by GC-MS and LC-MS to provide specific chemical identifications.

Early results are very encouraging. Direct analysis by LC-MS has demonstrated, in a MWF matrix, specific identification of N-nitrosamines, including N-nitrosodiethanolamine (N-DELA) and N-nitrosomorpholine (N-MORPH), and the biocide, hexahydro-1,3,5-tris (2-hydroxyethyl)-s-triazine. N-DELA and N-MORPH are potentially carcinogenic contaminants of MWF; the biocide has been associated with hypersensitivity pneumonitis.

Methods developed for chemical characterization of the broad range of compounds present in MWF formulations will likely be directly applicable to other sample matrices. The development of these methods is expected to shed light on occupational exposures to a larger array of compounds, including nonvolatile and thermally labile compounds. Detailed knowledge of chemical composition is crucial to specific hazard identification and efficient intervention through product reformulation.

Session: 4 Paper Number: 59

Urinary PAH and Its Metabolites as Molecular Biomarkers of Asphalt Fume Exposure Characterized by Microflow LC Coupled to Hybrid Quadrupole Time-of-Flight Mass Spectrometry

Jin J. Wang, Daniel M. Lewis, Brandon Law, Samuel Stone, Travis Goldsmith, Amy Moseley, Janet Simpson, Ali Afshari, and David Frazer

National Institute for Occupational Safety and Health, Health Effects Laboratory Division

Prolonged, extensive exposure to asphalt fume has been associated with several adverse health effects. To study the molecular biomarkers of the effects, a microflow liquid chromatography (LC) coupled to hybrid quadrupole orthogonal acceleration time-of-flight mass spectrometry (Q-TOF MS) was used to develop a bioanalytical method to characterize benzo(a)pyrene and its hydroxy-metabolites from the urine of asphalt fume exposed rats. In the experiment, sixteen Sprague Dawley rats were exposed to asphalt fume in a whole body inhalation chamber for 10 days (4 h/day) and other eight rats were used as controls. The asphalt fume was generated at 150oC and the concentrations in the animal exposure chamber ranged 76-117 mg/m3. Benzo(a)pyrene and its metabolites of 3-hydroxybenzo(a)pyrene, benzo(a)pyrene-7,8-dihydrodiol(+/-), and benzo(a)pyrene-7,8,9,10-tetrahydrotetrol(+/-) were determined 2.19 ng/100 mL, 16.17 ng/100 mL, 6.28 ng/100 mL, and 29.35 ng/100 mL respectively from the urine of asphalt fume exposed rats. The results indicated that the benzo(a)pyrene and its hydroxy-metabolites in the urine of exposed rats were significantly higher than those from the control groups. The approach, which combined microflow LC separation and collision-induced dissociation for leading to a characteristic fragmentation pattern by hybrid Q-TOF MS, offered a distinct advantage for metabolites identification. The new method was sensitive, selective, and applicable toward the study molecular biomarkers of adverse health effects of occupationally related exposure to PAH hazards. The information obtained from these studies may assist prevent occupational illness by utilizing biomarkers of exposure to determine the need to eliminate or minimize exposure.

Session: 4 Paper Number: 60

Investigation and Follow-up of a Hypersensitivity Pneumonitis Outbreak Using a New Exposure Assessment Tool

Dennis O'Brien

International Union, UAW

Aerosol mapping is a relatively new technique that has been used in the automotive industry to identify sources of metalworking fluid mist, so that corrective actions may be taken. In response to an outbreak of hypersensitivity pneumonitis (HP), aerosol mapping was utilized by a labor union-based occupational health and safety program to establish an exposure baseline and to advise the local union and plant on priorities for corrective actions. This map was later used to estimate exposures for an epidemiological analysis: 30 HP cases were classified as low, medium, and high exposure based on job location. There were six cases among low exposure jobs (4%), 14 cases among medium exposure jobs (19%), and ten cases among high exposure jobs (34%), suggesting a relation between exposure to contaminated metalworking fluid mist and the development of HP. A second map was later generated to determine mist reductions, which varied from about 75 percent to an increase of about 20 percent. (Mist concentrations increased in the areas near an uncontrolled transfer line.) New cases of HP have been eliminated, and the plant and local union jointly perform aerosol mapping to monitor the performance of mist controls.

Session: 4 Paper Number: 61

A Simple Method for Evaluating Sample Size in the Houston ATAC (Air Toxics and Asthma in Children) Study.

D. Lai (1), S. Maberti (1), S. Abramson (2), M. Afshar (1), N. Hanania (2), C. Lusk (1), M. Morandi (1), M. Sockrider (2), T. Stock (1), C. Umeh (1) and G.L. Delclos (1)

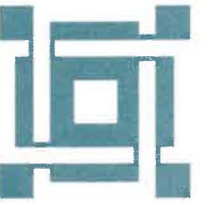
(1) Southwest Center for Occupational and Environmental Health, The University of Texas School of Public Health and (2) Baylor College of Medicine, Houston, TX 77030
This project has been funded by the Mickey Leland National Urban Air Toxics Research Center.

Background: The effect of air toxics (non-criteria airborne pollutants) on asthma is unknown. Given that these compounds are ubiquitous both indoors and outdoors, and that many are established respiratory irritants and/or sensitizers, it is possible that variations in daily exposure can influence the variability of asthma. The Houston ATAC Study is a prospective, pilot panel study investigating the association between exposure to aldehydes and asthma health outcomes (peak expiratory flow, FEV1, symptoms and expired nitric oxide) among persistent asthmatic middle school children, using a repeated measures design over a 12-month period. The study population centers on persistent asthmatic children on the assumption that they may manifest greater variability in asthma outcomes following exposure to airborne stimuli. The study methodology and findings should have important implications for future studies of both occupational and environmental asthma.

Sample size calculation is a key element in any study design. Although several approaches exist, few take into consideration the autocorrelation of repeated measurements of one individual. We studied the effect of sample size and number of repeated measurements on statistical hypothesis testing.

Methods: Preliminary results from 10 subjects with 10 consecutive daily measurements were used for the analysis. The proposed method was based on the asymptotic distribution of the estimated coefficient in general linear models with autocorrelation error structure for the different outcomes of interest. The AR (1) covariance structure was introduced in order to take into account the correlation of the repeated measurements on the subjects. Parameters for each regression and their standard errors were used to estimate sample size for each outcome.

Results: Model coefficients did not differ significantly from 0, probably due to the small sample size used in the calculations. However, the level of autocorrelation of each individual's measurements was very high, justifying the use of the autocorrelation structure. From the estimations, for a power of 0.80 and & #61537;=0.05, the required sample size would be 31 subjects sampled 40 times. The estimates of the ratios of the variance versus the coefficient (and therefore n) could improve by increasing the number of subjects and/or measurements. Given these estimates, we calculated the power obtained with different sample sizes. It was concluded that sampling 30 children would give reasonable power to detect the effect of aldehydes on FEV1 and PEF under the study assumptions.



The relationship between number of subjects, repeated measurements, and statistical power under linear mixed models is not trivial. Methods commonly used to compute sample size generally assume that all subjects have an identical value in the covariate at each time, which is not the case for the studied measurements. The proposed methodology allows correcting for the autocorrelation of the measurements as well as different covariance between and within subjects. Implementation of this methodology should allow for the design of more efficient studies and more powerful hypothesis testing. Additionally, the application of the mixed effects model in this type of data is a relatively new technique, which allows for the evaluation of within- and between-subject variability, so important in the derivation of inferences of causality.

Session: 4 Paper Number: 62

Measuring Physical Risk Factors of Musculoskeletal Disorders During Computer Work

J.T. Dennerlein (1), P.W. Johnson (2)

(1) Department of Environmental Health, Harvard School of Public Health (2) Department of Environmental Health, University of Washington, Seattle WA

The computer workstation is a ubiquitous tool in the office work environment; however, its use varies across many different tasks from surfing the Internet to typing. Furthermore, the positioning of the mouse within the workstation varies and often depends upon the accessible workstation furniture. The question, therefore, is how does exposure to different physical risk factors for musculoskeletal disorders of the upper extremity vary across tasks and various mouse positions within the computer workstation.

Thirty human subjects (15 f, 15 m) performed five different tasks: typing text, completing an html-based form, editing a document, a graphics task, and finally navigating through a series of web pages. For the two different mouse intensive tasks, editing text and web page browsing, the mouse was positioned in three distinct locations within the work station: the standard mouse (SM) position with the mouse directly to the right of the keyboard; the high mouse (HM) with the mouse horizontally one keyboard depth past the keyboard and two inches above the resting surface of the keyboard, emulating a workstation with a keyboard tray without provisions for the mouse and the mouse is placed on the desk; and finally the euro mouse (EM) with the mouse between the keyboard and the body centered with the body's center line. Force sensors underneath the keyboard and in the mouse measured typing force and mouse grip/side and button forces. Seven biopolar pre-amplifying EMG electrodes measured muscle activity of the upper extremity (Flexor Carpi Radialis - FCR, Flexor Carpi Ulnaris - FCU, Extensor Carpi Radialis - ECR, and Extensor Carpi Ulnaris - ECU, Anterior Deltoid - aDel, Medial Deltoid - mDel, and Trapizius - Trap). A magnetic motion analysis system measured the upper arm and lower arm postures, while electrogoinometers mounted inside a glove measured wrist flexion/extension and ulnar/radial deviation.

Muscle activity and shoulder posture was significantly affected by computer task. For the wrist, the extensors were the most active with the greatest activity occurring in the typing task. The wrist activity decreased when the work changed from a keyboard-based activity to predominantly mouse-based activity. The shoulder muscles were most active when both the mouse and the keyboard were required by the task.

Upper extremity posture was significantly affected by mouse position, followed by muscle activity and then applied force. The euro-mouse provided the most neutral upper extremity posture across all measures, with shoulder flexion and abduction 20% of that required for the high mouse and 40% of that for the standard mouse. The standard mouse provided more a neutral posture than high mouse. For muscle activity, significant differences were observed across positions for the shoulder muscles and only one wrist muscle, the FCU. The least amount of muscle activity occurred in the euro-position. Mouse side and button forces were the lowest for the euro-mouse position. The keyboard force was the lowest for the euro-mouse - likely due to the smaller movements needed to access the keyboard during the text-editing tasks.

Session: 4 Paper Number: 63

The Validity and Reliability of the University of South Florida Environmental Assessment Questionnaire

Robert R. Haight, MD, MSPH., Matthew A. Vuskovich, MD, MSPH., Stuart M. Brooks, MD

Department of Occupational and Environmental Medicine, The University of South Florida College of Medicine and College of Public Health, Tampa, Florida

Background: NIOSH, in the National Occupational Research Agenda (NORA), identified "exposure assessment methods" as a priority area for research in occupational medicine. Rapid, inexpensive tools are necessary for the collection of quality exposure data and effective interventions. Furthermore, many times an accurate diagnosis in occupational medicine hinges on an understanding of the exposure.

Methods: The University of South Florida Environmental Assessment Questionnaire (E.A.Q.) is designed to describe the exposures from the workers point of view. There are nine separate categories of exposure that are queried: 1) Dust; 2) Irritant gasses, vapors, and fumes; 3) Chemical exposures; 4) Smoke; 5) Mold, plant, and animal materials; 6) Liquids, mists and aerosols; 7) Physical agents; 8) Mental stress; 9) Lifting, carrying, and repetitive movements. The questionnaire was distributed to a sample of workers drawn from a population of over three thousand workers employed by a Florida food processing plant. The analysis of the validity was based on 211 subjects that responded to the questionnaire and the analysis of the reliability was based on 44 subjects that returned two separate questionnaires.

Results: For the category scores, the sensitivities ranged from 0.67 to 0.98, the specificities ranged from 0.28 and 0.83, the positive predictive ranged from 0.60 to 0.93, and the negative predictive values ranged from 0.55 to 1.0. All of the weighted kappas for the subcategories were above zero. The Spearman rank-order coefficients were above 0.5 for all of the exposure categories except the mold, plant, and animal exposure category which was 0.49. The correlation coefficient for the questionnaire as a whole was 0.85.

Conclusions: The unique features of the EAQ include: 1) It describes exposures from the workers point of view; 2) No knowledge of specific agents is required; 3) In many cases it can be completed by the workers themselves; and 4) It queries nine important exposure categories. This study showed the E.A.Q. as a whole to be reliable and valid. Gathering valid occupational exposure information with this method was both feasible and economical.

Session: 4 Paper Number: 64

Hexavalent Chromium and Lung Cancer in the Chromate Industry: A Quantitative Risk Assessment

Robert M. Park, James F. Bena, Leslie T. Stayner, Randall J. Smith, Herman J. Gibb, Peter S.J. Lees

National Insitute for Occupational Safety and Health

Objectives: The purpose of this investigation was to estimate excess lifetime risk of lung cancer death resulting from occupational exposure to hexavalent chromium-containing mists and dusts.

Methods: The mortality experience in a previously studied cohort of 2357 chromate chemical production workers with 122 lung cancer deaths was analyzed with Poisson regression methods. Extensive records of air samples evaluated for water-soluble hexavalent chromium were available for the entire employment history of this cohort. Diverse models of exposure-response for hexavalent chromium were evaluated by comparing deviances and inspection of cubic splines. Smoking cumulative exposure imputed from cigarette use at hire was included as a predictor. Lifetime risks of lung cancer death from exposure to hexavalent chromium were estimated using an actuarial calculation that accounts for competing causes of death.

Results: A linear relative rate model gave a good and readily interpretable fit to the data. Combining races, the estimated rate ratio for 1 mg/m3-yr in cumulative exposure to hexavalent chromium (as CrO3), with a lag of 5 years, was RR = 2.44 (95% CI=1.54-3.83). The observed chromium effect depended strongly on race in the better fitting models, with nonwhite workers showing a strong trend of increasing risk with (lagged) cumulative exposure to chromium (RR=5.31, 95% CI=2.78-10.1 for 1 mg/m3-yr). White workers showed an overall excess weakly related to measured cumulative exposure. Based on all men, the excess lifetime risk for exposure to respirable hexavalent chromium at the current OSHA Permissible Exposure Limit (0.10 milligram/m3) was 255 per 1000 (95% CI: 109-416). This estimate is comparable to earlier estimates by U.S. EPA and OSHA using different occupational data.

Conclusions: Current occupational standards for hexavalent chromium permit lifetime risks of lung cancer far in excess of that usually considered acceptable by OSHA (less than one in a thousand).

Session: 4 Paper Number: 65

Development and Field Testing of a Local Positioning System Using GPS and Near-Real-Time Monitors for Exposure Assessment in the Outdoor Environment

J.L. Hornsby-Myers (1), L. Lee (1), M. Flemmer (1), R. Gali (2),S. Soderholm (1)

(1) National Institute for Occupational Safety and Health (2) West virginia University

Workers in many outdoor occupations move about frequently during a typical day of work. Certain workers, such as agricultural and construction workers, are particularly mobile. The National Institute for Occupational Safety and Health (NIOSH) designed and developed a prototype exposure monitoring system which combines outdoor geographical location with current off the shelf industrial hygiene monitors and outputs the information to a user-friendly interface. By linking worker location throughout the workday to exposure levels from real-time monitors, Local Positioning System (LPS) units with software processing of data identify and document where to focus exposure analysis and control efforts. Post-processing of LPS data will enable researchers, regulatory inspectors, and industry safety and health personnel to map exposure intensity and location, reveal hot spots to identify sources, and provide exposure intensity distributions. Focused exposure control efforts, in turn, should allow a high return on investment, facilitating acceptance and implementation, and provide subsequent reductions in occupational injury and disease.

This project used a second generation prototype version of a LPS that was recently designed and developed. The prototype weighs 2.5 pounds; the GPS is differentially corrected to an accuracy of two meters. This requires a separate stationary differential corrections transceiver which supports an unlimited number of LPS units for up to several miles depending on geography and obstructions. Modular software was developed to process downloaded data collected from the prototype LPS. The software allows the researcher to determine the time weighted average or peak exposure along with location and frequency of an exposure level. Field tests have been conducted at NIOSH's Lake Lynn Laboratory and on construction sites using the prototype LPS with a real-time dust monitor, sound level meter, temperature probe, and a personal four gas monitor. The results of the fields tests indicate the prototype LPS, sensors and software are valuable tools for characterizing exposures in outdoor work environments. A third generation prototype is being constructed which is smaller and lighter. The ultimate goal of the project is a technology transfer of the system to the general public so that safety professionals will be able to use the system to determine hot spots of outdoor work exposures and protect workers accordingly.

Session: 4 Paper Number: 66

A Philosophy for Developing Job Exposure Matrices to Reduce Exposure Misclassification

P.A. Stewart (1), P.S.J. Lees (2)

(1) Division of Cancer Epidemiology and Genetics, National Cancer Institute, (2) Bloomberg School of Public Hygiene, Johns Hopkins University

Background: Job Exposure Matrices (JEMs) are a popular approach for assessing exposures in occupational epidemiologic studies but rarely have they been described in detail. Lack of documentation increases the difficulty reviewers have in understanding the results of the epidemiologic study. It also makes comparison of epidemiologic results across studies difficult, because there is no way to know whether the populations and exposures are comparable. This paper discusses the types of decisions, either explicit or implicit, that must be made before developing a JEM.

Methods: Sources of misclassification are described. The use of substances varies across industries and jobs. Exposure levels of some occupationally "low exposed" subjects may be lower than some occupationally nonexposed subjects due to exposures in the ambient air, diet, water, etc. The calculation of cumulative exposure, a measure often used in the investigation of chronic disease, requires point estimates (i.e., weights) for each exposed job, yet information on appropriate weights has not been identified. In many cases, there are no measurement data available on jobs. Eight-hour time weighted averages do not necessarily reflect threshold effects and exposure can occur through the skin. The frequency and duration of exposure varies across jobs and industries. Use and exposure patterns change over time. Information from the literature varies in quality; oftentimes, information is from another country or presents a list of uses without detail.

Results: Procedures to reduce misclassification from these sources are provided. These procedures are illustrated by an exposure matrix on PCBs.

Conclusions: More information needs to be provided as to how JEMs are developed. Examples of this type of information is provided.

Session: 4 Paper Number: 67

The Cortisol Response to Awakening: A Potential Biomarker for Occupational Stress

D. Landen, C. Burchfiel, L. McWilliams, D.B. Miller

National Institute for Occupational Safety and Health

Workplace stress may result in adverse health outcomes through its effect on the function of the Hypothalamic-Pituitary-Adrenal (HPA) axis. The cortisol response to awakening has recently been shown to be a useful marker for evaluation of HPA function. The normal cortisol response to awakening is a brisk increase in cortisol by about 30 minutes after awakening, followed by a decline to baseline within 60 minutes. However, in some individuals, perhaps 20 percent of the population, there is no increase in cortisol upon awakening. This "flat" pattern indicates lack of responsiveness, or dysfunction, of the HPA axis. HPA axis dysfunction, assessed by changes in the diurnal pattern of cortisol production, has been shown to be associated with a wide range of chronic conditions including metabolic syndrome, depression, and autoimmune disorders. The literature examining the cortisol response to awakening as a measure of HPA function is new, and relatively few studies have been published. No studies have shown how a person's early morning cortisol response might change over time from "normal" to "flat." However, stress may be a factor in this process. Subjects reporting chronic stress show abnormalities in the cortisol response to awakening: response patterns include increases in cortisol, delays in the timing of the peak cortisol value, and, in subjects experiencing "burnout," decreases in cortisol production.

In preparation for using the cortisol response to awakening for a study of workplace stress among coal miners, we conducted a pilot study among 23 male NIOSH employees, aged 40-54 (the age and gender distribution of the planned mining study). The study was designed to compare the response of cortisol on early morning awakening to the response to a protein load, which had been previously reported to be a reliable stimulus for cortisol production by the HPA axis. Each subject obtained 10 saliva samples for analysis of cortisol levels using a commercial collection device (Salivette). The first five samples were obtained at 15 minute intervals beginning with time of awakening. The sixth sample was obtained at noon, at which time subjects drank a commercial high protein drink containing 55 gms of protein (Pro Complex). The last four samples were collected at 15 minute intervals following ingestion of the protein drink. Subjects recorded their stress level on a visual analog scale each time they obtained a saliva sample. The patterns of cortisol response to awakening were divided into three groups: 1) Normal (8 subjects) 2) Flat (2 subjects) and 3) Downsloping (12 subjects). One subject with an otherwise normal pattern was excluded from analysis because of an unusual spike in cortisol at 60 minutes. Among subjects with normal profiles, there was a high and consistent correlation between the reported stress level and the cortisol level for all the awakening samples, and for the first two samples obtained after ingestion of the protein drink. (Range of r = -.67 to -.79, p-value range .02-.07). Among subjects with downsloping profiles, no consistent pattern was detectable. We conclude that a downsloping profile of cortisol response to awakening, not reported previously in the literature, may indicate poor responsiveness of the HPA axis to stress. This pattern may be intermediate between the "normal" profile and the "flat" profile. Further research is needed to determine how chronic stress may contribute to changes in HPA responsiveness, assessed by the cortisol response to awakening.

Session: 4 Paper Number: 68

Development of a Chlorinated Solvent Exposure Data Base for Use in Case-control Studies

M.A. Waters (1), P.A. Stewart, A. Ruder (1)

(1) National Institute for Occupational Safety and Health, (2) National Cancer Institute.

Case-control studies rely on the use of questionnaire data such as job titles and task descriptions to rank or assign exposure estimates to study subjects. For case-control studies where detailed exposure information has been collected by job for specific exposure agents, quantitative subject-specific exposure estimates can be developed using a variety of information sources. NIOSH and NCI are both conducting case-control studies of gliomas in adults, for which the etiology remains ambiguous (except for risk due to ionizing radiation). These case-control studies collected detailed information on job title, industry classification, processes, tasks, activities, chemicals, other materials used, and use of protective equipment for every job in a participant's work history, including for some jobs process-specific and exposure-specific questions. We have developed an exposure levels and exposure determinants data base for chlorinated solvent exposures to be used in these studies.

This data base has been compiled with exposure information from the primary literature, NIOSH Health Hazard Evaluations and Industrywide Studies reports, compliance data from the Occupational Safety and Health Administration, and other published sources. Variables include industrial process, job title, airborne exposure levels (arithmetic and geometric means), variability of exposures (geometric standard deviations), and exposure-modifying factors such as engineering controls, industrial process properties, the use of personal protective equipment, and opportunity for dermal exposure. Presented here are data for six chlorinated solvents with hypothesized linkages to brain cancer: perchloroethylene, chloroform, methylene chloride, tetrachloroethylene, 1,1,1-trichloroethane, and carbon tetrachloride, by era, from 1940s to present time. This is the first comprehensive occupational exposure levels and exposure determinants data base for these agents. These data will be used with determinant modeling to develop subject-specific solvent exposure estimates for the current NIOSH and NCI glioma case-control studies. The data base should improve the accuracy of the exposure estimates, reduce misclassification, and improve comparability of exposure estimates and exposure assessment methods across these studies, as well as serve as a resource for other epidemiologic studies.

Session: 4 Paper Number: 69

California Occupational Pesticide Illness Tracking Using Laboratory Reporting: Preliminary Findings

Christine Geiser, PhD (1), Rupali Das, MD, MPH (2) and Laura Ellerbe, MS (1)

(1) Public Health Institute, Occupational Health Branch, California Department of Health Services, 1515 Clay Street, Suite 1901, Oakland, CA 94612, (2) Occupational Health Branch, California Department of Health Services, 1515 Clay Street, Suite 1901, Oakland, CA 94612

Introduction: Occupational pesticide illness is a serious health issue that is most likely underreported to the existing workplace pesticide illness tracking system in California. Cholinesterase-inhibiting pesticides are widely used and affect employees in a variety of industries.

Purpose and Methods: The California Department of Health Services, Occupational Health Branch, pilot-tested clinical laboratory reporting of cholinesterase test results to assess its utility for occupational pesticide illness tracking. Three clinical laboratories voluntarily provided cholinesterase test reports. Individuals with depressed cholinesterase test results compared to individual baseline or low laboratory normal values were defined as initial cases. Medical records were requested, and patient telephone interviews were attempted.

Findings: Depressed cholinesterase test results were noted in 624 of 6,462 cholinesterase test reports (10%) collected by the tracking system from May 1, 2000 through July 31, 2002, and these comprised 535 initial cases (some included more than one laboratory report). None of the cases were identified through existing physician-based tracking. The majority of medical records received contained only the laboratory report. Contact information was unavailable for 402 cases (75%). Symptomatic occupational pesticide illness was present in 6 cases (1%), suspected in 1 case (0.2%), not present in 140 cases (26%), and unknown in 388 cases (73%). Most cases with medical information were asymptomatic. Of 535 cases, 458 (86%) were work-related, 12 (2%) were not work-related, and 65 (12%) were unknown. Most cholinesterase tests were ordered by employers and represented a variety of industries even though testing was required only for agricultural employees. Routine monitoring was the most common reason for the test. Pesticide exposure was documented in 221 cases (41%) and unknown in 201 cases (38%). Interview data suggested a lack of communication between physicians and employees regarding the cholinesterase test.

Conclusions: Laboratory reporting is a useful tracking tool for pesticide illness; however, this tool must be supplemented with other data sources to allow adequate case follow-up. Cases identified by this system may lack clinical signs and symptoms in spite of laboratory abnormalities. Workers in various industries are at risk for pesticide illness. Gaps may exist in the regulations requiring monitoring of cholinesterase tests in agricultural workers. Laboratory reporting of cholinesterase results should be considered as a valuable supplement to existing tools used to track occupational pesticide illness. The data obtained through such a system can help to improve workplace health and safety. Laboratory reporting may identify interventions for both individual workers as well as at the regulatory level.

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Session: 5 Paper Number: 70

Evaluation of Jolting and Jarring and Its Effects among Operators of Mobile Equipment

N.K. Kittusamy (1), F. Biggs (1), A.G. Mayton (2),C.C. Jobes (2), and T.R. Waters (3)

(1) National Institute for Occupational Safety and Health—Spokane Research Laboratory, (2) National Institute for Occupational Safety and Health—Pittsburgh Research Laboratory, (3) National Institute for Occupational Safety and Health—Division of Applied Research and Technology

The goal of the research program is to reduce back injuries resulting from jolting and jarring while operating mobile equipment used in the construction and agricultural industries. This work supports two of the NORA priority areas: Low Back Disorders and Traumatic Injuries. Three divisions are collaborating in this project: Spokane Research Laboratory (SRL), Pittsburgh Research Laboratory (PRL), and Division of Applied Research and Technology (DART). Reducing back injuries would be a significant benefit, not only to construction and agriculture, but to the transportation industry as well. Back injuries are the most common nonfatal injuries in many industries including construction and agriculture. The U.S. Bureau of Labor Statistics (BLS) incident rates (1996-2000) of nonfatal construction injuries with days away from work averaged 3.3 (per 100 full-time workers). This compares with averages for farming of 2.9, mining of 2.3, and private industry of 1.9. Also, during the same reporting period, the BLS average number of nonfatal farm injuries involving days away from work because of back injury was 12,181. The project objectives include: 1) characterize the magnitude of jolting and jarring on construction and agriculture equipment in a field setting, 2) conduct laboratory studies to understand the response of low-back muscles to sudden and unexpected side-impacts, 3) evaluate health and work history among operators of heavy construction and farm equipment, and 4) estimate the loading on the spine due to jarring and jolting using a specialized multi-body biomechanical model of the musculoskeletal system. This paper highlights the major aspects of the project including: field measurements to assess levels of jolting and jarring on construction and agriculture equipment; human subject testing using unanticipated low-level bilateral and vertical impacts while subjects sit on a rigid seat fixed to a suspended platform; questionnaire data to assess demographics, work information, job history, and musculoskeletal symptoms in operators of heavy construction equipment; and focus group discussions to obtain health and work history information from operators of farm equipment. Moreover, this paper discusses the estimation of the loading on the spine due to jolting and jarring derived from a general multi-body dynamics computer simulator. Some results show noticeably high levels of jolting and jarring for specific tasks performed by operators of construction and agriculture equipment. Highly demanding tasks showed higher frequency of these jolts and jars. Transmissibility data shows that the seat was amplifying vibration particularly in the lower frequencies for these equipment. The questionnaire data shows: 1) that workers might be at risk of developing musculoskeletal disorders; 2) the need to perform larger studies to substantiate the outcome; and 3) the need to quantify risk factors. Furthermore, the biomechanical model is discussed in terms of its capability to: 1) estimate potential tissue damage from predicted spinal forces and spinal tissue tolerance limits and 2) calculate ISO exposure limit values. This project will better enable us to characterize exposures in a field setting and motivate us to explore possible engineering and administrative controls to effectively reduce or eliminate the risk factors experienced by the operating engineers.

Session: 5 Paper Number: 71

Assessing PPE Protection - Development of a Safety Eyewear Coverage Coefficient

J.R. Harris, R. Whisler

National Institute for Occupational Safety and Health

With nearly 2,000 medically-treated occupational eye injuries each day, there is a continuing effort by employers and others to increase safety eyewear usage. Among eyewear manufacturers, varying safety spectacle style has been a focal point for increasing usage. Whereas the current eye and face protection standard, ANSI Z87, ensures minimum impact resistance and various optical properties independent of style, it does not provide performance guidelines for eyewear coverage-an important parameter considering the number of eye injuries that occur from flying or falling particles while a worker is wearing safety spectacles.

To develop safety eyewear coverage guidelines, we have developed a lab-based measurement of an eyewear coverage coefficient by using 3-D laser scanning of safety spectacles on standardized headforms. We use a combination of CAD software and a custom program developed at NIOSH to "fit" the digital headform and eyewear data together and then calculate the number of particles blocked from reaching the eye area by the safety eyewear. The ratio of the number of particles blocked by the eyewear to the number of particles that would contact the eye area (without safety eyewear) is termed the coverage coefficient and potentially varies from 0 (no coverage) to 1 (complete coverage). To date, we have measured coverage coefficients on 25 pairs of safety eyewear and for three Alderson headforms (5%, 50%, and 95%). We chose eyewear styles to be representative of the most popular designs worn in the workplace. We also included styles marketed to select "large" or "small" populations.

When examining coverage of safety eyewear for the standard Alderson 50% headform, the coverage coefficient values for the 25 pairs of eyewear varied from 0.51 to 0.97. The average for this group was 0.88 with a standard deviation of 0.08. For the Alderson 5% headform, the coverage coefficient range was 0.65 to 0.99 with an average of 0.95 and a standard deviation of 0.06. For the "large" headform, the Alderson 95%, the coverage coefficient varied from 0.54 to 0.97 with an average of 0.89. The standard deviation for this sample was 0.07.

In the next phase of this project, a laboratory setup will be developed whereby coverage coefficient values can be calculated without the use of lasers or scanning. By doing this, it is hoped that many third-party laboratories that evaluate optical, impact, and other eyewear attributes for manufacturers would be able to perform these calculations also.

Session: 5 Paper Number: 72

Occupational Injuries and Illnesses Among Emergency Medical Services Providers

B.J. Maguire (1), KL Hunting (2), T.L. Guidotti (2), G.S. Smith (3)

(1) Department of Emergency Health Services, University of Maryland, Baltimore County; MD; (2) The Department of Environmental and Occupational Health, The George Washington University, Washington, DC; and, (3) The Center for Safety Research, Liberty Mutual Research Center for Safety and Health, Hopkinton, MA.

Emergency medical services (EMS) providers treat approximately 25 million patients a year in the US. In addition, our nation depends on these personnel to respond in times of natural and man-made disasters. Despite the crucial role they play in both our healthcare system and our disaster response system, little is known about the occupational risks faced by these personnel. One recent study found that the occupational fatality rate for this group was more than twice the national average.

The purpose of this study was to examine the epidemiology of occupational injuries and illnesses among EMS providers.

This study was a retrospective evaluation of over 550 injury and illness cases from two, large, urban EMS systems whose personnel worked approximately 3 million hours during the study periods between 1998 and 2002. Standard epidemiologic measures were used to calculate the injury and illness rates.

The study found that the leading causes of injuries were lifting, transportation incidents and falls. Needlesticks and assaults also resulted in a large number of injuries. The leading types of complaints were strains, sprains, exposure and fractures. The body parts most commonly injured were the back, ankle/foot and knee. The month with the most injuries was January (13%); Mondays were the weekday with the highest number (17%). The overall injury and illness rate was more than five times higher than the national average. In comparison, the Bureau of Labor Statistics found that the industry with the highest rate of occupational injuries and illnesses in 2000 was "meat packing plants": the rate was four times the national average.

This is the first study of its kind ever to calculate the rates of non-fatal injuries and illnesses in this population. Further, it is the largest population based study ever done on the occupational risks faced by this group. It documents for the first time, the extremely high incidence of injuries and illnesses experienced by this workforce.

The study helps to improve workplace safety and health by identifying the overall problem and bringing it to the attention of public health officials, EMS administrators and personnel. It serves as a foundation for future studies and provides researchers, risk managers and EMS administrators information with which to assess prevention opportunities, prioritize intervention strategies and to focus on those hazards that pose the greatest risks to EMS personnel. Finally, it illustrates the need for immediate interventions to mitigate this serious problem among a group of workers vital to the health and safety of the nation. Efforts must be made to establish a national database of EMS injuries, illnesses and fatalities. Resources must be devoted to further study of the problem and for the development and evaluation of interventions.

Session: 5 Paper Number: 73

Prevention of Injuries-Nursing Homes and Hospitals

A. Garg (1), K. Hegmann (2)

(1) University of Wisconsin-Milwaukee, (2) University of Utah

The primary objective of this study was to reduce injuries to health care workers resulting from manual lifting and transferring of patients. The "zero-lift programs", using employee-management advisory teams (participatory-team approach), were implemented in seven nursing homes and one hospital. The eight facilities varied in number of beds (mean = 145, range = 85-253) and number of nursing personnel (mean = 94, range = 57-136). All eight facilities had a large number of acute care patients.

The "zero-lift programs" were implemented by replacing manual lifting and transferring of patients, with modern, battery operated, portable hoists and other patient transfer assistive devices. Ergonomics committees with nearly equal representation from management and employees selected the equipment and implemented the "zero-lift programs". Injury statistics were collected during post-intervention for 51 months (range = 36 - 60 months) and were compared with pre-intervention data for 37 months (range = 30 - 54 months).
The number of injuries from patient transfers decreased by 62% (range = 39% - 79%), lost workdays by 86% (range = 50% - 99%), restricted workdays by 64% (96% decrease to 17% increase), and workers' compensation costs by 84% (range = 53% - 99%). Overall, the eight facilities experienced decreases of 32% in all injuries, 62% in all lost workdays, 6% in all restricted workdays, and 55% in total workers' compensation costs.

The program produced many intangible benefits including improvements in patient comfort and safety during transfers and patient care. The nursing personnel perceived their backs were less sore and they were less tired at the end of their shifts. More pregnant and older workers were able to perform their regular duties and stay on the job longer.

Session: 5 Paper Number: 74

Priority Outcomes for Research in Work-Related Musculoskeletal Disorders: Qualitative and Quantitative Analysis

Glenn Pransky (1,2), Katy Benjamin (2), Carolyn Hill-Fotouhi (2), Jay Himmelstein (2), Jeff Katz (3)

(1) Liberty Mutual Center for Disability Research, (2) University of Massachusetts Medical School, (3) Harvard University

Background and Purpose: To evaluate the effectiveness of treatment and prevention interventions in work-related musculoskeletal disorders (WRMSDs), scientifically validated outcome measures are required. They should capture those issues of importance for workers and other stakeholders, with reasonable sensitivity to change and stability over time. Ideally, these measures should be applicable across a range of workers, workplaces, and WRMSDs. These measures are necessary in order to supplement the limited information available on outcomes through administrative data sources. Thus, this study (funded by NIOSH) was conducted to develop, evaluate, and apply self-reported outcome measures that would satisfy these criteria.

Methods: Employer and employee focus group qualitative analysis, cognitive interviews, test-retest evaluation, correlation with return-to-work and other outcome measures.

Findings: Initial domains were identified through expert interviews, and subsequently refined through focus group and cognitive interviews. Consensus priority measures addressed five separate domains:

1. Work absence
2. Ability to return to same job and same employer
3. Concern about an actual occurrence of reinjury
4. Change in capacities and attitudes regarding work
5. Future concerns - earnings, job stability, advancement

Items representing these domains were developed for an eight grade reading level. In test-retest reliability evaluation, intra-class correlation coefficients ranged from 0.61 to 0.99, with a mean of 0.80 - indicating excellent reliability. Similar results were obtained for dichotomous (yes/no) items, with kappa values from .72 to 1.0. In subsequent evaluation of these measures in a retrospective questionnaire study of 176 workers with work-related injuries, each set of items demonstrated statistical independence, and were easily completed by over 95% of study participants, representing a wide range of low back and upper extremity disorders. Subsequently, these measures have been used in several investigations of newspaper workers, older workers with work-related injuries, workers' compensation claimants, and individuals with chronic WRMSDs.

Importance of Findings: These brief questions reliably measure critical outcomes of importance to workers and employers, across a variety of WRMSDs. They can be applied in workplace surveillance programs, research studies, and clinical settings. By employing a standardized approach to data collection and analysis, comparison across workplaces and studies can be easily facilitated.

Session: 6 Paper Number: 75

Relative Contributions of Particulate and Vapor-Phase Semi-Volatile Organic Fractions to Inflammatory and Cytotoxic Effects of Fresh Engine Emissions

Joe Mauderly(1), Jean Clare Seagrave(1), Jacob McDonald(1), and Ingvar Eide(2)

(1) Lovelace Respiratory Research Institute, Albuquerque, NM,(2) Statoil Research Center, Trondheim, Norway

Exposure to high concentrations of fresh gasoline and diesel engine emissions are common to many workplaces, leading to concern for acute irritating and inflammatory effects as well as concern for cancer and non-cancer effects from long-term repeated exposures. Research has largely been focused on health hazards and risks from the particulate phase of engine emissions, but exposures to engine emissions are always mixed exposures to gases, vapors, and particles. There is growing evidence that the non-particulate phases may contribute to, or even dominate, certain effects. As an example, the semi-volatile organic vapor phase of fresh emissions may warrant more attention than given in the past. Samples of particulate (by filter) and vapor-phase semi-volatile organic (by PUF/XAD trap) fractions of engine emissions were collected from a traffic tunnel, from normal and high-emitting gasoline and diesel vehicles operated on chassis dynamometers, and from animal chambers during inhalation exposure to diesel emissions. The inflammatory and cytotoxic potencies of the samples were evaluated by instillation into rat lungs, followed by bronchoalveolar lavage and histopathology. For some samples, the two fractions were tested both separately and recombined together in their original mass ratios. For other samples, the fractions were only tested together followed by statistical analysis to disentangle the relative contributions of different physical-chemical components. Results suggest that organic emissions have substantial inflammatory and cytotoxic potential and that both particle-borne organic and vapor-phase semi-volatile organic fractions are of concern. In some, but not all, cases the effects per unit of mass were greater for the vapor-phase semi-volatile fraction than for the particulate fraction. These findings suggest the potential importance of vapor-phase semi-volatile organic compounds in mixed workplace exposures for non-cancer lung health hazards. Supported by the Freedom Car and Vehicle Technology program of the U.S. Department of Energy, and by the U.S. Environmental Protection Agency and other government and non-government sponsors of the National Environmental Respiratory Center.

Session: 6 Paper Number: 76

Assessment of Mixed Exposures in a Population-Based Study on Occupational Asthma

M. Kogevinas (1), J.P. Zock (1), H. Kromhout (1, 2) J.M. Antó (1), J. Sunyer (1), and D. Jarvis (3) for the Occupational Asthma working group of the ECRHS.

(1) Municipal Institute of Medical Research (IMIM), Barcelona, Spain, (2) University of Utrecht, Utrecht, The Netherlands, (3) Guy's and St Thomas's Medical and Dental School, London, U.K.

Asthma is the most common occupational respiratory disease in industrialized countries. Few studies have examined occupational asthma in general population samples and research has focused on male occupations. The European Community Respiratory Health Survey (ECRHS) evaluated occupational asthma and lung function in a large general population sample. Emphasis was put on female occupations, such as nurses, cleaners and homemakers, and on occupations at risk for asthma that, however, do not have clearly identified risk factors. The evaluation of exposures and asthma risk in the community is more complex than in an industry setting. We examined methods to evaluate patterns of exposure since workers are regularly exposed to mixtures rather than single chemicals. This analysis focuses on exposures among cleaners in the Spanish component of the study applying factor analysis. A complete analysis of the international database will be presented at the conference.

The 10 year follow-up study (around 1992-2002) includes approximately 9,800 subjects with 18,000 jobs, from 14 European and North American countries, aged 20 to 44 years at the first contact in 1992. Complete job history during the follow-up and job specific questionnaires were used for seven different occupations. In this analysis of cleaning workers in the Spanish component of the ECRHS occupational history was obtained for 1,823 subjects, resulting in 3,297 different jobs of which 159 covered cleaning workers.

Ten specific cleaning exposures were assessed semi-quantitatively. The number of subjects assessed to have had high exposure to house dust (allergen) was 50, to detergent enzymes (n=40), highly reactive chemicals (n=113), bleach/chlorine (n=103), aerosols from cleaning sprays (n=88), perfumed and scented products (n=93) and other.

A major drawback of the traditional approach when evaluating specific chemicals is that these exposures are correlated. A factor analysis was applied to identify patterns of exposure through an evaluation of the correlations between the set of observed exposures. Three factors with Eigenvalues higher than 0.4 were identified. This led to the following, independent groups of exposure:

- Factor 1 (irritants) including 'Highly reactive chemicals', 'Bleach (chlorine)' and 'Aerosols from cleaning sprays'.
- Factor 2 (allergens) including 'House dust (allergen)' and 'Detergent enzymes'.
- Factor 3 (mixed cleaning) including 'Ammonia' and 'Industrial cleaning agents'

No strong correlations were found for other tasks or exposures such as Kitchen cleaning, Perfumed and scented products, and Polishes.

The ECRHS is a large population based study including subjects from Europe, N America and Australia and covers a wide spectrum of exposures present in the community and frequently disregarded in industry-based studies. The approach followed will help identify the risks associated with mixed exposures, that is the predominant pattern of exposure among workers.

Focused research is necessary on specific exposures and on populations that have unrecognized risks for occupational respiratory diseases such as working women and persons working in dispersed work places either on their own account or in small transitory companies that may escape recognition and prevention. The analysis of mixed exposures is essential for understanding risk patterns and for implementing preventive measures.

Session: 6 Paper Number: 77

Pollution Prevention and Worker Toxic Exposures: A Method

D.D. Sivin

International Union, UAW

Environmental policy in the U.S. is shifting from control to prevention. Under the control paradigm, harmful substances are dealt with only after their production or acquisition. In contrast, the prevention paradigm seeks to change production processes in order to achieve the same product, while reducing the generation and use of harmful substances. Intuitively, reducing the generation and use of such substances is likely to reduce occupational exposures as well. However, pollution prevention (P2) is not always beneficial to workers. For example, worker exposure to trichloroethylene, a probable human carcinogen, has resulted from the elimination of ozone-depleting trichloroethane. Unfortunately, there is a scarcity of scientific knowledge as to the conditions under which pollution prevention increases or reduces the severity of occupational exposures. This research is an attempt to contribute to scientific knowledge in this area.
The study examined the impact on occupational exposures of a P2 program at an air conditioner and dehumidifier manufacturing facility. In the first phase of the project, an airborne contaminant concentration model was validated by comparing model results to indoor measurements of particulate matter in the facility. Modeled values for large compartments (> 39,000 m3) differed from measured values by 25-60%. The results were worse for small compartments (< 5 m3) indicating that the model is unreliable for these. The validated a model can be used to estimate historical contaminant concentrations in industrial facilities. This will allow other researchers to use the model to estimate the impact on occupational exposures of pollution prevention programs in other industrial facilities.

In the second phase of the project, the model was used to evaluate the impact of pollution prevention on occupational exposures. The plant eliminated a trichloroethylene (TCE) degreaser and undertook other process changes in order to be able to produce air conditioners and dehumidifiers without degreasing parts with TCE. The study found that, as a result of these process changes, the worker population in the plant experienced an overall reduction in exposure severity. A small subset of workers experienced statistically significant increases in exposure severity. They had very low TCE exposures before the degreaser was eliminated and experienced increased naphtha exposure afterward. The increase in naphtha exposure was due to the use of a more volatile metal press lubricant so that parts would arrive at the assembly line relatively free of lubricant even though they were not degreased.

Other plants may be able to reduce occupational exposures while implementing P2 programs to reduce environmental releases. However, it is possible for modifications designed to accommodate production processes to pollution prevention to increase the severity of exposure for some workers. Plant personnel who are responsible for designing and implementing pollution prevention would be well-advised to look for both potential occupational exposure reductions and potential new workplace hazards when projects are still in the planning stage. Policy makers should design and implement pollution prevention policies with explicit incentives for incorporating occupational health at the planning stage.

Session: 6 Paper Number: 78

Urinary 1-Hydroxypyrene and Polycyclic Aromatic Hydrocarbon Exposure Among Asphalt Paving Workers

McClean MD (1), Rinehart RD (2), Ngo L (1), Eisen EA (1), Kelsey KT (1), Wiencke JK (3), Herrick RF (1)

(1) Harvard School of Public Health, (2) Occupational Safety and Health Administration, (3) University of California - San Francisco

In the United States, the road-paving industry accounts for 87% of domestic asphalt production and employs approximately 300,000 workers. Asphalt contains a complex mixture of polycyclic aromatic hydrocarbons (PAHs), some of which are either known or suspected to be carcinogenic. Though numerous epidemiological studies have described an excess risk of cancer among asphalt-exposed workers, there is currently insufficient evidence to establish a causal relationship between occupational asphalt exposure and cancer risk.

Historically, the assessment of occupational exposure to PAHs has relied primarily on air monitoring; however, there has been increasing evidence that dermal contact is often the primary route of exposure to PAHs. Using urinary 1-hydroxypyrene (1-OHP) as a measure of total absorbed dose, the primary objective of this study was to evaluate the cumulative effect of inhalation and dermal PAH exposures while considering other factors such as age, BMI, and smoking that may also have a significant effect on urinary 1-OHP.

The study population included two groups of highway construction workers: 20 paving workers and 6 milling workers. During multiple consecutive workshifts, personal air and dermal patch samples were collected from each worker and analyzed for pyrene. Urine samples were collected at pre-shift, post-shift, and bedtime during the same time period, and were analyzed for urinary 1-OHP. The urinary 1-OHP data were analyzed using distributed lag models to estimate the independent effect of inhalation and dermal exposures that occurred at each of several lagged exposure periods, and to identify the relevant period of influence for each pathway.

The paving workers had inhalation (mean of 0.3 mg/m3) and dermal exposures (5.7 ng/cm2) to pyrene that were considerably higher than the milling workers (means of 0.008 mg/m3 and 2.4 ng/cm2). At pre-shift on Monday morning, following a weekend away from work, the pavers and millers had the same mean baseline urinary 1-OHP level of 0.36 mg/g creatinine. The mean urinary 1-OHP levels among pavers increased considerably from pre-shift to post-shift during each workday, while the mean urinary 1-OHP levels among millers varied little and remained near the baseline level throughout the workweek. Among pavers there was also a clear increase in the pre-shift data during the workweek, such that the average pre-shift results on Day 4 (1.4 mg/g creatinine) were approximately four times higher than the average pre-shift results on Day 1 (0.36 mg/g creatinine). The results of the distributed lag model indicated that the impact of dermal exposure was approximately eight times the impact of inhalation exposure. Furthermore, dermal exposure that occurred during the preceding 40 hours had a statistically significant effect on urinary 1-OHP, while the effect of inhalation exposure was not significant.

Our results indicate that dermal contact is the primary route of exposure to PAHs among asphalt paving workers, and suggest that control strategies aimed at reducing occupational exposure to asphalt-related PAHs should include an effort to reduce dermal exposure. Similarly, an exposure assessment of PAHs that does not consider dermal exposure may considerably underestimate cumulative exposure.

Session: 6 Paper Number: 79

Investigating Principles of Workroom Exposure

C.E. Feigley (1), J. Khan (2), E. Lee (1), M. Ahmed (2), S. Tamanna (2), R.O. Semeniuc (1), J.J. Jenkins (1)

(1) Department of Environmental Health Sciences, Arnold School of Public Health, Rm. 311, University of South Carolina, Columbia, SC 29208, (2) Department of Mechanical Engineering, University of South Carolina

The ability to estimate worker exposure accurately is essential for evaluating workplace hazards and protecting workers. However, exposure assessment is often the weakest element in research examining the relationship between contaminant exposure and occupational disease. Thus, improving the performance of exposure estimation methods is extremely important. Here experimental and mathematical methods were used to explore important determinants of exposure to airborne contaminants, particularly worker presence and activity. All aspects of this research address the inherent challenge presented by the variation of workroom concentration with time and location.

Three-dimensional tracer gas distribution patterns have been observed in a chamber (0.21 m3) and an experimental room (19.2 m3) under isothermal and nonisothermal conditions, and in the presence and the absence of worker surrogates. Computational fluid dynamic (CFD) methods were tested against observations and used to investigate: the effects of dilution air flowrate; the impact of inlet, outlet, and source locations; and the performance of simple deterministic models.

For three of four flowrate-location combinations, a stationary worker near the tracer gas source was exposed to higher concentrations than the concentrations observed at that location when no worker was present. Average exposures were higher when the worker was facing the source. The tracer concentration encountered by a worker moving along a fixed path and the concentration along that path when no worker was present differed by less than 5%. These findings were similar for different air flowrates and for both isothermal and nonisothermal conditions.

Measured and simulated concentration distributions for various room configurations and conditions were used to evaluate the performance of three deterministic models, near to and far from the source. Of the models evaluated, the simple box model was judged to be the best for use in occupational epidemiology because it had the lowest absolute error and the least variable error. The two-zone box model was the best for protecting workers and for compliance determination because it moderately overestimated exposures close to the source, providing an additional safety margin.

A method for determining the sampling time required to estimate average concentrations at various locations in the experimental room was validated and applied to the steady-state experimental room with air flows corresponding to 2.8, 10.2, 15.8, and 21.9 air changes/hour. The lowest air flowrate was excluded from further analysis because a statistically stationary concentration could not be obtained at one location, even after 6 hours monitoring. Required sampling time varied with location in the room over three orders of magnitude. Locations near to and downwind of the source required the longest sampling times. These results have important implications for research and for practical air monitoring applications. Also, a comparison of measured and CFD-generated chamber concentration patterns, showed that use of measured air inlet velocity profiles, instead of uniform inlet velocity, as a CFD boundary condition was required to achieve good agreement.

The understanding derived from these efforts is now being used to develop improved practical models for exposure assessment.

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Abstracts

Session: 7 Paper Number: 80

NIOSH Control Technology Research for Mining Hazards

J.A. Breslin

National Institute for Occupational Safety and Health

NIOSH research is developing and evaluating control technology to protect miners against the most significant health and safety hazards. This research is being done in collaboration with partners in industry, labor, and other government agencies, and this has greatly facilitated the practical implementation of research results in operating mines. Examples of successful control technology research will be described for three major mining problems: silicosis, noise-induced hearing loss, and fatalities from roof falls in underground mines.

Dust sampling conducted by the Mine Safety and Health Administration (MSHA) shows that the average percent of silica dust samples exceeding the permissible exposure limit for high-risk occupations in mining varies from 23 to 30 percent. Mobile equipment operators at surface mining operations generally have the highest exposure to airborne respirable silica/quartz dust. NIOSH has established partnerships with several manufacturers, mining companies, and MSHA to demonstrate that older equipment cabs can be refurbished to provide effective dust protection. Collaborative field demonstrations showed that they can provide clean, positive air pressurization of the cabin interior. Dust-contaminated work clothing can cause up to a tenfold increase in a worker's respirable dust exposure. NIOSH, working in cooperation with a mineral-processing corporation, has developed a quick and effective method for cleaning dust laden work clothing. The system uses a compressed air nozzle manifold to blow dust and product from the clothing in an enclosed booth. It has been tested successfully at a cooperating silica sand operation.

Most miners have a hearing loss by the time they retire. Engineering control of noise is the best solution to the miners' hearing loss problem, but the application of engineered noise controls has had many problems. NIOSH is identifying existing noise controls and evaluating their effectiveness. An example of an effective treatment is a "windshield" in use on roof bolters that reduces noise levels on average by 5 dB(A). The findings of this study will be disseminated to the mining industry through handbooks and seminars so that the industry can focus noise control efforts on areas where they will have the most impact.

Roof falls remain the greatest single safety hazard faced by underground miners. They cause nearly 50% of fatal injuries. Various forms of roof support are used to provide a stable mine opening to protect the mine workers from fatal falls of ground. To facilitate the application of new roof support technologies, NIOSH developed the Support Technology Optimization Program (STOP). STOP is a Windows-based software program that provides mine operators with a simple, practical tool to make engineering decisions about the selection and placement strategy of various standing roof support technologies. STOP is being used by every major coal company throughout the United States and by all support manufacturers. It is also being used in Australia, the Republic of South Africa, and the United Kingdom. MSHA uses the program with regard to the approval of roof support systems in underground coal mines.

Session: 7 Paper Number: 81

The Work Zone Analysis System: A Tool For Quantifying Worker Interaction With Mobile Equipment in Dangerous Work Zones

W.H. Schiffbauer, G.L. Mowrey

NIOSH PRL

Worker injuries and fatalities in industrial work zones are a major concern to the National Institute for Occupational Safety and Health Administration (NIOSH). Highway workers (SIC 1611) are at great risk from both passing motorists and construction vehicles. The Mine Safety and Health Administration (MSHA) database has identified a high number of mine workers killed or disabled as a result of working near heavy equipment. Surface drilling operations have been investigated by the Occupational Safety and Health Administration (OSHA) to determine how many workers have lost or have had their hearing impaired by working close to drill rigs. Dust exposure in industrial work environments has also been heavily investigated by OSHA and MSHA. Addressing each of these areas, NIOSH has developed a research tool, collectively called a Work Zone Analysis System (WZAS), which can greatly enhance data collecting and analysis of workers around vehicles and mobile equipment.

The basic components of the WZAS include: differential mode GPS receivers, wired and wireless video links (ground and air-borne), machine vision processors, proximity determination devices, computers, and data analysis tools. The WZAS is housed in a mobile trailer which has self-contained power, a 58-foot telescoping mast with a remote-controlled video camera, a satellite internet dish, weather monitoring, and numerous other features. The WZAS will enable NIOSH researchers to perform detailed task analyses of outside work environments. This information will help identify what remedial actions could benefit worker safety. Expected outcome variables include: incidence of workers-on-foot (WOF) within vehicle blind spots; amount of time a WOF is in a blind spot, or within a specified distance of a vehicle; number of WOFs in proximity to operating vehicles; amount of time a vehicle backs up per hour of operation; process operational efficiency; intervention feasibility; areas of exposures to high noise levels; and areas of exposures to high dust levels. This paper describes all system components and their associated functions.

Session: 7 Paper Number: 82

Integrating Occupational Safety and Health - Pollution Prevention in Hospitals: An Intervention Study

Margaret Quinn, ScD, Anila Bello, MS, Thomas Fuller, MS, Catherine Galligan, MS

Department of Work Environment, University of Massachusetts Lowell

Numerous initiatives and government, industry, labor, and community-based partnerships have recently been established to foster pollution prevention (P2) in hospitals and other healthcare facilities. A major focus is to replace medical products, materials and work practices that generate pollution with those that are more environmentally-sound. Thus far, many of these P2 initiatives are applied without considering their impact on workers, even though it is well-known that changes in materials and work practices can have significant effects on occupational safety and health (OSH). Traditionally, occupational and environmental health and safety hazard assessments and interventions have been conducted separately. The purpose of this work was to develop an integrated approach to assess occupational and environmental health and safety in hospitals and use the approach to: 1) identify and implement effective intervention strategies to replace the use of conventional materials and products with more environmentally-sound, healthy and safe alternatives; and 2) to evaluate the impact of the alternatives on worker health and safety.

An integrated approach, called a "P2OSH" assessment, was developed by adapting elements of existing P2 and OSH survey methods including production process mapping, process hazard analysis, and job-task hazard analysis. The survey consists of multiple, nested questionnaires that begin at the level of the entire health care facility and progress to more specific levels of work organization, concluding with a detailed analysis of the tasks associated with the use of a hazardous material or product targeted for the intervention. The survey assesses OSH risks in five categories: safety, chemical, biological, physical, and ergonomic. The survey also includes environmental impact and cost analyses of the conventional material and its alternative. The survey is conducted pre- and post-intervention and the results compared.

The survey was applied to assess the use of formaldehyde in a hospital pathology laboratory and to implement a less toxic alternative (the intervention). The hospital was motivated to engage in the study because excess formaldehyde was found in its wastewater discharge. The survey was first applied to evaluate specific processes where formaldehyde was used and the workplace factors contributing to the environmental releases. Results of this step identified several occupational safety and health practices that directly impacted environmental quality and protection. It was also shown that the use of formaldehyde incurred high costs to the hospital. In the second step of the study, alternatives to formaldehyde were identified and one was selected by the hospital laboratory staff. A protocol was developed to implement the alternative and the survey was re-applied. Results of this second step showed both positive and negative impacts on worker health and safety and the environment. It was concluded that an environmentally motivated change of materials is unlikely to be effective unless the impacts on workers and their job tasks are evaluated. In this study, a survey and methods were developed for integrated assessments of workplace interventions. These can be applied in other workplaces to perform integrated P2 and OSH analyses.

Session: 7 Paper Number: 83

Protecting Emergency Responders - Lessons Learned from Terrorist Attacks

Brian Jackson, D.J. Peterson, James Bartis, Tom LaTourrette, Irene Brahmakulam, Ari Houser, Jerry Sollinger

The RAND Corporation

This report presents a summary of a December 2001 working conference, sponsored by NIOSH. Attending were emergency workers who responded to the bombing of the Murrah Building in Oklahoma City, the September 11 attacks on the World Trade Center and the anthrax incidents that occurred during autumn 2001. The report addresses the equipment, training, and information required to protect emergency responders as they meet the challenge of protecting their communities

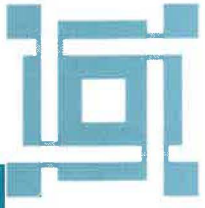
Session: 7 Paper Number: 84

Lessons Learned in Adapting OSHA Training Institute Course Content to the Web

M.H. Hodges (1), S. Tillett (2)

(1) Georgia Institute of Technology, (2) George Meany Center for Labor Studies-National Labor College.

Many workers have difficulty leaving their jobs to attend safety and health classes. For this population, distance education appears to be a viable alternative for strengthening knowledge of workplace safety principles. Students taking web-based classes can digest course material at their convenience and return to the course repeatedly to reinforce learning. Typical disadvantages of virtual classrooms are the diminished capacity it provides for interactivity among teachers and students and the inability of students to practice "hands-on" learning of work tasks in these environments. Recent advances in computer network capacity and animation software, however, have enhanced the ability of web courses to provide robust student-teacher interaction and animated depiction of work exercises. The OSHA Training Institute (OTI) Education Centers in Region III and IV are collaborating to develop web offerings that provide the standard advantages of Internet courses along with improved interactivity and work-task animation. They are establishing a model for web education through development of a 21-hour course in Permit-Required Confined Space Entry (OTI 226). The web version of OTI 226 has been designed to offer learning material through a blend of text, still images, video clips, and Flash animations. A data management system monitors students' performance and determines if they are eligible for certificates of completion. Evaluation of this web course has begun and will continue through the next year as the class is offered to Region III and IV students. This presentation will describe how the course was created, present the response of students to initial course offerings, and summarize lessons learned to date in the development process.



Abstracts

Session: 8 Paper Number: 85

NAT2 Slow Acetylation and Bladder Cancer in Workers Exposed to Benzidine

T. Carreón (1,2), A.M. Ruder (1), P.A. Schulte (1), R. B. Hayes (3), N. Rothman (3), G.K. LeMasters (2), M.A. Waters (1), D.J. Grant (4), R. Boissy (4), D.A. Bell (4), F.F. Kadlubar (5), G.P. Hemstreet (6), S. Yin (7)

(1) National Institute for Occupational Safety and Health, (2) University of Cincinnati, (3) National Cancer Institute, (4) National Institute of Environmental Health Sciences, (5) National Center for Toxicological Research, (6) University of Oklahoma, (7) Chinese Academy of Preventive Medicine

The slow NAT2 N-acetylation genotype inhibits detoxification of a range of monoarylamines and has been associated with increased risk for bladder cancer in cigarette smokers and workers in arylamine dye production. The diarylamine, benzidine, is also a strong bladder carcinogen, however, NAT2 N-acetylation is not key to its detoxification. This study expands a previous study that evaluated the impact of NAT2 polymorphisms on bladder cancer in male subjects occupationally exposed only to benzidine.
The combined analysis of 68 cases and 107 controls from a cohort of production workers in China occupationally exposed to benzidine, included 30 new cases and 67 controls not previously studied. NAT2 enzymatic activity phenotype was characterized by measuring urinary caffeine metabolite ratios. PCR-based methods identified genotypes for NAT2, NAT1 and GSTM1. NAT2 phenotype results were consistent with NAT2 genotype data. A protective association was observed for the slow NAT2 genotype (bladder cancer odds ratio = 0.3, 95% confidence interval 0.1-1.0) after adjustment for cumulative benzidine exposure and lifetime smoking. Individuals carrying NAT1*10, a low activity allele, showed a higher risk of bladder cancer (OR=2.3, 95% CI 0.8-7.0). No association was found between GSTM1 null and bladder cancer. The results of this study were compared with the results of a meta-analysis of case-control studies of NAT2 acetylation and bladder cancer conducted in general Asian populations not exposed occupationally to arylamines. The lower limit of the 95% CI of the risk estimate in the general Asian populations (OR=1.7, 95% CI 1.0-2.7) does not overlap the upper 95% CI for the estimate obtained in the current analysis.

Study findings demonstrate that slow acetylators are not at increased risk of developing benzidine-induced bladder cancer, in contrast to slow acetylators who smoke cigarettes or are exposed to monoarylamine dyes, who are at increased risk. Some evidence was found of the existence of an interaction between NAT2 acetylation and benzidine exposure. The data actually suggest decreased risk, although the mechanism for risk reduction needs further delineation.

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Session: 8 Paper Number: 86

Male Reproductive Effects From Occupational Exposure to Boron

F. Wei (1), W.A. Robbins (2), G. Wu (1), B.L. Chang (2), J. Hu (3), L. Xun (2), N. Kennedy (2) and Boron Epidemiology Research Group (1,2)

(1)China National Environmental Monitoring Center, (2) University of California, Los Angeles, (3) Chinese Institute of Health Education

Boric acid has been identified as a high priority reproductive toxicant for occupational health studies (Moorman et al. 2000). Boric acid is challenging to study in workers due to its ubiquitous nature in the environment (soil, food, drinking water) and contamination of communities located on or near ore beds/processing plants. To address this challenge, a descriptive, correlational, epidemiologic study utilizing community-based participatory methods with workplace sampling and analysis of biomarkers (exposure and effect) is being conducted in Kuandian, PR China. This area, half the size of Los Angeles County, houses ~30 boron mines/processing plants. The research involves community members, government officials, local industry, and environmental and occupational professionals concerned about exposures in China, as well as NIOSH funded researchers in the USA. In addition, boron industry representatives in the USA have attended and contributed expertise to the research planning. The goal is to gather data useful to all regarding safe exposure levels.

Animal data indicates males are more sensitive than females, thus, health outcomes are targeted to male workers. The specific objectives are to describe relationships between workplace boron exposure and:

1. Direct measures of toxicity on male reproduction using conventional semen parameters, sperm X:Y chromosome ratios, sperm chromatin integrity measures, protamine analyses, blood and urine steroid hormone markers.
2. Indirect measures of reproductive toxicity including fertility history and physical exam data, and to
3. Determine sources of exposure (workplace, environmental, dietary).

The first phase of study is complete and has established a local community advisory board; measured background levels of boron in food, water, soil; analyzed ore elements throughout processing; and collected data on types and ranges of work exposures. Preliminary sampling indicates a broad range of workplace boron exposure with relatively low contribution of food and water to total boron intake (Table 1.). However, bioavailability studies at different stages of ore processing will be required.

Table 1. Selected examples of environmental and biological sampling for boron

Media	Boron content	Media	Boron content
Drinking water	2.5 ug/ml	Local grown corn	3.3 ug/g
Plant waste water	31.4 ug/ml	Local grown soy beans	32.6 ug/g
Urine from dusty worker	15.0 ug/ml	Foreign grown rice	1.3 ug/g
Urine from plant manager	0.91 ug/ml	Local soil	4.6 ug/g

Interview data on 835 male workers in boron mines/processing plants indicates heterogeneity in race, age (15-60 years), years of exposure, and use of PPE. The population is relatively homogeneous in diet, exposure to tobacco smoke at work (96.5%), marital status (87%), general good health, and family planning. Preliminary data suggests boron miners have higher stillbirths and abortion rates compared to national data for populations in the rural countryside.

This information has been used to identify specific workers and sampling strategies for the next phase of study that includes intensive longitudinal exposure assessment, individual-based assays of dietary boron, biological sampling, and reproductive history / exam for 60 workers. The findings will be used to inform workplace policies to protect reproductive health of hundreds of thousands of men estimated to be exposed to boron containing compounds.

Session: 8 Paper Number: 87

Applying New Biotechnologies to the Study of Occupational Cancer: A NORA Cancer Research Methods Workshop

M. Toraason (1), A. Blair (2), N. Rothman (2), A. Ruder (1), R.E. Savage (1), P. Schulte (1), M.T. Smith (3), E.M. Ward (4), A. Weston(1).

(1)National Institute for Occupational Safety and Health, (2)National Cancer Institute, (3)University of California, Berkeley, (4)American Cancer Society.

As high throughput technologies in genomics, transcriptnomics, and proteomics evolve, questions arise about their utility in assessing occupational cancers. To address these questions, the National Institute for Occupation Safety and Health (NIOSH), the National Cancer Institute (NCI), the National Institute for Environmental Health Sciences (NIEHS), and the American Chemistry Council (ACC) sponsored a workshop on May 8-9, 2002 in Washington D.C. The workshop brought together 80 international specialists. Their objective was to identify the means for best exploiting new technologies to enhance methods for laboratory investigation, epidemiological evaluation, risk assessment, and prevention of occupational cancer. The workshop was organized around 6 major topic areas: (1) the challenge of applying new biotechnologies to the study of occupational cancer, (2) markers of early biological effect, (3) inherited modifiers of risk, (4) applying genetic biomarkers to human studies, (5) applying new biotechnologies to the understanding and control of known or suspect occupational carcinogens, and (6) case studies on diesel exhaust, perchloroethylene, and metal working fluids.

Session: 8 Paper Number: 88

Development of Pharmacokinetic and Non-invasive Biomonitoring Approaches to determine Dosimetry and Assess Risk in Potentially Sensitive Sub-populations Following Exposure to Individual Chemicals and Mixtures

Charles Timchalk, Yuehe Lin, Ahmed Kousba and Torka Poet

Battelle, Pacific Northwest Division

There is an ongoing need to develop approaches for quantitatively assessing risk associated with occupational exposures to a broad-range of chemical agents and to determine the potential implications of these occupational exposures to human health, particularly with regards to sensitive sub-populations. In this regard, efforts are underway to develop state-of-the-art physiologically based pharmacokinetic and pharmacodynamic (PBPK/PD) modeling approaches to assess dosimetry and biological response following exposure to single agents or more complex mixtures. These models have also been used to assess risk in potentially sensitive populations such as children and individuals with a genetic polymorphism associated with critical detoxification pathways. In addition, the development of non-invasive biomonitoring approaches that utilize readily obtainable fluids like saliva have been coupled with PBPK models to readily determine systemic chemical exposure by the rapid analysis of "spot" saliva specimens. A PBPK/PD model has been developed for the organophosphate (OP) insecticides chlorpyrifos and diazinon utilizing available data from rats and humans. These OP insecticides share common metabolic activation/detoxification pathways and a common mechanism of neurotoxicity associated with excessive cholinergic stimulation, due to the inhibition of acetylcholinesterase in nerve tissues. Therefore, these two models have been combined into a binary OP PBPK/PD model to quantitatively assess dosimetry and response due to occupational exposure to these chemical mixtures that are routinely encountered in the workplace. This binary model facilitates understanding the mixture interactions and the potential for additivity, synergism or antagonism from multi-OP exposures for assessing risk. In addition, these models have been extended to incorporate age- and polymorphism-dependent changes and have been successfully used to quantitatively determine the dose-dependent impact of OP exposure on potentially susceptible sub-populations. To advance the application of non-invasive biomonitoring a portable microfluidic/electrochemical device has also been developed for the rapid analysis of lead (Pb), based on square wave anodic stripping voltametry. Appropriate pharmacokinetic analyses have been used to quantitate systemic dosimetry based on determination of saliva Pb concentrations. The PBPK model for Pb is capable of predicting blood and saliva Pb concentration based on a limited data set obtained in rats. In addition, saliva has recently been used to quantitate chlorpyrifos exposure in a rodent model system by measuring the major metabolite, trichloropyridinol, and saliva cholinesterase inhibition following acute exposures. These results suggest that technology developed for non-invasive biomonitoring can provide a sensitive, and portable analytical tool capable of assessing exposure and risk in real-time. By coupling these non-invasive technologies with advanced PBPK modeling it is feasible to quantitatively assess occupational exposure to a broad range of chemical agents involving multiple routes of exposure (i.e. skin, ingestion, inhalation) that are routinely encountered in the work environment. In summary, it is envisioned that once fully validated, these monitoring and modeling approaches will be a very useful for accessing exposure and health risk to a wide range of occupationally exposed individuals. Supported by: CDC/NIOSH 1 R01 OH03629-01A2; EPA-STAR R828608; NIEHS 1 R01ES/OH10976-01A2; and DOE contract DE-AC06-76RLO-1830.

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Session: 8 Paper Number: 89

Circadian Rhythm Disruption: A Chronic Occupational Hazard Among Flight Attendants?

B. Grajewski (1), E.A. Whelan (1), M.M. Nguyen (1), L.C. Kwan (1), R.J. Cole(2), M.J. Hein (1)

(1)National Institute for Occupational Safety and Health, Cincinnati, OH 45226,
(2) Synchrony Applied Health Sciences, Del Mar, CA 92014

America is a nation of tired workers. In 1990, the direct U.S. costs of sleep disorders and deprivation were estimated at $15.9 billion, and the indirect costs which result in stress-related, reduced workplace productivity were estimated at $150 billion. Air travel during normal sleep hours and multiple time zone changes are an integral part of the workplace for many of the 198,000 air crewmembers employed in the United States, including about 113,700 flight attendants. Flight attendant sleep cycle/circadian rhythm disruption issues may in some ways be similar to those of shift workers, but a flight attendant's work schedule often lacks the regularity which assists a shift worker's circadian resynchronization; also, a flight attendant's work often involves rapid movement through multiple time zones, and the resultant disruption of zeitgeibers (external time cues) is different than for shift workers. Because circadian disruption may affect the hormonal balance requisite to reproductive health, it is being assessed among flight attendants in reproductive health studies which The National Institute for Occupational Safety and Health (NIOSH) is currently conducting. Our objectives were to determine whether female flight attendants are more likely than teachers (comparison group) to experience circadian disruption, as measured by melatonin production and sleep displacement, and to identify metrics of disruption for future studies of reproductive health.

Each day for one menstrual cycle, 45 flight attendants and 26 teachers kept a daily diary, collected and measured their overnight urine, and wore an activity monitor to assess sleep displacement. Relations between melatonin production, sleep parameters, and flight attendant/teacher status were analyzed with linear and multiple logistic regression. Relations between sleep displacement, melatonin, and flight history-derived variables (including time zones crossed) were examined with exploratory factor analyses.

Flight attendants experienced increased circadian disruption as measured by a higher adjusted melatonin rate variance than teachers (2.8 x 105 vs. 1.0 x 105 (ng/h)2 , respectively; p=0.04) and the likelihood of being in the highest quartile of melatonin variance (Odds Ratio = 2.3; 95% Confidence Interval: 0.6 - 9.1). Although flight attendants slept longer than teachers, models for two indices of sleep displacement indicated that flight attendants incurred significant impairment of sleep compared to teachers. In factor analysis, time zones crossed was related to both melatonin desynchronization and sleep displacement.

Flight attendants experienced increased circadian disruption, as measured by more variable melatonin rates and increased sleep displacement, than a minimally-flying comparison group. For epidemiologic studies of flight crew in which melatonin measurement is infeasible, time zones crossed is a useful indicator of both sleep displacement and melatonin desynchronization.

Rest requirements for flight attendants may address issues such as alertness, but misalignment of the sleep-wake cycle and circadian rhythms may be a chronic occupational condition which may not be readjusted fully by rest after each duty period. Although worker alertness is a key safety issue in many industries, sleep and circadian rhythm research need to be expanded to determine chronic health effects of sleep impairment and, for air crew, circadian disruption.

Session: 9 Paper Number: 90

Respiratory Health Effects at an Automobile Assembly Plant

S.K. Hammond (1), E. Gold (2), R. Baker (1), J. Balmes (1,3), P. Quinlan (3), W. Smith (2), R. Pandya (1,3)

(1) University of California, Berkeley, (2) University of California, Davis, (3) University of California, San Francisco

Obstructive lung diseases (e.g. asthma, chronic bronchitis, and emphysema) are important causes of morbidity and mortality among adults in the United States and affect 8.5% of the U.S. population; approximately 15% of both asthma and COPD is work-related. In 1999 the New United Motor Manufacturing, Inc. (NUMMI) and the United Auto Workers Local Union 2244 (UAW) decided to support a research project to determine if respiratory problems were increased among employees in the welding and the paint departments, because employees in these departments occasionally reported respiratory irritation that was believed to be associated with occupational exposure. The NUMMI facility assembles trucks and passenger cars.

A cross-sectional survey was used to compare respiratory health effects among NUMMI employees in welding and paint departments to those in assembly . A scannable, self-administered questionnaire was designed specifically for this study, with questions taken from standardized instruments, specifically, the American Thoracic Society and NHANES questionnaires. Workers completed the questionnaires in small groups while on their lunch breaks. Union representatives provided logistical support during the survey administration. Subsequently, to enhance response rate, the questionnaire was mailed to all employees from these areas. The specific outcomes of interest were respiratory symptoms derived from (yes/no) responses to closed-ended questions. Five categories of self-reported symptom outcomes were developed: allergy, asthma, cough, heartburn, and diarrhea. Unadjusted prevalence odds ratios (ORs) were computed for the association of each of the five symptoms with work in welding or in painting, each compared to work in assembly. Multiple logistic regression models were used to adjust prevalence ORs simultaneously for differences among the work groups in demographic and lifestyle characteristics.

Reporting of all respiratory symptoms (allergy, asthma, and cough) as well as heartburn and diarrhea in the prior three months was significantly increased among welders compared to assembly workers, after responses were adjusted for the confounding effects of age, race, and smoking. Welders compared to assembly workers were also significantly more likely to report that their symptoms improved on weekends or on vacation and that they believed their symptoms were related to work exposures. However, no significant elevations in adjusted prevalence odds ratios were observed for welders compared to assembly workers for ever having been diagnosed by a health care provider to have asthma, COPD, sinusitis, nasal/eye allergy, or heartburn. In contrast, no statistically significant elevations among painters compared to assembly workers were observed for any self-reported respiratory symptoms in the prior three months. However, significantly more painters than assembly workers had been diagnosed by a health care provider to have COPD.

The elevation of self-reported respiratory effects in the Body Weld area is particularly important given recent findings that fine particle concentrations are highest in the welding areas of automotive plants. The increased symptoms observed in the Body Weld area indicated further action was warranted. Researchers made recommendations to improve the ventilation in the welding area, and the process of implementation involved cooperative work with the company, the union, and the academic researchers.

Session: 9 Paper Number: 91

Reliability And Validity Of An Asthma Questionnaire For Healthcare Workers

G.L. Delclos(1), A. Arif (2), L.A. Aday (1), K. Bartholomew (1), A. Carson (1), D. Lai (1), C. Lusk (1), T. Stock (1), E. Symanski (1), L.W. Whitehead (1)

(1) The University of Texas School of Public Health, Houston, Texas, and (2) Department of Health Services Research, Texas Tech University Health Sciences Center, Lubbock, Texas. Supported by grant number 1R01OH003945 01A1 from CDC/NIOSH.

Background: Attention has focused on respiratory hazards among healthcare workers (HCWs), partly because of reports of asthma linked to latex, glutaraldehyde and other airborne exposures in hospital settings. Our group is conducting a study to develop, validate and field test a new survey instrument for work-related asthma in HCWs (Phase I) that will then be streamlined for use in a population-based survey (Phase II) of occupational exposures and asthma in healthcare settings. The Phase I questionnaire was designed to be completed in under 30 minutes and consisted of four general sections: asthma symptoms (12 questions, with subquestions); nonoccupational exposures and family history (9 questions), job exposure history (focused on current and longest held jobs); and demographics (8 questions). Initial results are presented on validation of the asthma section of the questionnaire.

Questions on asthma were originally derived from the IUATLD questionnaire, supplemented with additional items in consultation with pulmonary, occupational health and survey design experts. After pretesting in a small pilot study, a cross-sectional study was conducted in a convenience sample of 102 nonsmoking, employed HCWs (with and without asthma). Participants completed the questionnaire, a methacholine bronchial challenge test, a detailed interview with an industrial hygienist and provided a blood sample for measurement of specific IgE antibodies to common aeroallergens. Two weeks later, they completed and returned a second questionnaire containing selected items from the original questionnaire, to assess test-retest reliability (% agreement between the two questionnaires).

Lacking a universal "gold standard" for asthma for use in epidemiology studies, the questions on asthma were validated against two frequently used measures, methacholine PC20 and a previous physician diagnosis of asthma (MD asthma). Performance of these questions was also compared to that of a 5-question discriminant function predictor (DFP), previously validated by Burney et al (1).

Results: Time to completion of the questionnaire ranged from 13 to 25 minutes. Internal consistency for respiratory symptoms (Cronbach alpha=0.86) and allergic symptoms when near animals or trees (Cronbach alpha=0.86) was excellent. Test-retest reliability of questionnaire items related to asthma-like symptoms ranged from 78% to 94%. Based on analysis of receiver operating curve characteristics, a subset of 8 questions was identified (related to wheezing, difficulty breathing, nocturnal symptoms, and symptoms near animals, feathers or trees) that offered the best combination of sensitivity and specificity, while retaining good internal consistency (Cronbach alpha=0.75). Table 1 summarizes the results of our 8-question predictor, and Table 2 presents the findings when the DFP was used in this study population.

Table 1. Performance of the 8-question predictor.

	Sensitivity	Specificity	%Correctly classified
PC20<or=8mg/ml	72%	71%	72%
PC20<or=4mg/ml	56%	85%	72%
MD asthma	89%	98%	96%

Table 2. Performance of the DFP.

	Sensitivity	Specificity	%Correctly classified
PC20<or=8mg/ml	50%	83%	66%
PC20<or=4mg/ml	50%	80%	66%
MD asthma	94%	79%	81%

Conclusions: Initial evaluation of the asthma section of this questionnaire indicates good validity and reliability for the 8-question predictor, in preparation for further field testing and cross-validation in the Phase II population-based survey.

(1) Int J Epid 1989; 18:165-173.

Session: 9 Paper Number: 92

Creating Effective Partnerships in Occupational Safety and Health

S.J. Johnson (1), J. Armstrong (2)

(1) United Auto Workers, International Union, (2) New United Motor Manufacturing, Incorporated

For several years, United Auto Workers (UAW) members employed at New United Motor Manufacturing Incorporated (NUMMI) reported respiratory problems in the paint and body/weld shop. In response, NUMMI conducted air sampling that indicated that the exposures were well below the OSHA limits. Although this was the case, workers wanted to know whether their symptoms could be work-related even at these low levels. As a result, during the 1998 negotiations, the union and NUMMI agreed to a jointly funded research project aimed at exploring this issue.

In keeping with this agreement, the UAW and NUMMI contracted with the Northern California for Occupational and Environmental Health (COEH) to conduct a study on potential respiratory health hazards. The study examined self-reported respiratory health effects among NUMMI workers. Specifically, the investigators sought to determine if there was an increase in clinical symptoms and self-report complaints among employees in the paint and body shops. The study reported increases in respiratory complaints among workers in the body/weld shop. It was also observed that these symptoms appeared to be less of a problem on weekends, indicating the potential for chemical exposure in the body shop.

One of the recommendations made by the investigators was improved ventilation in the body shop. In response to this recommendation, the UAW International Health and Safety Department conducted a full-scale ventilation assessment. This assessment included an initial mapping of the particle concentrations in 2 sections of the body shop. Once the "hot spots" had been identified, the UAW trained NUMMI staff on the use of the Handheld Aerosol Monitor (HAM) and loaned them the device so as to allow for mapping to be completed in the body/weld shop. The mapping allowed for the identification of high exposure areas and helped NUMMI to prioritize operations that needed to be controlled.

The ventilation assessment resulted in the UAW making a number of recommendations. In particular, control of the welding smoke was a major priority. Several options were proposed and evaluated to accomplish this. They options included: 1) use of a custom fitted hood; 2) use of an enclosure with an exhaust; or 3) the elimination of oil/clean parts before welding.

As a result, NUMMI has completed a variety of design enhancements to their ventilation system in the existing body shop. In addition, they incorporated these enhancements into the design of a system for their new body shop.

Session: 9 Paper Number: 93

Investigation Of Health Effects Due To Handling Of Irradiated Mail

Stephen Mallinger (1), Glenn Lamson (2), Patrick Hearty (2)

(1) Office of Compliance, Office of the General Counsel, Occupational Safety and Health Admin., (2) Salt Lake Technical Center, Occupational Safety and Health Admin.

Following the discovery of anthrax spores in items of mail in 16 Congressional offices in October, 2001, all mail sent to Capitol Hill addresses was treated with electron beam, or e-beam irradiation. Shortly after delivery of the irradiated mail began in January, 2002, some employees handling mail began to experience a number of adverse health effects, including dry, itchy skin and visible skin rash.

A Request for Inspection was filed with the General Counsel of OSHA's Office of Compliance, and an investigation was instigated. Surveys were conducted to determine the nature and extent of the problem. On-site samples were collected and samples of irradiated mail were analyzed at OSHA's Salt Lake Techincal Center for the presence of VOC's and irritant chemicals. Some preliminary research was done to determine the feasibility of on-site screening of paper and mail samples for formaldehyde and other aldehydes.

As expected, the amounts of volatile chemicals found and the degree of damage to the paper varied with the intensity of the e-beam irradiation, and the amount of heat generated in the irradiation process. Although only low levels of chemicals were found in samples of irradiated mail, it was concluded that exposure to irritant chemicals could have contributed to the symptoms reported. OSHA's analytical results compared favorably with those obtained in parallel studies by the Hazardous Materials Response Division of the National Oceanic and Atmospheric Administration (NOAA/HMRD) and the Defense Advanced Research Projects Agency (DARPA).

Although a number of steps have been taken to reduce potential exposure to irritant chemicals while handling irradiated mail, DARPA and the Armed Forces Radiobiology Research Institute (AFRRI) will continue study of the problem on an ongoing basis.

NORA
Symposium 2003

Abstracts

Session: 9

Paper Number: 94

Evaluation of the Dermal Absorption of Common Solvents

Karla D. Thrall, Karl K. Weitz, and Angela D. Woodstock

Battelle, Pacific Northwest Division, Richland WA, USA

Exposure assessment is an important component in estimating health risk for individuals exposed to chemicals. Regulatory agencies have established standards for allowable occupational exposures, primarily via the inhalation pathway. In contrast, very little data is available to provide agencies sufficient guidance to establish permissible dermal exposure levels. Part of this shortfall lies in the fact that measurement of the amount of chemical absorbed through the skin is both experimentally difficult and time consuming. In the research described here an innovative methodology was utilized to non-invasively evaluate dermal absorption by continually analyzing exhaled breath. Because breath concentrations can be used to reflect blood concentrations, constant analysis of exhaled breath provides an opportunity to evaluate differences in the rapidly changing blood compartment that occurs immediately following peak exposure. Animal studies were conducted to collect time-course data on the dermal absorption of two common solvents - toluene and xylene. Both of these solvents are components of various paint and adhesive products, and may be frequently encountered in the occupational setting and by the consumer. Studies were conducted to expose animals to these compounds as both aqueous material and as vapors in order to provide an understanding of the impact of exposure matrix on dermal absorption. The exhaled breath kinetic data collected from each exposed animal was subsequently evaluated using an established mathematical model to determine the rate of dermal absorption. The studies conducted to date indicate that the aqueous compounds are rapidly absorbed through the skin of a rat with permeability coefficients of 0.074 +/- 0.005 and 0.058 +/- 0.009 cm/hr for toluene and xylene, respectively. In comparison, the rat in vivo permeability coefficient was significantly higher for toluene and xylene vapor exposures, at 0.91 +/- 0.05 and 0.65 +/- 0.08 cm/hr, respectively. However, numerous investigators have shown that the dermal absorption of a variety of compounds is greater in rats than in humans. Therefore, focused human studies were conducted to evaluate the dermal absorption of aqueous toluene and xylene in a realistic exposure scenario to mimic bathing. Volunteers were exposed at initial water concentrations of approximately 500 µg/L toluene or xylene, and exhaled breath collected and analyzed as described for the animal studies. The human dermal permeability coefficients estimated from the exhaled breath data using the PBPK model were 0.012 +/- 0.007 cm/hr for toluene and 0.005 +/- 0.001 cm/hr for xylene. Although a comparative human value for xylene was not located in the literature, the U.S. EPA estimate for toluene absorption in the human of 1 cm/hr is in sharp contrast to the data determined here and suggests that a reevaluation of human dermal absorption may be warranted. Furthermore, although these studies were conducted using vapor and aqueous exposures, the resulting permeability estimates form the basis for comparing relative dermal bioavailability of these common solvents in the organic matrices of occupational and consumer products (Supported by NIOSH 5-RO1-OH03658-02 and NIEHS 1-P42-ES10338-01).

Session: 9

Paper Number: 95

Dermal Exposure Research Program

S.C. Soderholm, H.W. Ahlers, M.F. Boeniger, B.D. Lushniak

National Institute for Occupational Safety and Health

Estimates indicate that more than 13 million workers in the United States are potentially exposed to chemicals that can be absorbed by the skin. A worker's skin may be exposed to hazardous chemicals through direct contact with contaminated surfaces, deposition of aerosols, immersion, or splashes. When substantial amounts of chemicals are absorbed, systemic toxicity can result. Contact dermatitis can also result when chemicals are absorbed through a worker's skin. Contact dermatitis is one of the most common chemically induced causes of occupational illness, accounting for 10 to 15 percent of all occupational illnesses at an estimated annual cost of at least $1 billion.

The National Institute for Occupational Safety and Health (NIOSH) and approximately 500 external partners created the National Occupational Research Agenda (NORA) to guide occupational safety and health research in the nation. As part of NORA, NIOSH encouraged its intramural researchers to join together to develop large scale programs in and across NORA priority areas. One of the three interdisciplinary cross-divisional priority program areas funded in 2000 was the development of dermal policy based on laboratory and field studies. The overall goal of this program is to promote the development of improved NIOSH policies and recommendations for identifying and controlling dermal overexposures and dermatitis. This goal will be accomplished by (1) adding critical information to our current knowledge base through laboratory and field investigations and (2) developing and applying scientific decision-making processes for policy development using that knowledge base. For simplicity, this program is frequently called the NORA Dermal Exposure Research Program (NORA DERP).

There are currently eight research projects in the program contributing information in such areas as developing biomonitoring methods; developing colorimetric methods; conducting case studies in the field relating to exposure assessment, intervention evaluation and engineering controls; developing improved mathematical relationships to predict percutaneous penetration and sensitization potential; conducting laboratory studies of decontamination and penetration; and developing recommendations for improving current NIOSH skin notations. One core project applies the Local Lymph Node Assay (LLNA) to predict the sensitization potential of pure chemicals and mixtures. Another core project coordinates the program and encourages scientific forums on dermal exposure issues.

Highlights of accomplishments include improved measurement and analysis methods, protocols for field studies, funding to encourage other researchers to enter this field, as well as leadership for a series of international conferences with representatives of governments, industry, labor and academia in North and South America, Europe, Africa, Asia and Australia. This presentation describes the objectives, research accomplishments and anticipated impact of each of the 10 projects in the NORA Dermal Exposure Research Program. Having completed approximately one-third of the proposed lifetime of this Program, we anticipate significant progress in the next few years toward the improvement of NIOSH recommendations for identifying and controlling chemical over-exposures to the skin of workers.

Session: 10 Paper Number: 96

Injury Surveillance in Migrant Farmworker Families

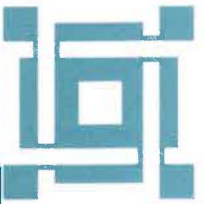
S.P. Cooper (1), K. Burau (2), E.M. Shipp (1,2), R. Frankowski (2), N. MacNaughton (2), C. Hanis (2), A.M. Sweeney (1), L. Freimanis (2), D. Oliphant (1,2), N. Weller (3)

(1) Texas A&M School of Rural Public Health, (2) The University of Texas School of Public Health, (3) Harvill E. Weller & Associates

Injury prevention efforts have been hindered by a lack of effective surveillance in agriculture. The objective of this NIOSH-funded cohort study was to use a school-based tracking system for migrant farmworker students as a surveillance method to identify migrant farmworker families in Starr County, along the Texas-Mexico border, in order to estimate the frequency and risk factors for occupational injuries over a two-year period. Injuries were defined as getting hurt when working or traveling to or from work while migrating in the past year. Rio Grande City Consolidated Independent School District (RGCCISD) is the largest of three school districts in Starr County, and enrolled nearly 60% of all students in Starr County. The Migrant Education Program in RGCCISD maintained files computerized through the New Generation System on 1,200 families in the 1998-99 school year.

Randomly sampled from the New Generation System, our cohort consisted of 267 families, who in the spring of 2000 responded to a screening questionnaire and indicated their intention to migrate. All were Hispanic, with an average family size of 4.6 people, average education of 7 years, and had lived in Starr County for a mean number of 17 years. The mother was the primary respondent for the family, and questions were asked about the mother, father, oldest and youngest child (Year 1 only). For both years, only 62% of the eligible participant families migrated (n=154 at Year 1 and 143 at Year 2) and 96% of these completed the follow-up interviews. These families represented about 310 individuals each year who had worked in the fields on average 6 days a week, 10 hours a day, for 2.7 months in the past year. During each year, 14 work-related injuries were reported. The most frequent injuries were cuts/jabs, transportation-related injuries (including head injury), blisters/rashes from pesticides, and heat exhaustion/stroke. Over one-third of the injuries resulted in lost work time. On average each year, 30% of mothers, 22% of fathers, 15% of oldest children and 10% of youngest children (Year 1 only) also reported chronic back pain. In terms of hazard surveillance, from 1/3 to 2/3 of all family members who worked in the fields were exposed to tractors, knives, chemicals, repetitive bending, repetitive handwork, hitched equipment, irrigation ditches, and repetitive lifting (fathers). Of 102 mothers who participated in migrant farm work during the summer of 2001, only 44 (43%) reported having received EPA regulated pesticide safety training within the previous 5 years.

The New Generation System proved to be an effective method to identify migrant farmworker families in Starr County for epidemiologic studies or future interventions. Given that a majority (57%) of the migrant farmworker women in our study had not received Worker Protection Standard employer-mandated pesticide safety training, increased enforcement, education, and alternative delivery of this training are recommended. If person-time at risk for injuries is taken into account as well as symptoms of chronic back pain, the reported injuries are substantial. These data support the need for systematic streamlined surveillance and school-based and community interventions.



Session: 10 Paper Number: 97

Occurrence of Scabies across the Country in VA Healthcare Facilities: An Initial Look

G.A. Roselle (1,2,3), L.H. Danko (1,2), S.M. Kralovic (1,2,3,4)

(1)VA Central Office Infectious Diseases Program Office, (2)Cincinnati VA Medical Center, (3)Division of Infectious Diseases, University of Cincinnati School of Medicine, (4)Division of Epidemiology and Biostatistics, University of Cincinnati School of Medicine

Infection with Scabies sarcoptei, scabies, has been noted to be increasing in incidence for a number of years. In addition, the concern for anti-scabitic-resistance has been growing with repeated reports of treatment failures with 'standard' anti-scabitic therapies. Currently, scabies is not a reportable disease and there are few sources of information that provide numbers and incidence of occurrence for this infection. In the healthcare setting, infestation with scabies also becomes an occupational exposure issue; there is the potential for transmission from patient-to-healthcare worker, and vice versa. In the recent annual infectious diseases/infection control survey performed at Veterans Affairs (VA) Healthcare facilities across the country, a single question about patient cases of scabies was asked: If the answer was 'Yes', two follow-up questions pertaining to total number of patient cases of scabies and the number of occupational exposures for which anti-scabitic treatment was prescribed were asked. For federal fiscal year (FY) 2000, and 2001, 77 of 138 (56%) reporting sites, and 85 of 140 (61%) reporting sites nationwide, respectively, indicated 'Yes'. In FY 2000, there were 766 (range per reporting site 1-64) patient cases of scabies reported nationwide (766/3.647 million persons for a rate of 21/100,000), and in FY 2001, there were 820 (range 1-79) patient cases reported nationwide (820/4.060 million persons for a rate of 20.2/100,000). 935 treated occupational exposures were reported for FY 2000, while there were 869 treated occupational exposures reported for FY 2001. The number of treated occupational exposures ranged from 0-150 and from 0-123 per FY, respectively, for sites reporting patient cases of scabies; these ranges suggest the possibility for large exposure events. The number of employees treated for occupational exposure was larger than the reported patient cases, potentially related to the contagiousness of scabies, the fear that scabies-exposure engenders or an underreporting in cases of scabies. Further, since scabies is not a reportable disease for public health except in unusual outbreak situations, it is likely that more cases occur without being noted and reported. This initial snapshot of scabies within the VA suggests that there is significant occurrence among our patients as reported during this review. This information, along with the information on treated occupational exposures, indicates that there is need for more data to better define the issues with scabies in healthcare facilities.

Session: 10 Paper Number: 98

Predictors Of Successful Work Role Functioning Following Carpal Tunnel Release Surgery

B.C. Amick (1), J.N. Katz (2), J.M. Ossmann (1)

(1)University of Texas Health Sciences Center-Houston, School of Public Health, (2) Brigham and Women's Hospital; Harvard Medical School

Importance and Purpose: Return to work (RTW) research has identified many predictors of RTW which, until now, have not been examined collectively in a single study. We developed a multidimensional model focused on six major predictor categories (demographic, clinical, psychosocial, economic/legal, job conditions, and organizational conditions) and consider significant predictors of successful RTW following carpal tunnel release surgery (CTRS). In addition, recent research suggests the transition from not working to working (i.e., RTW) may not be the most appropriate outcome. We introduce a newly validated measure of successful work role functioning which captures the impact of health on job functioning following return to work. We hypothesize that clinical, worker and economic/legal factors will be important predictors of successful return to work at 2 months following carpal tunnel surgery, but that the employment situation (job and organizational conditions) will be important at 6 months following surgery.

Methods: Patients with confirmed diagnosis of CTS and scheduled for CTRS from fifteen participating community-based physician offices completed questionnaires by mail preoperatively and postoperatively at two, six and twelve months. The two-month and six-month analysis samples were 128 and 122 respectively. Successful RTW was measured using a 3-level ordered measure of work role functioning (not working, working with limitations, working well) created from a 15-question subset of the 26-item Work Limitations Questionnaire. Predictor variables were grouped into six a priori conceptual categories: Demographic, Clinical, Psychosocial, Economic/legal, Job conditions, and Organization. Ordered logistic regression with robust estimation procedures was used to estimate risk transitions.

Principal Findings: Multivariate results for 2-months following CTRS found baseline work role functioning, OR 1.02; CI 1.01-1.04, being depressed, OR 0.32; CI 0.14-0.74, and being a workers' compensation claimant, OR 0.30; CI 0.14-0.66 were significant predictors of successful RTW. Multivariate results for 6-months following CTRS found baseline work role functioning, OR 1.04; CI 1.02-1.05, improved self-efficacy post-surgery, OR 7.11; CI 2.47-20.46, and a supportive organization, OR 5.20; CI 1.68-16.05 predicted successful RTW.

Conclusion: Physical health as measured by baseline WRF, depression and being a workers' compensation claimant were significant predictors of short-term return to work. Employment conditions such as working in a highly supportive organization were important at six months. Unexpectedly, self-efficacy change for CTRS was a strong predictor at 6 months.

Implications for Research and Improving Outcomes: This work highlights the importance of using multidimensional models in examining the return to work process and using multiple time points following an intervention. While further studies need to confirm our findings, the results suggest interventions targeting improving self-efficacy and developing highly supportive organizational policies and practices help promote successful return to work. These results further illustrate the importance of a new outcome measure of work role functioning.

Primary Funding Source: The National Institute for Occupational Safety and Health

Session: 10 Paper Number: 99

Health Care Savings from a Partnership Approach to Occupational Medicine

S.L. Long (1), W.B. Bunn (2)

(1) Stephen Long, M.D., M.P.H., Medical Director, IC Corporation, 751 South Harkrider, Conway, AR 72032
(2) William B. Bunn, III, M.D., J.D., M.P.H., Vice-president Health, Safety, and Productivity, International Truck and Engine Corporation, 4201 Winfield Road, P.O. Box 1488, Warrenville, IL 60555

Introduction: Care of the sick or injured worker typically involves referral to facilities away from the actual work site, such as a local family practice or occupational medicine clinic, to save money by "out-sourcing" occupational medicine services. Non-occupational illnesses and injuries are traditionally the responsibility of the individual employees through their health insurance. Some larger facilities employ physicians to provide on-site care strictly for work-related conditions. A partnership of IC Corporation, United Auto Workers, Aetna, and the University of Alabama at Birmingham developed a hybrid approach to occupational medicine at IC Corporation in Conway, Arkansas, in the form of an on-site clinic that combines the care of occupational with non-occupational injuries and illnesses. Economic benefits range from direct savings of physician fees to indirect savings of lost time and wages for off-site doctor visits. The work force benefits from immediate access to care, continuity of care, and availability of focused wellness programs.

Objective: To measure the economic impact of on-site physician services in a major manufacturing facility employing 1600 workers.

Methods: Data was collected on 8,383 patient visits from June of 1999 through April of 2002. The data included demographics, department, work restrictions, medications, referrals, and diagnosis. Costs were assigned to measurable parameters.

Summary: The cost savings for work-related injuries and illnesses totaled $415,250 and for non-occupational health care, $307,320. $168,130 was saved in wages, and $687,608 in lost time. The total cost savings for the study period was $1,578,308 with clinic expenses of $544,000, leaving a net savings of $1,034,308. The annualized savings was $354,619 per year.

This study provides objective evidence of the economic benefits of an on-site physician treating both occupational and non-occupational illnesses and injuries with full support of labor and management. The demonstrated savings may encourage other facilities to begin similar in-house physician coverage, resulting in cost savings and a healthier work force through the combination of occupational and non-occupational medical care.

Session: 10 Paper Number: 100

Characteristics and Relative Risk of Occupational Fatalities of Hispanic Construction Workers

J.W. Platner and X. Dong

The Center to Protect Workers' Rights

In 2000, Hispanic construction workers were nearly twice (1.84, 95% CI: 1.60-2.10) as likely to be killed by occupational injuries as their non-Hispanic counterparts, largely due to falls. Hispanic construction workers consistently faced higher relative risks, for every year from 1992 to 2000 and for every age group. A majority of Hispanic construction workers (57%) are non-citizens, of which 22% had emigrated within the past 3 years. More than one third (36%) of Hispanic construction workers are under 30 years old, compared to 22.6% of the non-Hispanics, resulting in an average age which is 5 years younger than non-Hispanics. Hispanic construction workers are at higher risk of being killed on the job than non-Hispanic construction workers, even after correcting for participation in high-risk trades. Census of Fatal Occupational Injuries (CFOI) data between 1996 and 2000 were combined to allow reliable comparisons of age and occupational groups. Relative risk and 95% confidence intervals were calculated by occupation comparing Hispanic and non-Hispanic construction workers: Helpers, construction trades, 2.31 (95% CI: 1.41-3.80); Roofers 1.77 (95% CI: 1.38-2.28); Carpenters 1.39 (95% CI: 1.08-1.79); and Construction laborers 1.31 (95% CI: 1.17-1.46).

The incidence of reported occupational injuries and illnesses among Hispanic construction workers increased by more than 60% from 17,738 in 1994 to 28,757 in 1999, however the reported injury rates are relatively stable (2.4% to 2.5%) similar to the reported injury rates for the non-Hispanic workers. Given that both fatality and injury rates should be proportional to exposures to risk, this suggests significant under-reporting of injuries and illnesses by Hispanic construction workers. Additional research is required to evaluate factors which place Hispanic construction workers at higher risk, and to develop and evaluate the effectiveness of targeted public health interventions.

Session: 11 Paper Number: 101

The Impact of Demanding Work Schedules in a Nationally Representative Cohort of Working Adults

Allard E. Dembe (1), J. Bianca Erickson (2), Rachel Gross (2), Steven M. Banks (1), Robert Reville (3)

(1) University of Massachusetts Medical School, (2) Applied Epidemiology, Inc., and (3) RAND Institute for Civil Justice

This study utilizes data from the National Longitudinal Survey of Youth (NLSY) to examine two questions: (1) Do demanding work schedules increase the risk of occupational injuries and illness, and (2) Do the vocational, social, and economic consequences of occupational injuries and illnesses depend on whether the affected worker has a demanding work schedule.

The NLSY is a national probability sample of 12,686 men and women who have been repeatedly surveyed since 1979. This study examines the experience of these individuals between 1987 and 2000, a 13-year period when members of the cohort were 22 to 43 years of age. The survey's longitudinal design allows us to track the employment, occupational, work schedules, and injury and illness experiences of the cohort members, and assess their vocational, disability, economic, and social outcomes. Several types of scheduling arrangements are examined in this study including: overtime, extended hours/week (60+), extended hours/day (12+), prolonged commute time (2+ hours), night shift work, evening shift work, rotating shift work, split shifts, and irregular schedules.

This study reports on the experiences of 10,801 cohort members who reported working at least one job between 1987 and 2000. Our data covers 88,058 worker-years, during which 5,283 occupational injuries and illnesses were reported. Incidence rates were determined by dividing the number of injuries and illnesses reported to exposed workers by their total accumulated exposure time. Relative risks were determined by comparing these rates to those for workers in unexposed scheduling arrangements.

Our analysis indicates that overtime and extended hour schedules increase the risk of occupational injuries and illnesses by 49%, and that shift work increases the risk by approximately 25%. We found that the types of schedules with the greatest risk of injury include overtime (RR=1.95), night shift (RR=1.43), extended (12+) hours per day (RR=1.42), and evening shift (RR=1.41). Multivariate regression analyses were conducted to control for the potential confounding effect of age, gender, race/ethnicity, occupation, and industry. We will also be reporting on the relative influence of each type of demanding work schedule on selected outcomes of occupational injuries and illnesses including time missed from work, job transitions (e.g., being laid off, fired), filing for and receiving workers' compensation benefits, job satisfaction, and selected social and behavioral impacts, such as divorce, and alcohol/drug use.

This study advances this field of knowledge by estimating the relative impact of several types of demanding work schedules on workplace injuries and illnesses among a nationally representative cohort of working adults. The extensive employment and outcomes history available in the NLSY allows for quantification of the effects among various occupations and population subgroups. The ultimate goal of this research is to identify the most dangerous aspects of demanding work schedules and devise effective strategies for mitigating the dangers. These strategies could include: (1) changes to work organization and procedures, (2) targeted employer-sponsored health promotion activities, and (3) individual coping and behavior related to the specific hazard.

Session: 11 Paper Number: 102

Diagnosing and Treating Abusive Behavior in the Medical Workplace - Creating Healthy, Abuse-free Environments.

D.J. Anderson (1), C. Cassirer, ScD, MPH (2)

(1)Park Nicollet Excelsior Center for Healthy Organizations, (2)Carlson School of Management, University of Minnesota

Increasing national attention continues to focus on the how we treat each at work as health professionals and its impact on both individual and organizational performance. Recent reports in the media and the research literature indicate that abusive behavior is increasing in health care among both providers and patients. There is a growing concern that our relationships at work are significantly strained creating stress and opportunities for unhealthy behavior to root and grow.

During the past 12 years a wealth of data and research information has been accumulated from work with health and non-healthcare organizations on the impact of unhealthy and healthy workplace behaviors on performance. Our research and other studies continue to show that employee satisfaction, turnover, absenteeism, and patient safety are negatively affected when abusive behavior is present.

The purpose of this paper is to:

- Present information from surveys of 16,500 health care workers collected during the past 10 years on perceptions of abusive and unhealthy behavior in healthcare workplaces.
- Present a case study examining the impact of a 5-stage process for addressing abusive behavior and improving organizational performance.
- Share better practices and lessons learned from our ongoing work with hospitals and clinics to address abusive behavior and how it is improving turnover, satisfaction and patient safety.
- Discuss a report entitled, Guidelines: Diagnosing and Treating Abusive Behavior in the Medical Workplace to be published by the American Medical Association in the Spring of 2003.

Session: 11 Paper Number: 103

A Comparison Of Time Loss Injury Rates Between Employer And Employee Choice States

R.W. Watson

Arbor Occupational Medicine

Time loss injuries present a significant problem for employers and employees. In the year 2001, there were 5.2 million injuries that resulted in time away from work. Managed care models have demonstrated the ability to effectively decrease the rate of time loss injuries without sacrificing the quality of health care. The treating physician is one of the key components in this system. How the physician is selected can then effect the outcome of the case. State laws usually regulate the choice of treating physician. The purpose of this study is to compare time loss injury rates between states that allow the employer to choose the physician and states that allow the employee to choose the physician.

The data for this study was obtained from the Bureau of Labor Statistics and Employee Standard Administration of the Department of Labor. Time loss injury rates were compared from states that allow employer-choice and employee-choice from 1996 -2000. Analysis was done nationally and regionally.

The results demonstrate, nationally, that states that allow the employer to choose the treating physician have lower time loss injury rates than states that allow the employee to choose the treating physician. Between 1996 and 2000, the average time loss injury rate for employer-choice states was 1.9/100 workers, compared to 2.4/100 workers for employee-choice states ($p<.01$). This finding is present regionally, with the most significant difference in the west. Findings in the east region and central region show similar trends but were not as significant.

How states regulate the selection of treating physicians for occupational injuries can impact outcomes with regard to time loss injuries. This becomes more imperative when it is recognized that nationally, in 2000, the median lost workdays was 6 days, with a fourth of the cases resulted in more than 21 days of lost time. Employers should be more inclined to select physicians who understand occupational health and the benefits of workplace safety. States, allowing for the effective designation of the treating physician, should lead to better management of occupational injuries, decreased lost time workdays and improved preventive occupational health.

Session: 11 Paper Number: 104

Characteristics of Work Scheduling and Work-Related Injuries in Construction

Sue Dong

The Center to Protect Workers' Rights

Importance: Construction is a highly hazardous production industry. One in five fatal work injuries each year in US private industry, and over 11 percent of the total cases with days away from work occur in construction, despite construction's comprising between 6 and 7 percent of the national workforce. Construction workers face rapidly changing workplaces, a high degree of competition, bouts of unemployment, as well as vast overtime. When such pressures are brought to the job, they may affect workers' health and ability to remain safe in the workplace. Therefore, it is necessary to understand work scheduling variables such as work-rest schedules, weekly duration of work, shift work, and extended periods of overtime among construction workers, and the effects on their safety and health.

Objectives: The objectives of this study are 1) to examine work scheduling in construction and 2) establish any connection between hours of work patterns and safety outcomes among construction workers.

Methods: The National Longitudinal Survey of Youth, the 1979 cohort (NLSY79) between 1986 and 1996, was used for the data analysis. Injury rates and other statistics were used to measure risk.

Results: The findings indicate 1) work scheduling in construction differs from non-construction scheduling and 2) overtime is strongly associated with work-related injury among construction workers, especially construction laborers.

Implementation: The findings may be the first examination of work-related injuries and working hours among construction workers. The results may be used to persuade construction project owners and contractors of a need for more careful planning, staffing, and training to reduce unscheduled and excessive overtime; and guide construction managers in the implementation of optimal work schedules that would minimize the risks and cost of safety and health to workers, employers, and the public. The results may also suggest appropriate public policy interventions, tailored to construction and industries experiencing similar consequences, to produce work schedules that might help reduce the risk of injuries and illnesses.

Session: 11 Paper Number: 105

Evaluation of Hearing Conservation Program Effectiveness - A Case study of How Safety and Health Policy and Standards are Translated into Workplace Practice

M.M. Prince (1), M.L. Colligan (1), C.M. Stephenson (1), B.J. Bischoff (2)

(1) National Institute for Occupational Safety and Health, (2) Crowe, Chizek and Company LLP

The Occupational Safety and Health Administration (OSHA) Hearing Conservation Amendment (HCA) has mandated that general industry employers must establish hearing conservation programs for workers exposed to noise levels having a time-weighted average (TWA) of 85 dBA or higher (OSHA, 1983). Although specific with respect to program structure, the regulation describes the minimum framework or structure of a hearing loss prevention program and leaves employers some latitude with respect to program design, implementation and administration. The present paper describes how focus groups (comprised of line workers and supervisors) were used, in conjunction with traditional audit measures, to assess the extent to which formal hearing loss protection policies became integrated into day-today work practices across three organizations. Descriptive data on plant hearing conservation program practices at each plant are presented with a comparison of proactive elements of each program relative to the OSHA HCA requirement and to internal plant policy.

Study results indicate that exclusive reliance on such practices as policy review, audiometric testing audits, and noise surveillance to evaluate the effectiveness of workplace hearing conservation programs fails to capture the impact of these programs as experienced by workers at the "shop floor" and offers little insight into the reasons and potential remedies for noted deficiencies. Paper audits of programs completed by program managers were insufficient by themselves to provide a realistic picture of actual implementation of and compliance with various program components, as evidenced by the discordance between focus group reports, onsite observations, and the audit checklists. With regard to implementation of effective hearing conservation programs, the study findings indicated that: (1) employees preferred annual training in small groups or one-on-one with more information on HPD fit training, explanations of audiometric results and noise monitoring; (2) in this time of downsizing, senior peer employees (with the best training) should be cultivated as role models and champions for hearing loss prevention to newer employees; (3) a high quality audiometric test program, conducted on schedule, is perceived to correspond with positive company attitudes toward worker safety and health; The implications for both in-house and contracted programs are significant in that workers recognized that testing hearing during the work shift was a best practice that facilitated identifying early hearing damage; (4) While engineering controls is first in the hierarchy of controls, it is not prudent to neglect HPD compliance until noise monitoring assures the absence of hazardous noise. Partial engineering controls may have led to complacency, decreased HPD use where still needed, and perhaps more hearing loss than predicted.

Occupational health and safety program evaluation is a process of continuous learning which provides important mechanisms by which management and employees can measure and document program successes, identify problems, and guide new interventions. While audits by management of records, policies, procedures and examination of hearing loss trends through audiometric database analysis are critical to program evaluation, companies who enrich this data with periodic focus group discussions may uncover a richer understanding of problem areas or successful strategies that can be shared within or industries.

Session: 12 Paper Number: 106

Fall-Safe Partnership: Results of Organizational Intervention Research to Prevent Construction Falls

P.B. Becker, ScD. (1), M.D. Fullen (1), M. Akladios, PhD (1)

(1) West Virginia University Safety and Health Extension, (2) The Center to Protect Workers Rights, (3) National Institute for Occupational Safety and Health, (4) The Construction Safety Council, and (5) St.Paul Insurance Company

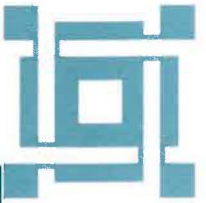
Falls are the leading cause of injury in construction. The construction safety literature recognizes available engineering controls, work practices, and personal protection which are effective in preventing construction falls. However the equipment and practices are not widely used in the industry. This presentation will report the results of an innovative intervention research project intended to improve and evaluate contractor performance and practices needed to decrease construction falls.

The program implements a construction contractor certification program called Fall-Safe. Fall-Safe is a fall hazard management system that works to improve managements use of existing fall prevention methods through use of training, program development and implementation, safety committees, site inspections and an audit system to provide accountability system for fall prevention on construction job sites. WVU Safety and Health Extension serves as the certifying organization for contractors in West Virginia, and is assisting contractors in developing office and site fall prevention programs, training of supervision and workers, and quarterly audit of both company and site fall prevention efforts. Considerable project resources have been allocated to marketing the program to contractors. Construction Safety Council and St. Paul Insurance also serve as sponsoring organizations for Fall-Safe in the Midwest.

The site audit of fall prevention practices also serves as the tool for evaluating impact of the program. The audit has been programmed into a Pocket PC handheld computer that scores contractors on their fall prevention site programs and their compliance with OSHA standards related to construction falls. The evaluation compares the changes in scores for an intervention group of contractors and a control group that does not participate in Fall-Safe over a period of one and a half years.

Statistical analysis of the data collected from 16 contractors in a pilot phase of the research (10 intervention, 6 control) indicates that an intervention group of contractors has shown more improvement in site program and site hazard control scores than the control group. Results also indicate that scores for site hazard control audits can be associated with scores on site program audit.

The expanded study currently includes 40 additional contractors and the two participating partners. The current study tests whether the intervention can succeed when implemented by other third party organizations in other regions of the country. Continuing research should obtain more power for evaluation, including analysis of workers' compensation claims data as a measure of intervention impact.



Session: 12 Paper Number: 107

Reporting Systems For Fatal Occupational Injuries: A Comparison Of The United States Of America And The European Union

F.G. Benavides (1), G.L. Delclos (2), S.P. Cooper (3), J. Benach (1)

(1) Occupational Health Research Unit, Department of Health and Experimental Sciences, Pompeu Fabra University, Barcelona, Spain, (2)Southwest Center for Occupational and Environmental Health, The University of Texas School of Public Health, Houston, Texas, U.S.A., and (3) Department of Epidemiology, Texas A&M University School of Rural Public Health, College Station, Texas, U.S.A.

Background: Assessment and comparison of workplace accidents among countries can be problematic because of differences in national recording and notification systems, underreporting, industrial structure differences and inaccurate employment figures. An appropriate comparison between the United States (U.S.) and European Union (E.U.), where these limitations might be less of a factor, could provide insight towards improving global cooperation in occupational health and safety.

Objectives: To describe fatal work injury surveillance system characteristics and compare basic statistics between the U.S. and the E.U.

Methods: Definitions of fatal work-related injury, identification of reference populations and other surveillance system characteristics were compared between the U.S. Census of Fatal Occupational Injuries (CFOI) and the annual European Statistics on Accidents at Work (ESAW). Numbers and crude rates of fatal occupational accidents were collected for the U.S. and recalculated for the E.U. by sex, age and for two common industrial sectors (construction and manufacturing) for the period 1995-1998.

Results: The CFOI and ESAW employ similar case definitions for workplace fatality. Both exclude commuting accidents and workplace deaths due to non-external causes, such as heart attacks or strokes, unless these were clearly preceded by a traumatic event. However, many European countries do not include work accidents that affect the self-employed or certain public services workers. CFOI employs active surveillance, with confirmation of a death by at least two separate sources; ESAW is based on passive notification linked to specific insurance schemes or labor inspection records.

Daily fatal occupational accident figures in the U.S. and the E.U. for 1995-1998 were similar: around 17 workers die every day as a consequence of their jobs. Although decreasing trends were observed in both, annual average fatality rates were 24% higher in the U.S. Age and gender-related trends were similar in both regions. However, from 1995 to 1998, differences between the U.S. and E.U. by age group progressively widened with increasing age, from approximately 7% for workers <25 years of age to over 50% in those >=65 years of age.

Specific rates for manufacturing were higher in the E.U. than in the U.S., although there was a 20% improvement in E.U. rates over the study period, whereas U.S. rates increased slightly. Conversely, specific fatality rates for

construction were consistently lower in the E.U. than in the U.S., with a progressively widening difference from 1995 to 1998, since rates decreased by 21% in the E.U. (from 13.8 to 11.4/1,000,000), but varied little in the U.S. (from 15 to 14.5/1,000,000). Approximately five times more workers died in construction than manufacturing in the U.S., as compared to a three-fold difference in the E.U.

CONCLUSIONS: Direct comparisons are complicated, but help enhance data collection for fatal occupational accidents, a priority for both CFOI and for ESAW. Both systems might consider formally addressing the comparability of the two reporting schemes, which would allow a better understanding of differences in rates and trends. Given current global trends, there is a need for comparable information systems that can allow the development of regional and global policies to prevent occupational accidents.

Session: 12 Paper Number: 108

Active Injury Surveillance in Residential Construction

Hester J. Lipscomb (1), John M. Dement (1), James Nolan (2), Dennis Patterson (2), Wilfred Cameron (3)

(1) Division of Occupational and Environmental Medicine, Duke University Medical Center, (2) Carpnters District Council of Greater St. Louis, and (3) Center to Protect Workers Rights

Construction workers have among the highest fatal and lost time injuries in the U.S. Residential workers present particular challenges to study as a mobile workforce with frequent changes in job sites and employers. The work at any given site is short in nature, the work changes daily, and sites are typically small with few workers.

We report on an active injury surveillance project conducted with the Carpenters' District Council and Homebuilders Association of Greater St Louis, Missouri - the only area in the U.S. with a large unionized residential workforce. Contractors reported injuries as they occurred on their job sites. Journeymen carpenters, with safety training and training in questionnaire administration, interviewed peers about the circumstances surrounding their injuries. Site assessments were conducted where falls occurred. The union enumerated the carpenters and hours worked allowing the estimation of injury rates. These data were supplemented with focus groups to collect information about exposures, training, mentoring, and risk perception.

Over 5,000 carpenters who worked 9 million hours between September, 1999 and September, 2002 comprised the study group. A total of 783 injuries were reported; 586 carpenters participated in investigation interviews (75%). Ninety-five site visits were conducted. Examples of findings are below:

- Pneumatic nail guns were the greatest cause of injuries from carpenters being struck. Rates were 3 times higher among apprentices than journeymen. Over 65% of injuries associated with contact trip nail guns could likely be prevented by sequential triggers. The residential construction industry would be well-served by an alliance with the trade association (ISANTA) and manufacturers to develop, test and evaluate tool improvements and training programs.
- At the time of manual materials handling injuries, the carpenter was handling an object weighing greater than 100 pounds 48% of the time and 200 or more pounds 28% of the time. Raising framed walls and setting steel I-beams by hand were significant problems.
- Apprentices, compared to journeymen, have different patterns of risk for different injuries. Some risk is related to different work assignments - more use of pneumatic nailers and more materials handling responsibilities, for example. Failure to recognize this leads to continued assignment of some dangerous tasks to inexperienced workers and attribution of injuries to inexperience.
- Sites on which falls from height occurred were less likely to have workers using hard hats and eye protection and more likely to have poor housekeeping, materials storage and unacceptable scaffolding - providing some indication that the overall safety climate may be poorer on these sites.

Dissemination activities included monthly reports in the union newsletter; presentations to contractors; talks at union local meetings; and articles in trade and academic journals. The apprenticeship school initiated nail gun training for apprentices in response to early findings.

The effort yielded information on factors contributing to injuries among high risk workers who are difficult to study. Though more time consuming than passive surveillance, the information is more useful in understanding injury circumstances and formulating preventive recommendations. Labor management collaborations made the project possible and provided venues for dissemination.

Session: 12 Paper Number: 109

A Randomised Controlled Trial of Participative Ergonomics for Manual tasks (PerforM)

R. Burgess-Limerick (1), R. Egeskov (2), C. Pollock (3), Straker(3)

(1) The University of Queensland, (2) Department of Industrial Relations Queensland, (3) Curtin University of Technology

Aim: The aim of this paper is to describe the results of randomised and controlled trial of a participative approach to reducing injuries associated with manual tasks.

Study Design: Between Oct - Dec 2000, 177 small to medium sized workplaces (30 - 100 employees) located within 200 km of Brisbane were audited by state government workplace health and safety inspectors. The workplaces were categorised as either food processing, construction related manufacturing and wholesaling, and nursing homes/accommodation for the aged. The information gathered covered management systems, legislative compliance, productivity, absenteeism, lost time injuries, organisational culture, safety activity and physical risk estimates. Workers compensation data was also obtained subsequently.

Following the audit, this group of workplaces was offered the opportunity to be involved in the evaluation of a participative ergonomics intervention program aimed at reducing manual tasks injury risk (PErforM). 48 workplaces volunteered and 31 were randomly assigned to an experimental group which received the intervention immediately (Mar-July 2001), with the remainder forming a control group who were again offered the intervention at the completion of the evaluation in 2002. Nine months following the intervention for the experimental group, all workplaces were audited again by government inspectors (April-July 2002).

Results/Discussion: The government inspector estimate of risk exposure to employees at a workplace reduced in the experimental group following intervention compared with no change or an increase in the control group ($F1,31 = 5.40$, $p = .027$). This suggests the participative ergonomics intervention was successful in reducing the risk of musculoskeletal disorders associated with manual tasks. Interestingly there was a trend for different types of manual task risk to be more effected by the intervention. Aspects of task repetition and duration and postural awkwardness appeared to be more influenced by the intervention than commonly perceived risk such as exertion force. The pattern of risk across body regions was similar. The number of formal advices provided by government inspectors was greater for the control group than the experimental group, matching the differences in physical risk estimates. The PErforM intervention also appeared to change the safety management systems, with an increase in the provision of information to employees on manual tasks and an improvement in health and safety structures.

Conclusion: This study provides the highest level of evidence yet available that a participative ergonomics intervention can successfully reduce the overall risk of musculoskeletal injury associated with manual tasks. However the success of the intervention varied between organizations and industry sectors and further research needs to characterise the organizations likely to be successful with this approach.

Session: 12 Paper Number: 110

Coupling Safety And Profit In Dairy Farming: An Intervention In A High Hazard Industry

L.J. Chapman, A.T. Taveira, B. Karsh, K.G Josefsson, C.M. Brunette

University of Wisconsin Biological Systems Engineering Department

Broad Importance of the Problem: When production practices which are marginally more efficient and relatively easy to adopt become available, previous research shows that many if not most firm managers are likely to adopt them, given adequate information flow and sufficient time. Practices that are both more efficient and safer are especially interesting for high hazard industries such as production agriculture and may be useful as supplements to, but not substitutes, for regulation.

Purpose: Dairy farming work is hazardous. Injury rates exceed averages for production agriculture, which as a whole, exceeds averages for all industries. Long day barn lighting, bag silos for cattle feed storage, and a site for distributing calf feed are more profitable practices that can reduce exposures to injury hazards. We investigated whether improving information flow to managers could persuade them to adopt these three practices.

Methods: The intervention disseminated information about the three practices through all the information channels that the 4,300 dairy managers in Northeast Wisconsin were known to rely on for learning about new production practices (print media, other farmers, public events, etc.). We evaluated the treatment group at baseline and after each intervention year with rolling, independent samples. We added an "exposed control" group of Maryland dairy farmers to the evaluation after the second year of the intervention who were likely to be exposed to the same print media but not other intervention components.

Findings: Questionnaire results after five years of the intervention showed that, compared to the baseline, more Northeast Wisconsin dairy farmers reported adopting bag silos and barn lights. More reported being aware of barn lights and the calf feed mixing site. However, there were no differences after five intervention years for adoption or awareness between the Northeast Wisconsin dairy farmers and the Maryland controls.

How the Findings Advance the Particular Research Field: This work was innovative because the intervention successfully:

- promoted engineering controls by substituting safer practices that were also more profitable,
- intervened with a relatively large, region-wide subject population made up of thousands of operations,
- utilized the full range of existing information channels farmers traditionally pay attention to,
- evaluated the intervention at baseline and after each year over a multi-year time frame,

How the Findings Can Improve Workplace Safety and Health: In most industries, there are many managers who continue to rely on "older" production methods despite the ready availability of less costly, less hazardous practices. Often, what appears to stand in the way is a lack of manager awareness about the existence, value, and ease of use of the improved practices, at least in part attributable to the absence of convincing, comprehensive, and well-targeted information dissemination. This research provides evidence that better information flow is associated with rapid, widespread adoption of practices that combine productivity improvement with improved occupational safety.
Funding from NIOSH supported this research.

Paper Number: 111

Finding the Right Image to Illustrate the Priority Areas of Health and Safety in the Workplace: The NORA Photolibrary

Kimberly Clough Thomas (1), Dorothy Tan-Wilhelm (2)(3), Susan Hogan (3), Wendy Heaps (3), Sam Hart (1)(2), Thomas Mandell (1)(2), Tanya Headley (1)

(1) National Institute for Occupational Safety and Health, (2) West Virginia University (STUDENT), and (3) Formerly employed with the National Institute for Occupational Safety and Health

As part of the communication enhancement efforts around National Occupational Research Agenda NORA, the Health Communication Research Branch HCRB is working to develop a library of visual images to help put a face to the hazards faced by the nation's workforce. Creating such a resource library will help tell the story about NORA and its importance to the rapidly changing U.S. workplace. Through NORA, NIOSH strives to reach broader audiences with its messages and to define itself within the public health spectrum, providing a visual presence will compel audiences to see and listen.

For many outside of NIOSH, the visual reference points for occupational safety and health are black and white images depicting work conditions of an earlier age, and an earlier economy. While often powerful and evocative, these images are not representative of today's American workplace. This new photo resource library would allow NIOSH to define the contemporary occupational safety and health setting embodied in the NORA initiative; explain the hazards faced in today's workplace, show those affected by them, and demonstrate the solutions for reducing those hazards.

Additionally, given the Institute's difficulty in finding the right image to illustrate the priority areas of health and safety in the workplace, it is not unlikely that occupational safety and health professionals outside of NIOSH also struggle with this issue. As we build this new resource, consideration would be given to assessing the needs of external occupational safety and health professionals. By determining their needs, interests, and preferred formats for the resource, NIOSH could create a product that would serve not only its own purposes, but those of occupational safety and health educators and professionals throughout the nation.

Paper Number: 112

Musculoskeletal Disorders Among Dental Students

(1) Linda J. Thornton DDS, MS, CAE, (2) Ann E. Barr PhD, PT

(1) Temple University School of Dentistry, (2) Temple University School of Allied Health

Background: Musculoskeletal disorders are a major concern among dental health care providers. Research on dentists and hygienists has shown that extreme static positions, repetitive movements and, force exertions are risk factors for work-related musculoskeletal disorders (WRMSD's) in the neck, shoulders, upper extremities, and lower back. While dental students perform the same type of work, there has been no scientific evidence to suggest that they are at risk for adverse health outcomes.

Objectives: The objectives of this study were to: (1) identify clinical job tasks that place dental students at risk, (2) determine the existence of symptoms, (3) determine if a relationship exists between WRMSD's and symptoms and, (4) determine the ergonomic risk factors present in those tasks.

Methods: Two pilot studies were conducted. In the first preliminary study, senior, junior and sophomore dental students from 4 dental schools (Howard, Maryland, Pennsylvania and Temple) completed a standardized Nordic questionnaire. In the second preliminary study, video recordings were conducted during the performance of a drilling/excavation task (use of the drill, hand tools and mouth mirror). Strain Index and Rapid Upper Limb Assessments (RULA) were used to evaluate the physical risk factors (duration, exertion, repetitiveness and posture). Fourteen (14) subjects (7 students and 7 patients) from Temple University School of Dentistry volunteered to participate. This study represents the first time that either RULA or Strain Index have been used in the field of dentistry.

Preliminary results from the questionnaire: There was a total response rate of 61% (670/1100). Sixty-one percent (358/590) of all respondents reported that during the last year they had experienced symptoms of discomfort related to work at dental school. Of those students, seniors represented 21% (123/590), juniors 29% (172/590) and sophomores 11% (63/590). There was a significant difference in the proportion of reported symptoms among the three classes (p=.000). Of the 590 students reporting symptoms of discomfort, the neck represented 48% (281/590), shoulder 31% (181/590), back 44% (259/590) and, hands 20% (120/590). The proportion of affected body areas among the study population was highly significant (p=.000).

Preliminary results from the assessment methods: RULA— The grand scores for the drill, hand tool, and mirror task elements were > 3 for all subjects tested. The syringe task element received scores of 3 and 4 in only two test subjects. The drill, hand tool, and mirror task elements consistently showed scores of 5 or higher for all participants. Strain Index—The SI scores for the drill and syringe task elements were 3 or less for each test subject. The hand tool task element received a score of <3 for only one participant. The hand tool and mirror task elements showed scores of >3 but <7 among five test subjects. The mirror task element was >3 but <7 in only one subject, however, it scored >7 in six participants.

Conclusion: Since preliminary studies have found students to be at risk. Further investigations should focus on the implementation of dental ergonomics awareness programs at the dental school level. Thus allowing dental students to enter the work force as competent clinicians who are ready to provide long-term service to the public.

Paper Number: 113

Effectiveness of Safety Inspections at a Construction Site

Michael McCann, PhD, CIH, (2) Matthew K. Murphy, (3) Janie Gittleman, PhD, MRP

(1) Director of Safety and Ergonomics, The Center to Protect Workers' Rights, Silver Spring, MD (2) Vice President, SEE, Inc., Merrifield, VA (3) Associate Director, Safety and Health Research, The Center to Protect Workers' Rights, Silver Spring, MD

Self-inspections and inspections by outside consultants are an important safety management tool in construction safety. The effectiveness of such inspections, however, has not been evaluated. The purpose of this study was to evaluate the effectiveness of regular inspections with follow-up at a construction site.

The construction site chosen was that of a 12-story building, in Washington, D.C., whose construction started in the fall of 2000. The construction manager hired a safety consultant to conduct regular safety inspections of the construction site. These inspections were documented and listed hazards found, potential regulatory penalties, and remediation dates. A foremen and the site superintendent were required to sign off when hazards identified by the inspection were abated. Between 11/6/00 and 2/3/03, 65 safety inspections were conducted.

Analysis of the safety inspection reports identified 1,782 separate OSHA violations or other hazards (such as violation of the 100% tie-off rule above 10 feet). Overall, fall hazards accounted for 41% of the total number of hazards, followed by electrical hazards (17%), personal protective equipment hazards (11%), housekeeping hazards (9%), fire hazards (8%), and other hazards (16%). Other hazards included risk of impalement from rebar, rigging hazards, overhead hazards, access/egress hazards, lack of lighting, and more. Twenty-seven percent of the hazards were repeat violations. One quarter of the hazards were abated on the same day as the inspection, half within 2 days, and four fifths abated within 3 days. Just over 5% had no abatement date listed although they were signed off as abated, and 6% were not abated.

The results demonstrate that regular inspections with careful follow-up can reduce the number of hazards, and presumably the number of injuries, on a construction site. The repeat violations could also serve as a basis for timely toolbox talks with workers to emphasize unsafe aspects of the work.

This study is the first such evaluation of the effectiveness of inspections of a construction site by outside consultants as an intervention. It shows that such evaluations are relatively simple to do, and can be an effective tool in identifying hazards and improving workplace safety.

Paper Number: 114

Semi-Quantitative Mold Exposure Index Predicts Building-Related Respiratory Symptoms

JH Park, PL Schleiff, MD Attfield, JM Cox-Ganser, K Kreiss*

National Institute for Occupational Safety and Health, Division of Respiratory Disease Studies, Field Studies Branch, Morgantown, WV, USA

The National Institute for Occupational Safety and Health (NIOSH) investigated 13 college buildings to examine whether a semi-quantitative mold exposure index (EI) could efficiently predict work-related respiratory symptoms. We collected work-related symptom data and room locations/time fractions through questionnaires. Industrial hygienists classified rooms for factors including extent of water stain, visible mold, mold odor, and dampness. We estimated 323 individual EIs based on each factor or a combination of the factors weighted by time fraction in particular rooms. In logistic regression models adjusting for age, gender, job position, hire years, smoking, allergies, and use of latex gloves, we found a significant exposure-response relationship for wheeze (Odds Ratio(OR)=2.3) with stain-based EI. EI based on the combined factors showed significant exposure-response relationships for chest tightness (OR=2.2), and shortness of breath (OR=2.7). Our findings suggest that an observational semi-quantitative exposure index can support public health action to prevent risk of building-related respiratory disease.

Our semi-quantitative mold exposure index, based on visual and olfactory observation, was associated with building-related symptoms that may reflect asthma, hypersensitivity pneumonitis, and nasal/sinus disease. From a public health perspective, these observational findings justify action to control water damage with attention to hidden reservoirs of bioaerosols, in order to prevent building-related respiratory disease.

(Footnotes)

* Contact author email: gzp8@cdc.gov

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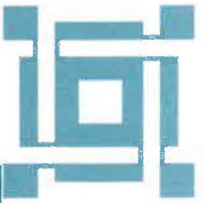

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