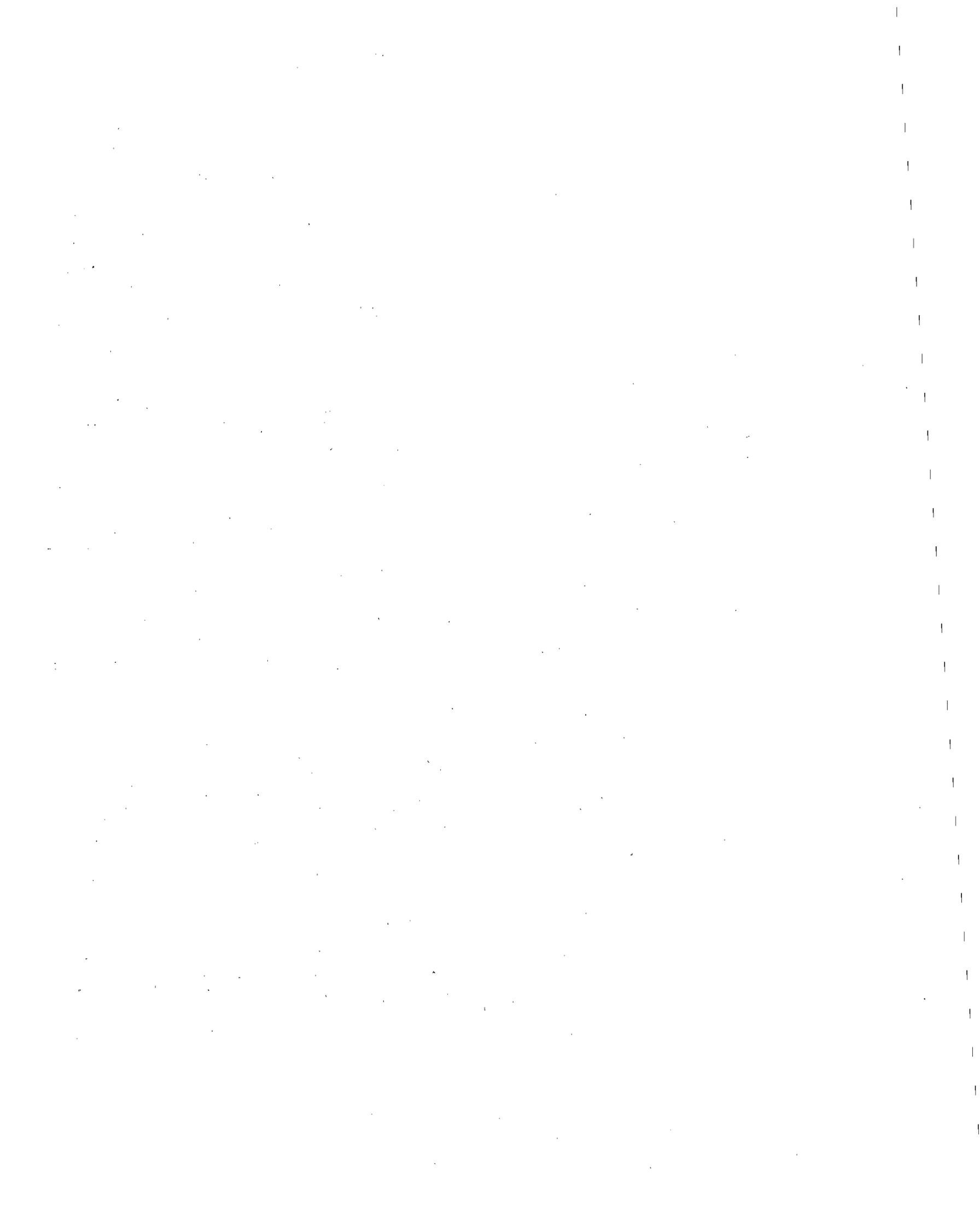




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**National Institute for Occupational Safety and Health  
Workplace-Related Skin Diseases and Exposure Assessment Workshop  
September 25-26, 1996  
Final Report**

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## Executive Summary

The goal of the National Institute for Occupational Safety and Health (NIOSH) Workplace-Related Skin Diseases and Exposure Assessment Workshop was to identify key workplace-related research issues and data gaps in exposure assessment, epidemiologic and prevention-oriented issues, and laboratory-based biomedical research including a review of the "state-of-the-art". The morning of the first day of the workshop was devoted to informational presentations on the Health Effects Laboratory Division and the epidemiological research and prevention-oriented activities of NIOSH, followed by discussion of research issues in these areas. On the second day, participants broke into three groups to discuss exposure assessment, and epidemiologic and prevention-oriented issues.

Major issues in laboratory-based skin biology:

- Mechanisms of occupational skin disorders (OSD)
- Relationship of molecular genetics and OSDs
- Barrier functions (hydrophobic, hydrophilic, microbial, and gas) and repair
- Relationship and possible interactions of skin and respiratory irritancy and sensitization

Major issues in exposure assessment and hazard control research:

- Absorption measurements
- Biomarker development
- Estimation of dose
- Standardization of data collection, reporting, and interpretation
- Development of sensors
- Training and education
- Validation of dermal exposure models
- Documentation of control measures effectiveness

Major issues in epidemiology and surveillance of OSDs:

- Communication of risk
- Epidemiological studies
  - Cross-sectional prevalence studies and prospective studies
  - Intervention studies
  - Early intervention in OSDs
  - Evaluation of the impact of worker education on outcome
  - Effectiveness of secondary and tertiary preventive intervention
  - Human response studies
- Surveillance
  - Improving data collection systems
  - Refinement of the Sentinel Event Notification system for Occupational Risks (SENSOR) dermatitis program
  - Promotion of the Health Hazard Evaluations (HHE) program
  - Re-examination of the Sentinel Event Monitoring Program

Day 1

**Health Effects Laboratory Division (HELD):**

Dr. Michael Luster presented an overview of NIOSH and HELD, a newly established NIOSH Laboratory Division in Morgantown, West Virginia, directed by Dr. Al Munson. Dr. Luster is Chief of the Toxicology and Molecular Biology Branch; Dr. Sid Soderholm is Chief of the Exposure Assessment Branch; Dr. Vince Castranova is Chief of the Pathology and Physiological Research Branch; and Mr. Alan Janssen is Chief of the Health Communications Research Branch.

Dr. Luster framed the discussion by presenting statistics showing that every day 9000 workers sustain injuries on the job, 16 workers die from work-related injuries, and 137 workers die from work-related diseases. In 1994, employers reported 6.3 million work-related injuries and 515,000 occupational diseases. Work injuries alone cost \$120.7 billion in medical expenses and lost productivity and wages. Dr. Luster asked that the meeting participants limit their discussion to identifying major data gaps and reviewing the "state-of-the-art", in three main research areas: laboratory-based research, exposure assessment, and epidemiologic and prevention-oriented issues.

The following questions were discussed for each of the three research areas to help determine the priority dermal issues:

1. Magnitude of the problem as it relates to the workplace.
2. State-of-the-art regarding current understanding of the problem.
3. Identification of major research data gaps.
4. Specific areas in which NIOSH could make a significant and unique impact.
5. Other groups/institutions having similar programs (who/what are they?).
6. Potential research partners and collaborators.
7. Resources required (e.g., staffing, [types/numbers of people] funds).

**Toxicology and Molecular Biology Branch (TMBB):**

Dr. Luster presented an overview of TMBB which will have five areas of capability: dermatology, neurotoxicology/neuroendocrinology, molecular carcinogenesis, inflammation, and molecular toxicology. Several possible skin biology research areas are being considered:

- allergic and irritant contact dermatitis (a NIOSH National Occupational Research Agenda priority)
- skin cancers
- wound repair

Dr. Luster indicated that one of the priorities for HELD is to develop a lab-based research program that takes advantage of expertise in other NIOSH divisions while keeping the needs of the U.S. workforce a priority. Dr. Luster noted that HELD's success will depend in large part in developing interactions both within NIOSH and with industry, academia, and clinicians. The NIOSH divisions with which HELD must interact are located in Atlanta, Morgantown, and Cincinnati, which presents logistical challenges for communication and collaborative activities. One way that the divisions can interact is for the field staff to provide populations for testing by the laboratory groups, and any NIOSH model for research should be based on real-world issues.

## **Exposure Assessment Branch (EAB):**

Dr. Sid Soderholm discussed the formation of a research group that he is assembling for research in EAB. Dr. Soderholm's group is seeking input and guidance on the limitations of current assessment models and technologies which are needed to properly evaluate the existence and magnitude of dermal exposures.

Dr. Soderholm posed the following questions:

1. What is the "state-of-the-art" in dermal assessment?
2. How can dermal exposure measurements be improved?
3. What is the purpose in measuring dermal exposure in the workplace?
4. Are there generalized assays to determine dermal exposure?

Dr. Soderholm noted that dermal exposure assessment is more difficult to conduct than for inhalation exposures. From an exposure stand-point, it is difficult to separate the two types of exposures. Measurement efforts should be directed to agents which have significant absorption, such as solvents. Biomarkers for exposure are needed. Directed biomonitoring from skin is needed to measure dermal exposure. Skin monitoring is complex because the areas of the skin are so varied. Using a patch to measure dermal exposure does not provide information about dose, which is essential for establishing exposure limits. No one yet knows how to assess total body burden for skin exposures. Exposure limitations of some sort must be established in order to provide workplace controls. If opportunities for controlling dermal exposures can be identified, the newly organized Engineering and Control Technology Branch could work in partnership with EAB to develop innovative technological solutions, such as microsensors combined with computer. The effect of PPE or ordinary work clothes is another area which needs research; a possible collaborative effort could be mounted with NIOSH's Division of Safety Research, which is currently testing clothing and gloves.

## **Epidemiological (EPI) Research and Prevention-Oriented Dermatologic Activities:**

Dr. Boris Lushniak, NIOSH's dermatologist, reviewed NIOSH's epidemiological research activities. One of NIOSH's goals for EPI research and prevention activities is to improve surveillance of dermatological diseases. Current NIOSH EPI research related to skin disease includes:

- Surveillance of occupational skin diseases/disorders through SENSOR Dermatitis
- NIOSH construction initiative
- HHE program

Dr. Lushniak noted that presently available national data from sources such as OSHA and the Bureau of Labor Statistics (BLS) often are misleading. It is also likely that these data under represent the true numbers of occupational skin disease cases. BLS statistics exclude small businesses, federal workers, and other groups, and rely on people self-reporting and company medical personnel reporting. Often there are disincentives for both companies and workers to report these incidences. The NIOSH construction initiative has been a good model for an industry-specific demonstration model. One component of this initiative is evaluating Occupational Skin Diseases (OSD) and developing methods to reduce the risk of OSD in plasterers and cement masons.

The SENSOR Dermatitis program has been a mixed success. A decision must be made this year to either continue the program, expand the program, or end the program. Problems include:

- Maintaining sentinel health care provider interest in the program so that OSDs are reported to the state.
- Reliance on worker's compensation as a prime health data source.

The SENSOR program for respiratory diseases in Michigan has had much success. Successes from that program need to be analyzed for possible duplication in SENSOR Dermatitis.

There have not been many skin disease cases referred to the Health Hazard Evaluation (HHE) Program. Only 1-2% of these cases are primarily skin disease problems; the rest are components of a larger problem, such as indoor air quality. It was pointed out that NIOSH's response time for responding to and closing HHE's (6 months) has also contributed to its lack of use by labor unions. When NIOSH is called in, management typically stops work on any remedies, preferring to wait until NIOSH issues a report. This delays problem resolution at the expense of the workers.

Dr. Lushniak noted that the OSD issues identified by NIOSH in its 1988 proposed national strategies for the prevention of leading work-related diseases and injuries/dermatological conditions are very similar to those existing today and are still unresolved. The National Occupational Research Agenda (NORA) includes similar priorities for OSD research as those identified in 1988.

#### **Christopher Packham--Five Questions Asked In the Workplace:**

Mr. Packham noted that the typical person charged with preventing exposures in the workplace is not a highly trained industrial hygienist. There are five questions that the person responsible for chemical safety in his or her workplace asks when trying to ensure worker safety:

1. What have I got in my workplace in terms of chemicals/substances?
2. What are the hazards of the chemicals I have?
3. Is there any skin contact with these chemicals?
4. If so, is it significant?
5. How do I control it? Process engineering? PPE?

Participants agreed that it is difficult to control worker behavior, and that it is far easier to control processes. Control is lost when work practices are relied on solely for safety and human error is not considered. Engineering controls must be combined with behavior modification and education/training. Management awareness is also critical.

#### **Mark Boeniger--Dermal Exposure Assessment:**

Even before 1950, the U.S. has had Threshold Limit Values (TLVs) and air sampling techniques; however, quality data for ingestion and skin exposure is lacking. For effective change to occur, the following are required:

- Recognition of need
- Adequate tools to monitor/modify situation
- Supportive environment
- Criteria
- Information transfer

The contribution of the workplace to dermal exposure is unknown. Adequate tools to qualitatively and quantitatively document exposure are needed, along with practical solutions for dealing with it. A supported environment (regulatory agency guidelines and rules) is needed for pushing forward with dermal exposure and prevention assessment. Development of evaluation criteria and standards against which workplace results can be measured is crucial, as are mechanisms for transferring this information to business and industry.

The significance of absorption of volatile and non-volatile compounds through the skin needs further study. The majority of toxins are non-volatile, and act as sources of surface contamination of a worker's bare skin. Volatiles have both skin and respiratory exposures. Dermal uptake and systemic contribution to exposure can often be greater than respiratory for some chemicals. Only one-third of the compounds listed on the 1988 TLV have a skin notation; however, if they are considered in terms of "dermal toxicity potential", 58% should have a skin notation. If they are considered in terms of "dermal absorption potential", 92% should have a skin notation. A large majority of compounds that should have skin warnings on their Material Safety Data Sheets (MSDS) do not have them.

Consideration should be given to total exposures: respiratory, ingestion, dermal. Ingestion exposure often occurs after skin contamination. Total exposure depends on the toxicant; each must be looked at separately. Substances seldom occur alone in the workplace; they are almost always present as mixtures.

In some cases, skin may be a greater contributor to exposure than the respiratory system, yet the focus of research to date has been on respiratory exposure. There is a European Economic Community Initiative on Dermal Exposure which may help provide direction of this committee. This committee requests that the following parameters be considered:

- Risk assessment modeling
- Biological monitoring
- Percutaneous penetration
- Skin/surface contamination measurements
- Source apportionment (where exposure really occurs)

#### **Roy Fleming--NIOSH:**

NIOSH has referral guidelines that need to be impacted by the results of this workshop. NIOSH funds many types of research projects, but the project must represent a good science proposal and address NIOSH's mission. Each project proposal must answer the following questions:

- How many workers are affected?
- What is the severity of the effect in the context of the specific proposal?

- What is the likelihood that someone else (business, industry, unions) could use the research results and will lend their support in a letter, showing how they will support the research effort?

NIOSH does not fund basic research unless the research has direct occupational relevance. The research results do not need to have immediate impact, but it should be at least foreseeable. The NIOSH home page has information on its programs, and funding opportunities. Dr. Fleming noted that no skin disease research proposals have been submitted to the Centers for Disease Control in the last 4 years, although many proposals indirectly involved the skin.

#### **Peter Elias---Basic Epidemiological Issues:**

Dr. Elias presented a summary of current research involving the stratum corneum. All participants agreed that this research is fundamental to any discussion of occupational skin disease research.

He indicated there is an evolving concept of the stratum corneum. Lipids, part of the "bricks and mortar" of the stratum corneum, mediate barrier function. The number of lipids in a particular layer of the stratum corneum affects skin permeability and the amount of lipids relates to the quality of the barrier. Eczema occurs in the areas of least lipids: the palms and the soles. These are the areas that need to be washed often in the workplace.

Continuous treadmill examination, the repetitive exposure and recovery of the barrier, identifies populations at risk. It shows abnormalities in various populations and can be linked to various metabolic activities. Interestingly, research results show that gender and race are factors in barrier recovery. Dr. Elias noted that darkly pigmented skin in all races has more rapid recovery rates, due to the better barrier in darkly pigmented skin. Dr. Elias also pointed out that people with "sensitive" skin constitute 40% of the population, so research in this area is vital.

Another major data group is identifying the signals that regulate metabolic response to barrier repair and the effect of occlusion on signaling molecules. Barrier repair cannot occur under vapor impermeable wraps (like a latex glove) but can occur under a vapor permeable wrap. *Hardening* is a phenomenon that occurs when there is an adequate repair response; contact dermatitis occurs when there is not an adequate repair response. Atopic dermatitis exists when a defective barrier exists, and many people have defective barriers. Potential mechanisms of epidermal homeostasis and disease pathogenesis represent other data gaps.

#### **Dr. Howard Maibach--Summary of ideas for establishing a dermal workplace laboratory:**

Dr. Maibach presented a summary of the first day's discussion and began with the following two questions:

1. How can we go about utilizing existing laboratories?
2. How can we accelerate product development?

Dr. Maibach pointed out that many large industrial laboratories have gone out of existence because they did not accomplish product development. Dr. Maibach listed several activities gleaned from the day's discussions that could be achieved which will provide immediate results at low cost:

Staffing:

1. Experts are needed who can sort out the diseases we now recognize and their proper preventive interventions; then will emphasize work on the remaining ones.
2. Chemistry expertise is needed.  
In Europe, dermatologists work with chemists to identify allergens. Chemists are needed to collaborate with clinicians and dermatologists to help patients.
3. A biometrician is needed to determine how allergenic and how potent different substances are and how to handle them.
4. An epidemiologist is needed.
5. A staff person is needed to collaborate with other laboratories and utilize their work on dermatitis.

Laboratory activities are needed in the following:

1. Standardize assays for allergies and irritancy: (urticaria, contact dermatitis.)
2. Develop barrier creams for prevention of contact dermatitis.
3. Develop and implement a communications strategy as it relates to health issues to help the public understand the significance of these research activities.
4. Barrier penetration research.
5. Research in skin bioengineering.
6. Facilitate the development and approval of standardized patch test technology.

## Day 2

Participants broke into three groups to discuss possible dermal research activities in exposure assessment, epidemiologic and prevention-oriented laboratory-based research. The following represent discussions by the three breakout groups.

### Laboratory-Based Research Issues:

#### I. Mechanisms of Occupational Skin Disorders

There is a need to focus on ICD and ACD as well as other skin disorders, including contact urticaria and photobiological skin disorders. This effort should include investigations in establishing predisposition of individuals to the above (e.g., atopic dermatitis) and the identification of biomarkers that underlie the mechanisms of these various skin disorders. There is also a need for efforts on developing new and more effective *in vitro* alternative methods (e.g., skin equivalent cultures and QSAR).

Another major occupational skin research goal should be molecular manipulation that could result in new preventive and/or treatment strategies for irritant and allergic contact dermatitis. One suggested approach could be *in vitro* evaluation of tolerance mechanisms.

#### II. Relationship of Molecular Genetics and Occupational Skin Disorders

There is a need to study the genetic aspects of both metabolic and allergic factors, taking into account current knowledge about skin barrier function and chemical metabolism.

#### III. Barrier Functions (Hydrophobic, Hydrophilic, Microbial and Gas) and Repair

The feasibility of developing barrier function models should be pursued. Studies are needed on development of biomarkers for loss of barrier function and repair and the evaluation of the applicability of current knowledge of worker protection as related to protective clothing, boots and protective topicals. There are several scientific and reproducible models for determining the various aspects of percutaneous absorption as it relates to the various layers of skin and systemic absorption. Utilizing these systems for occupational chemicals will benefit workers.

#### IV. Relationship and Possible Interactions of Skin and Respiratory Irritancy and Sensitization

Studies are needed on possible comparative models of irritancy and allergenicity of skin and respiratory systems. In terms of allergic sensitization, particular focus on the role of proteins and peptides as simultaneous skin and respiratory sensitizers (e.g., latex) need to be investigated. Such studies would encompass systemic manifestations of toxicity and allergenicity.

## Exposure Assessment Research Issues:

### I. Biomarkers and Absorption Measurements

Exposure assessment is a combination of the dose in contact with the skin and absorption through skin. Absorption can be facilitated or inhibited by other factors: vehicles/mixture, environmental condition, and pre-existing skin conditions. Absorption can be estimated using biomonitoring techniques or *in vitro* diffusion cell studies. Human percutaneous absorption values can be measured by *in vitro* techniques for exposure assessments. A permeability constant (steady-state rate/concentration) is handy for estimating exposure to chemicals at multiple doses. Absorption may be overestimated for short-term (15 minutes) exposures. EPA has published (in the April 3, 1996, Federal Register) a proposed protocol for measuring the absorption of a number of OSHA chemicals. Biomarkers need to be developed as indicators of local and systemic absorption. Knowledge of the metabolism of the parent compound may facilitate the identification of a biomarker. Pharmacokinetic modeling may be useful for estimating target organ concentrations of absorbed chemicals.

### II. Dose Estimation

The chemical dose in contact with skin is difficult to measure. It may vary at different body sites. Observation of worker activity patterns may help determine areas of body exposure. Additional work is needed to improve estimation of dose. This estimation can be divided into two areas:

1. Measuring the amount deposited on skin.
2. Assessing the effectiveness of control measures.

### III. Standardization of Data Collection, Reporting, and Interpretation

For measuring the amount deposited on the skin there are a number of exposure measurement approaches that have been used but standardization and evaluation of the approaches has not been adequately conducted. A way of standardizing data collection, reporting, and interpretation needs to be developed.

### IV. Development of Sensors

Sensors to indicate where dermal exposure occurs are useful (i.e., color change of gloves). These would include both direct reading and capture devices. These devices could be used for quantifying exposure or for notifying or training workers in personal exposure.

### V. Training and Education

Proper working techniques can reduce exposure. The best decontamination method varies with the contaminant. Health and safety professionals may require additional training in this area.

## VI. Validation of Dermal Exposure Models

There are existing models that use physical and chemical properties of contaminants and estimates of dose to estimate dermal exposure. These models may be useful for screening but they have not been adequately validated.

## VII. Documentation of Control Measure Effectiveness

Documentation of effectiveness of control measures is needed. Effectiveness varies with level of exposure, incompatibility with protective materials, temperature, mechanical damage, abrasion, and aging. Misuse and uninformed use can decrease their effectiveness.

### **Epidemiological Research and Prevention-Oriented Issues:**

#### I. Communication of Risk

The need to use communication sciences more effectively in conveying information about the risk of OSD was emphasized. Further objective study of such methods and their application to the prevention of OSD are needed. Specific attention should be given to improving the transmission of information about the risk of OSD between industry and workers. Cooperation with various stakeholders (unions, professional organizations, corporations) is essential as information is already available allowing many of these risks to be characterized.

#### II. Epidemiological Studies

##### A. Cross-sectional Prevalence Studies and Prospective Studies

An investigation to establish the prevalence of various skin diseases, not only OSD, in representative industries is needed. The data from NHANES 1974 was referred to as a database for such information. It was pointed out that the latter data was insufficient to evaluate the prevalence of skin disease due to work in various industries as the number of workers from any given sector was too small for one to have meaningful numbers of observations from which to draw conclusions. While NHANES may provide insight into the prevalence of "background" skin disease within the general working public, it is not adequate to provide valid data with respect to the prevalence of OSD. NHANES IV (1998) should collect information regarding occupation and the presence of skin disease as recommended by the Skin Disease Data Working Group. It was pointed out that "serious" OSD usually resulted in a permanent disability or job change. The tabulation of such data was recommended as a better measure of the importance of OSD. Studies are needed either using cross sectional or prospective designs to address such risk factors as age, sex, race, psychosocial and seasonal factors as predictors of outcome. Further studies of the risk factors affecting outcome in workers who have developed OSD are needed. This will allow more effective intervention strategies to be developed and subsequently evaluated in intervention trials.

The collection of incidence data as a better measure of the occurrence of OSD is needed. The evaluation of workers entering a given industry with follow-up to include unhealthy workers leaving the industry was recommended as a method to obtain more accurate data and to address risk factors for the development of OSD. A priority list of workers are:

1. Construction industry
2. Electronic manufacturing
3. Healthcare workers
4. Workers exposed to metal working fluids
5. Agriculture workers

It would be useful to repeat the National Occupational Exposure Survey to update present exposures that may be associated with OSD.

There are limited investigations of melanoma and non-melanoma skin cancer and in the relationship to work exposure and other risk factors (e.g., DNA adduct response to UV exposure, DNA repair efficiency, age, etc.).

#### B. Intervention Studies

Intervention studies are an important area of investigation. Since the prognosis in OSD may be inversely related to the length of time the worker remains exposed, early intervention models should be developed and evaluated as a secondary preventive intervention strategy.

Worker education for the primary and secondary prevention of OSD is important. Such educational interventions need to be better executed and coupled with prospective evaluation of the effect of such education on the incidence of OSD.

Careful assessment of the effect of medical intervention in OSD by primary care physicians, dermatologists and tertiary care specialists with expertise in contact dermatitis are needed.

#### C. Human Response Studies

Human exposure studies are needed with known environmental causes of OSD (allergens, irritants, ultraviolet light) by a dermatological clinical investigation unit.

Presently, the majority of occupational allergens in the workplace are not available for testing workers in the U.S. In other countries, such test materials are available but the validity of the methods used (e.g., the test vehicle, cut off dose) have not been rigorously evaluated to ensure the validity of the bioassay. NIOSH needs reliable data on such responses to evaluate populations of exposed workers in field studies and should foster accurate evaluation of such workers by dermatologists within the community. The development of criteria for the

preparation and use of such test materials for the common occupational contact allergens in the U.S. is needed.

Data relating to the dose-response relationships for allergens and irritants in humans with exposure to allergens and irritants are needed if primary preventive intervention is to be undertaken based on limiting skin exposure to doses below the minimal elicitation threshold level. While epidemiological data are not complete, the common causes and industries associated with allergic contact dermatitis (ACD) and irritant contact dermatitis (ICD) are known. Using this approach, a proactive approach to OSD could be developed based on recommending exposure standards for commercial products (e.g., gloves, soluble oils, cement) which would prevent the elicitation of such responses.

### III. Surveillance

#### A. Improving Data Collection Systems

It was recognized that present methods of data collection are inadequate. Studies need to be undertaken with demonstration models designed to improve the methods of data collection to be more representative of the true frequency of OSD in selected industries.

The present SENSOR program needs further refinement and a review of the effectiveness of the three current state-based programs in terms of methods evaluation. These programs should be refined and continued. Better definition of the leadership at the state and national level would improve these programs. Whether SENSOR Dermatitis represents the appropriate surveillance model for the nation is not clear. An expanded relationship with centers of excellence in OSD to allow the collection of detailed information about specific allergens and irritants associated with the development of OSD would improve the SENSOR programs.

The availability of the HHE program for OSD should be promoted to industry, unions and employees who may avail themselves of this program as this is potentially an effective way to identify new causes of OSD.

Presently some states, like California and Maryland, require the reporting of OSD to state Departments of Health, Labor or Environment. While there was agreement that the present systems do not seem to be working well, there is a need to examine how this method of surveillance could be more effectively used and foster development of sentinel event monitoring and required reporting.

Possible approaches to the collection of such data were discussed. Presently, a pilot investigation is underway in collaboration with the North American Contact Dermatitis group, which is evaluating the relationship between occupation and industry of work and the development of allergic contact dermatitis due to selected contactants. The possibility of using the American Contact Dermatitis Society members to collect data on OSD in relationship to job and industry on a voluntary basis was suggested as a further Sentinel Event System that may need to be implemented.

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18. Abstract (Limit: 200 words) A NIOSH workshop on work related skin diseases and exposure assessment was summarized. The goal of the workshop was to identify key workplace related research issues and data gaps in exposure assessment, epidemiologic and prevention oriented issues, and laboratory based biomedical research. Major issues covered in laboratory based skin biology included mechanisms of occupational skin disorders (OSDs), molecular genetics, barrier functions and repair, and interactions of skin and respiratory irritancy and sensitization. Major issues in exposure assessment and hazard control research included absorption measurements, biomarker development, dose estimation, data standardization, sensor development, training and education, dermal exposure model validation, and documentation of control measure effectiveness. Major issues in epidemiology and surveillance of OSDs included communication of the risk, cross sectional prevalence studies and prospective studies, intervention studies, evaluation of the impact of worker education on outcome, effectiveness of secondary and tertiary preventive intervention, human response studies, improving data collection systems, refinement of the Sentinel Event Notification System for Occupational Risks (SENSOR), promotion of the Health Hazard Evaluations program, and reexamination of the Sentinel Event Monitoring Program.

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