FOREWORD

The Surgeon General's Conference on Agricultural Safety and Health was convened by the National Institute for Occupational Safety and Health (NIOSH) in 1991. NIOSH was created in 1970 as a result of the passage of the Occupational Safety and Health Act. NIOSH is the national public health organization responsible for the occupational safety and health of all of the nation's workers. Moreover, NIOSH is a component of the Centers for Disease Control (CDC), The Nation's Prevention Agency.

In 1990, the Congress expressed concern that agricultural workers and their families experience a disproportionate share of injuries and diseases associated with numerous chemical, biological, and physical hazards. For example, agricultural workers have the second highest occupational fatality rate. They run a significantly higher risk of dying of certain types of cancer than persons in other occupations. The Congress also observed that inhalation of organic dusts from plant, soil, and animal sources, and from chemical and other substances, results in occupational health risks to agricultural workers.

The Congress, recognizing that agricultural workers continue to suffer high levels of injury and illness, directed NIOSH to lead a comprehensive national program and undertake a series of initiatives in surveillance, research, and intervention to prevent occupational injuries and diseases in agriculture. The Congress believed that NIOSH was in a unique position to lead a comprehensive national effort to prevent injury and disease in agriculture. The NIOSH initiative is intended to provide a balanced approach to substantially reduce the incidence of fatal and nonfatal traumatic injury, chronic injury, and occupational diseases among the 3.4 million agricultural workers in the United States. NIOSH expanded its research program to address the safety and health of workers in agriculture and awarded cooperative agreements to enhance the Institute's existing program in the areas of surveillance, research, and intervention.

The Congress also directed that NIOSH convene a Surgeon General's Conference on Agricultural Safety and Health. Held in 1991, its purpose was to raise consciousness, build coalitions, disseminate information, and encourage action to prevent injury and disease in rural areas. Several solutions for preventing diseases and injuries were presented and discussed at this Conference. The following is a summary of the Conference through the words of its participants, followed by a statement of the problem that emerged from the Conference, and a vision for the future of agricultural safety and health in America as well as a special mention of a particular, fully preventable agricultural injury—"an occupational obscenity"—which was repeatedly emphasized at the Conference.

CONFERENCE SUMMARY

The general design of the Conference was to, first in plenary session, address its purpose, then provide direction through keynote speeches and questions, and pose some assumptions about the future of both the agricultural workforce and workplace. The titles

of the sessions and titles in this document corresponding to this part of the Conference are: *The Potential for a National Coalition, Looking Ahead to the Next Century, Questions to Guide the National Agenda, Medical Intervention Problems and Opportunities,* and *Issues That Affect the National Agenda.*

The Conference included five concurrent sessions dealing with the issues of surveillance, research, and intervention. The proceedings from these sessions are addressed in this document in the chapters entitled *Surveillance–Agriculture-Related Diseases, Injuries, and Hazards, Research–Chemical and Biological Hazards, Research–Mechanical and Physical Hazards, Intervention–Worker Protection from Environmental Hazards, Intervention–Safe Behaviors among Adults and Children.* Within each of these sessions, presentations of factual information were made, and discussions ensued from the perspectives of a range of interested parties.

Returning to plenary sessions, the chair of each concurrent session reported the results of deliberations in their session. In addition, a report was made on the issues raised at another conference held concurrently on migrant and seasonal labor. These reports are presented in the chapter entitled *Elements of a National Agenda.* The closing plenary session provided an opportunity for concluding remarks from a variety of participants who ranged from governmental to those representing farm organizations to a victim. These remarks are documented herein in the chapter entitled *Actions for the Future.*

The Conference included a poster and video tape session with 102 posters presented. The abstracts of the posters and titles of the video tapes are presented in the chapter entitled *Making Connections.*

Six unifying principles emerged from the Conference as operational concepts for the future. They are found in the words of 72 speakers at the Conference—these themes offer a verbal tour through these *Papers and Proceedings*:

▸ CONTINUOUS IMPROVEMENT THROUGH PREVENTION. The Congress has directed that a national initiative, of which this Conference was a part, be launched so that *when sustained over a period of time, would result in a significant and measurable impact on . . . health effects among rural Americans.* Augmenting this direction for continuous improvement, the Surgeon General's Conference consistently and in multiple ways demonstrated the need to prevent problems in order to improve the safety and health of agricultural workers and their families.

Senator Tom Harkin of Iowa asserted, " . . . we need to make "Prevention First" our motto for health care in the 90's." Dr. Thomas Dean of the National Rural Health Association challenged the Conference, " . . . to go forth in these deliberations with a sense of urgency and with an understanding that every day lives are lost because families are being devastated and futures are being ruined because of our failure in the past to build these coalitions."

Speaking to a paradigm for prevention, Dr. William Popendorf from The University of Iowa said, " . . . we face yet another challenge; how to translate them (parameters of health effects) into "agricultural hygiene," the industrial hygiene paradigm of "anticipation, recognition, evaluation, and control learned in general industry . . . " Jeffrey Human of the Office of Rural Health Policy encouraged the Conference to, " . . . confront conventional approaches and make new choices with limited funds, choices that help solve rural health problems."

Willis Eken of the Minnesota Farmers' Union contended, " . . . that it is something of a sham if the most effective tool for safer environmental protection regarding machinery is a law suit." Joseph Kinney of the National Safe Workplace Institute urged the Conference, " . . . to begin to get realistic about how you would like to see these issues addressed." Merlin Plagge of the Iowa Farm Bureau observed about OSHA standards that, " . . . knowing they exist has encouraged farmers to work for safer farmsteads."

▸ RECOGNIZE THE NEEDS OF THE POPULATION AT RISK. Fundamental to prevention is recognizing the needs of agricultural workers and their families, a population at disproportionately high risk of work-related disease and injury.

Dr. Myron Johnsrud of the U.S. Extension Service asserted, "A national strategy could rest on the belief that the most effective preventive efforts will emerge from a process that emphasizes identifying and characterizing problem areas and populations at risk." Relatedly, Dr. James Merchant of the Institute of Agricultural Medicine and Occupational Health at The University of Iowa reported, "Agricultural production is now changing dynamically, resulting in a substantial increase in farmers with non-farm jobs, greater involvement of women and seasonal workers, and involvement of children and recreational farmers in agricultural operations."

Dr. Leslie Whitener of the Economic Research Service at the U.S. Department of Agriculture defined this population: "The largest component (46 percent) of the agricultural work force in 1987 was made up of the 3.6 million people who did unpaid farmwork . . . .the hired component of the agricultural work force will continue to grow in importance as hired workers increasingly replace family workers on farms and as the number of large, labor-intensive commercial farms continues to increase." Christopher Atchison of the Iowa Department of Public Health noted, "Because farming has traditionally been a family business, that it is not just the professional farmer, it is the farm family that is at risk for injury."

Cheryl Tevis from *Successful Farming* Magazine observed, " . . . that about half of farm women work outside the home." Todd Frazier from NIOSH expressed his viewpoint, "Because I am from a public health background and have always been interested in the population at risk, these demographics spell out to me a very serious challenge that we are facing when we look at projects that address the problems of farm families in generally rural areas."

Speaking of the migrant labor portion of the population, Roberta Ryder of the National Migrant Resource Program asked, "Is it really acceptable that such a large portion of our population be relegated to the edge for the duration of their lives?" Dr. Russell Currier from the Iowa Department of Public Health recognized two patterns of disease among agricultural workers, "Migrant farm workers experiencing human-host illnesses, often episodic and exacerbated by substandard living and employment conditions. All other farm workers experiencing sporadic, isolated illness that is most frequently zoonotic, vector-borne, or environmentally acquired in nature."

▸ SURVEILLANCE TO MEASURE IMPROVEMENTS. Part of prevention is the study of trends so as to measure progress. Surveillance is the means of doing so. Through surveillance, we can systematically and continually collect, analyze, and interpret data related to health and safety and direct prevention programs so as to control and, when possible, eliminate the occurrence of diseases and injuries.

With reference to John Donne's 16th century poem, Dr. William Halperin from NIOSH spoke to the role of surveillance as a guide to preventive action, "Surveillance in modern times is the equivalent of the tolling of the bells with the added commitment to investigation of the causation of morbidity and mortality and dissemination of data and analysis with the goal of prevention." Dr. John May from the New York Center for Agricultural Medicine and Health speaking to the use of sentinel events in surveillance relayed that, " . . . intervention should affect other workers by either addressing the hazardous exposure, by screening similarly exposed workers, or by insuring that at least adequate protection is provided to similarly exposed workers."

About surveillance and priorities, Dr. Dennis Murphy from Penn State University contended, "If we are going to let data guide us, we have to get to some specific categories to have some guidance." Dr. Henry Anderson from the Wisconsin Department of Health and Social Services reported, "We need to move away from the broad view to some specific, high-priority activities."

Regarding the role of the "helping" professions, Rodney Gilmore from the North Dakota State Department of Public Health related, "We learned that in order to keep a good surveillance system going, you must keep direct and frequent contact with the medical facilities and with the providers who are giving you the information." Dr. Eugene Freund from NIOSH suggested, "Inasmuch as the nurses, through their interactions with providers, can do case surveillance, they can help with the recognition of problems that may not be identified in the community."

▸ RESEARCH TO FIND ROOT CAUSES. A principle that emerged at the Conference was to base actions on facts. Research is a way of finding the facts, and through research, we work to understand the causes of work-related diseases, injuries, and hazards; detect their vulnerabilities to prevention; and discover, assess, and improve measures to reduce them. Dr. Lorann Stallones from Colorado State University reported, "National policy guidance is needed in order to provide focus for targeting proper areas of research and to define the scope of research to be performed within priority areas."

Regarding high technology, Dr. Ronald Eckoff of the Iowa Department of Public Health introduced two speakers saying that they, " . . . will reveal changes in the agricultural work place as it is affected by new and different crops and by biotechnology." Dr. Daniel Kugler from the Office of Agricultural Materials at the U.S. Department of Agriculture noted, " . . . that agriculture, indeed, is a very high-tech business." Dr. Jane Rissler from the National Wildlife Federation challenged the Conference with, "I hope that this presentation will provoke a wide-ranging consideration and evaluation of the potential impacts of biotechnology on farm worker health." Regarding noise-induced hearing loss, Dr. Matthew Marvel from the Oneonta Health Center observed that, "We also might find some high-technology solutions like using sound cancellation."

The occupational problems faced by farmers were seen to be numerous, significant, and preventable. Dr. Susanna Von Essen from the University of Nebraska summarized the problems with lung diseases on the farm, "The presence of inflammation is a common theme in these disorders." Other problems were addressed by Dr. Linda Rosenstock from the University of Washington when she maintained that, "On the basis of this study and the accumulating evidence in the medical literature, we feel that even episodes of acute organophosphate poisoning can cause permanent neurologic dysfunction." Dr. Aaron Blair from the National Cancer Institute observed, "A critical role for suppression of immune responsiveness by pesticides has been demonstrated for infectious disease and maybe for other diseases."

The injury problem was addressed by Dr. Sverker Hoglünd from the Swedish Farmers Safety and Preventive Health Association who explained that, "Machine design may be related to hazards of two kinds. One is accidents causing acute injuries. The other is chronic injuries or illnesses because of long-term, unfavorable effects on the body during work operations." Murray Madsen from Deere and Company observed that, "Sometimes equipment is in mint condition; other times it is not, or modified, or built from scratch in a local shop." Dr. Thomas Bean from Ohio State University reported that, "In either case, the majority of studies indicated that farm equipment was the single factor most associated with on-farm injury." John Crowley from the Equipment Manufacturers Institute urged that, "Behavioral research is needed to guide engineers on how equipment can be designed for safer operation and maintenance."

Dr. Susan Gerberich from the University of Minnesota maintained that, "A major barrier to progress in the prevention of agricultural injuries has not only been a lack of knowledge about the magnitude of the problem but also a lack of knowledge about specific causes or risk factors due to the lack of analytical studies." Penn Peters of the U.S. Forest Service stated that, "A high-priority research area is in the injuries that result from a felled tree having hit another tree, which includes hangup fell, broken limbs or tops, and butt rebound."

Regarding the hazards of overhead electrical lines, Robert McLymore from North Carolina State University remarked, "That moment of carelessness may end up with that piece of equipment getting in contact with that line. We know how electricity kills." Governor Robert Ray, Chairman of the National Advisory Committee on Rural Health

Policy, observed that, "the suicide rate for farmers is now 30 to 40 percent above the national non-farm rate."

Dr. David Cochran of the Occupational Safety and Health Administration recounted a conversation, "She was telling me that the top occupational category suffering from tendinitis in the state of Washington is farmworkers." Regarding greenhouse workers, Dr. John Coumbis of the Agency for Toxic Substance and Disease Registry related that, " . . . you find some of the reports of back pain in roughly a third of the work force, pain in multiple joints in 19 percent, pain of the upper extremities in 11 percent of the workers, lower extremities in 8 percent, and neck pain in 2 percent."

▸ RESPECT PEOPLE WHILE CONTROLLING THE PROBLEMS. Another principle that emerged overwhelmingly at the conference was respect for people, and also consistent with our Conference theme of *A National Coalition for Local Action*, our intervention must be based upon such respect.

Speaking to this theme through a video message, Secretary Louis Sullivan of Health and Human Services stated, "The key to making those strategies effective—the critical, vital factor that will determine our success in lowering the risks of agricultural work—is local initiatives and efforts." Assistant Surgeon General William Roper declared, "As the theme of this meeting, *National Coalition for Local Action*, clearly portends, the foundation of our public health system, as it functions in agriculture and other sectors, must be the local public health agency."

Dr. James Dosman from the University of Saskatchewan recommended, " . . . the establishment of health and safety committees at the local level, organized by target populations, for the purpose of identifying issues, facilitating programming, and achieving results." Referring to agricultural workers, Ellen Widess' Children's Advocacy Institute contended, "Unless we also deal with those economic realities of their lives and their limited choices, we will fail in our efforts to improve health and safety."

Regarding networking and community involvement, Dr. Dean Stueland from the National Farm Medicine Center related, "We need to close the loop between what is happening on the farm and what is happening in medicine so that people understand each other." Wayne Sprick of the National Young Farmer Educational Association said, "The FFA chapters and those younger people are looking for opportunities to conduct community-service types of projects." Robert Graham with the National Vocational Agriculture Teachers' Association commented, "We encourage students to sit down and do a community review by interviewing resource people with organizations, such as the community health organizations, the district representatives of OSHA and NIOSH, the Farm Bureaus, and National Grange Affiliates." Valerie Wilk from the Farmworker Justice Fund reported, "In a number of the workshops there were very concrete examples of groups who had worked in coalition, either within their community or statewide, on particular health and safety issues: workers' compensation or field sanitation."

Gene Graham with the W.K. Kellogg Foundation challenged the Conference, " . . . (how can we) develop meaningful opportunities for enfranchisement, access to the institutions of society, and the much needed occupational safety and health interventions for migrant and seasonal workers?" Craig Merrilees with the Consumer Pesticide Project contended, "Health and safety improvements come only when people are organized and when they are able to control their own destiny." Thomas Seymour from the Occupational Safety and Health Administration observed, "In the OSHA history of writing rules, regulations and enforcement, we have found that the people who are interested in trying to correct these problems need to be on board and in support of the process."

Regarding the issue of training, Cynthia Douglass from the Occupational Safety and Health Administration conveyed, "The answer lies in education, training, and increasing awareness of those hazards and how they can be reduced." Malanie Zavala from the University of California-Davis pointed out that, " . . . a lot of these people come here without an excellent education, and this is going to make a difference as to what they can understand in terms of reading—not so much in terms of spoken language, I think, but in terms of things that they are going to have to read."

On children and women, Marilyn Adams of Farm Safety for "Just Kids" proposed, "My experience with the youth tells me that they are our best bridge to the farm family. If you take this one step further and train farm women in tractor safety, chemical safety, rescue, and the other aspects of farming along with the youth, Dad and Grandpa will not have a chance after we start rocking the boat and making waves." Surgeon General Antonia Novello declared, "As a woman, I totally agree with the philosophy of Marilyn Adams' group, Farm Safety for "Just Kids," who say that the one person on a farm who can play the most pivotal role in educating farmers and farm children about the dangers of working on a farm is the woman." Nineteen-year-old Mark Timm from the National FFA Organization related, "Not only does America need its young, but young people need your help, support, guidance, and leadership." Dr. Walter Armbruster of the Farm Foundation observed, "We also know that reaching adults through youth is a very effective channel for modifying adult behavior."

▸ UNDERSTAND "THE SYSTEM" IN ORDER TO CONTROL THE PROBLEMS. A general principle that emerged was to develop win-win situations by understanding the system, recognizing people as part of the system, and intervening early in that system in its design.

Dr. Rice Leach, Chief of Staff to the Surgeon General, in speaking to a 'win-win' strategy conveyed it succinctly, " . . . I submit that the purpose of this endeavor or our mission is to prepare the next generation to live in harmony with nature." Judith Heffernan of the University of Missouri-Columbia remarked, "There is a social movement afoot that looks at environmental and food safety and a whole host of issues that are . . . put together, and so pesticide usage and water quality—and you know the litany—we have heard much of it here." Dr. Robert Pinger from Ball State University reported, "Integrated Pest Management is the use of the safest and most appropriate

combination of methods (physical, chemical, and biological) to control vector populations."

Dr. Kelley Donham from the University of Iowa reported, "One of the items that came out of the group was a call for a sustainable human resource in agriculture. This was based on an analogy to the sustainable agriculture movement from a natural resources conservation perspective." Larry Belmont from the Idaho Panhandle Health District 1 stated, "Our next best alternative is to develop new solutions or new systems of service to cover those areas."

Recognizing human behavior as an important part of the system, Dr. Robert Aherin from the University of Illinois propounded, "This theory has proven that intention is strongly correlated to one's behavior and behavioral intentions are formed by two basic determinants, one personal in nature and the other reflecting social influence." Assistant Surgeon General Michael McGinnis offered an avenue for prevention by noting that, " . . . the prominent role of behavior in health threats is not novel or unique, some of the lessons that can be gleaned from other public health areas may be germane to the kinds of approaches that we seek to establish for agricultural health and safety." In contrast, Dr. Pamela Elkind from Eastern Washington University contended, "This assumption, simply stated, is that to make agriculture safe for the farm families and workers, it is necessary to motivate them to protect themselves from health and safety hazards . . . I shall attempt to demonstrate to you that these assumptions lack validity."

Regarding design, Dr. David Pratt of the New York Center for Agricultural Medicine and Health reported, "Intervention strategies are most effective when they are applied early in the process." Dr. Gary Erisman, a private farmer, declared, " . . . design is the most critical stage for the prevention of hazards and hazardous products." Ray Crammond, consulting engineer, said of design, "I think the biggest problem is people who ignore the human input." Rollin Schnieder from the University of Nebraska stated, "You have to realize that a lot of the equipment that we have in agriculture is not totally designed." Professor Stephan Konz from Kansas State University maintained, "Designing out the problem is the best approach because it is a permanent solution." Dr. Richard Fenske from the University of Washington said, " . . . there are many opportunities, if we are creative, to reduce the hazard before we ever have to worry about personal protective equipment." Dale Baker from J.I. Case Company challenged the Conference, "Is anyone going to invest the time and effort to develop new designs unless there is, in fact, a demand?"

THE PROBLEM: DISEASE AND INJURY

To help establish priorities for the field of occupational safety and health, NIOSH in 1983 developed a list of 10 Leading Work-Related Diseases and Injuries and proposed national strategies to prevent each of them. NIOSH invited leading experts to improve

and elaborate on these strategies at two national symposia held in 1985 and 1986.[1] The initial list was based upon three criteria: the scope of the problem, the severity of the problem in the individual case, and the vulnerability of the problem to prevention. More recently, infectious diseases have also emerged as a significant problem in occupational safety and health.[2]

The problem is disease and injury, our common enemy. We have seen how this enemy attacks American agricultural workers and their families. Recognized at this Conference were a number of The Leading Work-Related Diseases and Injuries:

1. Occupational Lung Diseases – farmers' lung, asthma, hog lung, silo fillers' disease, etc.
2. Musculoskeletal Injuries – milkers' knee, tractor drivers' syndrome, tendinitis, repetitive motion trauma, etc.
3. Occupational Cancers – skin, bladder, and brain cancer, leukemia, etc.
4. Severe Occupational Traumatic Injuries – machine-related fatalities, electrocutions, suffocations, suicides, amputations, eye injuries, etc.
5. Occupational Cardiovascular Diseases – heat stroke.
6. Disorders of Reproduction – miscarriages, infertility, etc.
7. Neurotoxic Disorders – dementia, neurologic dysfunction, etc.
8. Noise-Induced Hearing Loss
9. Dermatological Conditions – burns, lacerations, dermatitis, etc.
10. Psychological Disorders – depression, stress, etc.
11. Infectious Diseases – zoonosis, tuberculosis, etc.

A VISION FOR THE FUTURE

In 1990, the Congress directed NIOSH to lead a comprehensive national program to prevent occupational injuries and diseases in agriculture. NIOSH gains its authority for responding to this direction from the Occupational Safety and Health Act of 1970, which

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[1] *Proposed National Strategies for the Prevention of Leading Work-Related Diseases and Injuries*. Part 1 in 1986 and Part 2 in 1988, Published by the Association of Schools of Public Health under a Cooperative Agreement with the National Institute for Occupational Safety and Health.

[2] For an example related to agricultural workers see: Centers for Disease Control. "Prevention and Control of Tuberculosis in Migrant Farm Workers: Recommendations of the Advisory Council for the Elimination of Tuberculosis," *MMWR* 1992;41 (No. RR-10).

established the national goal "to assure so far as possible every working man and woman in the Nation safe and healthful working conditions and to preserve our human resources."

NIOSH is charged in the Act to undertake scientific activities that will enable the goal to be won. In response to this charge, NIOSH identifies those populations at highest risk, defines risk factors that guide our efforts to reduce those risks, and provides information to whomever has the ability to act in preventing the problem.

The Surgeon General's Conference of 1991 has established a national commitment to the continuous improvement of safety and health among agricultural workers and their families. It is a "Total Quality" commitment! As a result of the Conference, the Surgeon General has identified a VISION for a national program for agricultural safety and health in America:

> *To continuously and measurably improve the safety and health of every working man and woman in American agriculture through the prevention of Leading Work-Related Diseases and Injuries consistent with the goals and objectives of 'Healthy People 2000.'*

In 1991, the U.S. Public Health Service published a report, *Healthy People 2000: National Health Promotion and Disease Prevention Objectives*. This document is a statement of national opportunities. This report is not intended as a statement of Federal standards and requirements, but as a product of a national effort that involved over 10,000 people. The Surgeon General addressed three overarching goals from this report in the *Preface*. These goals are buttressed by specific and substantive objectives, which are aimed at guiding decisions about programs, resource allocations, and professional and personal commitments.

The objectives enumerated in *Healthy People 2000* deal with **Health Status, Risk Reduction, Services and Protection,** and **Surveillance.** The Health Status Objectives address the problem of disease and injury, the Risk Reduction Objectives address the control of the causes of the disease and injury problem. The Services and Protection Objectives relate to the processes that require improvement so that risk can be reduced. The Surveillance Objectives address the process of diagnosing and reporting information about health status, risk reduction, and services and protection so as to better guide and focus our intervention to control disease and injury.

With the vision of the future in mind, *FarmSafe 2000* is a program commitment to *Healthy People 2000*. Consistent with this commitment, we have listed, as illustrative examples, 11 Health Status Objectives for the year 2000 that correspond with the

problem, the 10 Leading Work-Related Diseases and Injuries plus infectious diseases.[3] Each objective represents a significant improvement in health status over an existing baseline by the year 2000.

1. Occupational Lung Diseases – Reduce asthma morbidity, as measured by a reduction in asthma hospitalizations to no more than 160 per 100,000 people (11.1).

2. Musculoskeletal Injuries – Reduce cumulative trauma disorders to an incidence of no more than 60 cases per 100,000 full-time workers (10.3).

3. Occupational Cancers – Reverse the rise in cancer deaths to achieve a rate of no more than 130 per 100,000 people (16.1).

4. Severe Occupational Traumatic Injuries – Reduce work-related injuries resulting in-medical treatment, lost time from work, or restricted work activity to no more than 6 cases per 100 full-time agricultural workers (10.2c).

5. Occupational Cardiovascular Diseases – Reduce stroke deaths to no more than 20 per 100,000 people (15.1).

6. Disorders of Reproduction – Reduce the prevalence of infertility to no more than 6.5 percent (5.3).

7. Neurotoxic Disorders – Reduce nonfatal poisoning to no more than 88 emergency department treatments per 100,000 people (9.8).

8. Noise-Induced Hearing Loss – Reduce significant hearing impairment to a prevalence of no more than 82 per 1,000 people (17.6).

9. Dermatological Conditions – Reduce occupational skin disorders or diseases to an incidence of no more than 55 per 100,000 full-time workers (10.4).

10. Psychological Disorders – Reduce suicides to no more than 10.5 per 100,000 people (6.1).

11. Infectious Diseases – Reduce tuberculosis to an incidence of no more than 3.5 cases per 100,000 people (20.4).

Another Health Status Objective, which would be classified under Severe Occupational Traumatic Injuries, is to reduce deaths from work-related injuries to no more than 4 per 100,000 full-time agricultural workers. There was an annual average of 6 deaths per 100,000 for the period, 1983 to 1987. The next issue that I will discuss relates directly to this objective.

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[3] Each Objective is parenthetically followed by an identifying number. This number uniquely identifies each Objective within the document: U.S. Department of Health and Human Services, Public Health Service. *Healthy People 2000: National Health Promotion and Disease Prevention Objectives.* 1990; DHHS Publication No. (PHS) 91-50212, Washington, DC: Government Printing Office.

AN "OCCUPATIONAL OBSCENITY"

One final issue that was raised at the Conference cannot go without special mention. Amidst expressions of anguish and pleas for reason, there was an overwhelming interest in a particular issue, namely the need to reduce the risk of fatalities related to tractor roll-overs.

Deaths from tractor roll-overs are the leading cause of traumatic fatalities on the farm. There is no acceptable excuse for the persistence of this problem as deaths from tractor roll-overs are fully preventable. The problem justifies the term, "occupational obscenity." Twenty-seven speakers at the Conference addressed this problem. Categorized by the six principles that emerged as unifying concepts at the Conference, here is what they said:

▸ CONTINUOUS IMPROVEMENT THROUGH PREVENTION.

A good example of the need for such a model is the prevention of tractor roll-over deaths through the application of roll-over protective structures (ROPS) on both new and older tractors. The epidemiological evidence for the very significant risk posed by tractors without ROPS is clear . . . The data available from Sweden, which mandated such a program, makes it equally clear that ROPS can prevent almost all tractor roll-over deaths. An important question for this conference is whether an American intervention model can be developed that can produce a significant reduction of tractor roll-over deaths and injuries. A second question, with much broader ramifications, is, "If we cannot develop a U.S. model for a proven intervention on the single most important cause of agricultural mortality, how can we succeed in addressing less dramatic yet still important causes of agricultural diseases and injuries?"

— Dr. James A. Merchant
Director, Institute of Agricultural Medicine and Occupational Health
The University of Iowa

In Sweden in 1959 the law was put forward concerning safety frames (ROPS) in new tractors. It was also decided that employed agricultural workers were not allowed to work in tractors lacking such frames. Self-employed farmers and family members for many years were excluded from this law and could use old tractors without frames in farm work. A new tractor, of course, had this device. In 1983 the law was extended to include family farmers. It was later decided that even old tractors had to have frames if they were to be used in agricultural work. The effect on fatalities due to tractor turn-over since the year of legislation was striking. It is obvious that this action from the authorities, unpopular as it might have been, has had quite a significant effect in preventing severe accidents.

— Dr. Sverker Hoglünd
Director, Swedish Farmers Safety and Preventive Health Association
Stockholm, Sweden

▸ RECOGNIZE THE NEEDS OF THE POPULATION AT RISK.

Even though the land is so flat, we still have a tendency to have tractor roll-overs in the eastern part of the state . . . Tractor roll-overs are still a major source of fatalities in the state. — Rodney Gilmore
Injury Control Program Manager
North Dakota State Department of Public Health

Bob Aherin said something about ROPS that really interested me. He said to identify the farmers with high risk exposure and to identify appropriate intervention strategies . . . As a farmer, this makes much more sense to me than suggesting that all farmers should put ROPS on all tractors.

We need to start somewhere and give the farmer a realistic picture of the high-risk exposure with all tractors with end loaders or whatever the highest risk is . . . I heard Wes Buchele address the issue of retrofits. By all means, guarding for the older equipment needs to be made accessible and marketed. It is my personal feeling that dealers should not resell equipment without all protective shields. They have a responsibility to their customers to market the proper shielding for their own products.

— Marilyn Adams
President, Farm Safety for "Just Kids"

Farm children have been injured and killed for years. I was too young to remember a tragic tractor roll-over accident that claimed the life of our neighbor's son. Years later I remember finding the yellowed and brittle newspaper articles about it that my mother had saved. On looking back, I think that that accident may have had a lot to do with the fact that my brothers were not expected to function as hired hands at a young age . . . When asked, "If cost were not a consideration, would you use roll-over protection?" 89 percent said they would; 96 percent would use safety shielding; and 50 percent would use day care. These figures may be slightly high. We all know it is good to have good intentions.

— Cheryl Tevis
Senior Farm Issue Editor
Successful Farming Magazine

We have had a great deal of discussion, in this session, about ROPS. We have all seen the slide, many times, of the success of ROPS in Sweden. In 1985, we had a commitment by the North American tractor manufacturers to make ROPS standard on all tractors. With a few exceptions of tractors that are being imported into this country and those that are for orchard applications, all tractors since that time are equipped with ROPS. By 1970, ROPS in this country became available on virtually all major manufacturers' product lines. There was no demand for them. Therefore, we have a significant number of tractors in operation in the U.S. that were built in that interval between 1970 and 1985 that are not equipped with ROPS. I would suggest, in gross terms, that there are about a million tractors that are equipped with ROPS or that have ROPS built into the cab. About a million tractors that are out there could have a ROPS installed on them but do not. Another million tractors that are in use were built prior to this introduction of ROPS and here installation of ROPS becomes a real technological issue. Now we should look at those two issues separately.

In putting ROPS onto tractors that were built prior to 1970, there are some significant technical issues. Will the tractor structure survive an impact with this ROPS attached? The structure was not built for that kind of use. New frames could be designed, possibly, to accommodate the design by sharing the load forward to the transmission housing. There is now a need to develop that new structure. There were many applications for those old tractors where implements were attached to the same location that we would attach this ROP structure. If you destroy that, you have destroyed the utility of that tractor. There is also the issue of the economics of putting those ROPS on old tractors. If there is to be a program of that nature, it is going to have to start with the development of some pubic policy change that will create that demand. Is anyone going to invest the time and effort to develop new designs unless there is, in fact, a demand?

The issue for tractors built in the interval between 1970 and 1985 where a ROPS can be installed becomes an issue of how to create an environment where the public demands those ROPS. They are available. A demand undoubtedly could bring down the cost that was mentioned earlier. Until there is a demand, there will not be any initiative that will cause that to happen. It is the chicken and the egg situation. If you could decrease the cost, maybe you could increase the demand. You

cannot decrease the cost, however, until there is a demand. We are now again looking at what is a public policy issue of how you create that demand. I would say to you that my brother is aware of the issues of ROPS and tractor overturns. But fatal tractor overturns are a rare event (a farmer is far more likely to be killed in a car accident than a tractor overturn). Virtually all farmers are aware of the issue of fatal tractor overturns in the same sense that farmers (and the general public) are aware of the issue of cigarette smoking causing cancer.

— L. Dale Baker
Product Safety Engineer
J.I. Case Company

▸ SURVEILLANCE TO MEASURE IMPROVEMENTS.

For many conditions we are at different surveillance stages in this scheme. For one condition that we have heard much about, that of farm fatalities due to tractor roll-over, we have identified the problem, we largely know the scope of the problem, and we know what needs to be done to target interventions.

— Dr. Henry A. Anderson
Chief, Section of Environmental Epidemiology
Wisconsin Department of Health and Social Services

For example, in 1958, Sweden instituted a law that any new tractor that was produced had to have roll-over protection. In the years thereafter, surveillance data indicate a decline in roll-over fatalities. In 1978 Sweden instituted another law that any tractor in use had to have roll-over protection, and the problem was eradicated.

— Dr. William E. Halperin
Associate Director for Surveillance
Division of Surveillance, Hazard Evaluations, and Field Studies
National Institute for Occupational Safety and Health

The Olmstead Agricultural Trauma Study provided the basis for the Regional Rural Injury Study, currently being conducted in a five-state region: Minnesota, Wisconsin, North Dakota, South Dakota, and Nebraska. Data collection covers a twelve-month period of time for over 4,000 rural households, utilizing computer-assisted telephone interviews. This effort will enable the identification of injury rates for each state and the region as well as multiple analytic substudies, including tractor-roll-overs and animal-human injuries. The project also includes application of the results to the development of intervention strategies, to be achieved by convening nationally recognized experts and the regional participants in the Agricultural Injury Intervention Strategy Workshop.

— Dr. Susan Goodwin Gerberich
Division of Environmental and Occupational Health
School of Public Health, University of Minnesota, Minneapolis, Minnesota

We will look at safety risk factors, injuries, ergonomics, roll-overs, power-take-off's, and secondary occupations.

— Todd M. Frazier
Chief, Surveillance Branch
Division of Surveillance, Hazard Evaluations, and Field Studies
National Institute for Occupational Safety and Health

They (nurses) can identify that as a problem and trigger efforts to prevent it from happening again. Since they will be located in their own regions, they will often be able to identify all cases of a given condition, tractor roll-overs or power take-off injuries. They can identify the scope of those problems, use that information to target intervention efforts, and after intervention efforts, evaluate how effective they have been . . . The Extension service have people who know how to retrofit tractors with roll-over protection, if that is something someone wants to do.

— Dr. Eugene Freund
Medical Officer, Surveillance Branch
Division of Surveillance, Hazard Evaluations, and Field Studies
National Institute for Occupational Safety and Health

▸ RESEARCH TO FIND ROOT CAUSES.

Farm equipment accounted for 40 to 60 percent of deaths and injuries in the majority of studies, followed very closely by livestock injuries and falls. Numerous types of farm machinery have been implicated in all studies. Since the majority of farm machinery is associated with tractors, it stands to reason that injuries "involving" tractors were the most common type of machinery-related trauma. Tractor over-turns, it appeared, were involved in the majority of agricultural fatalities. Many studies indicated that youth and the elderly were most often associated as an at-risk population . . . The studies varied, though, when you compared those using statistics from government agencies that were not gathering the appropriate and associated data with youth . . .

The opportunity presents itself to include some homespun theory. This happens to be a theory of mine: on family farms, older tractors and equipment are often reserved for general duty while newer pieces of machinery are delegated to more production types of tasks. The general duty may be more hazardous than the normal production tasks on farms. As a result, general duty is often done by the youth or the elderly. The typical farmer, the principal operator, is using the newer machinery to plow and till the field, etc., while the older machinery may be relegated to cutting the fence rows or ditch banks and stationary operations that may be more hazardous than doing field-related operations. As a result, when you combine the inexperience of youth and the diminished capacity that comes with aging (because the elderly or youth usually do this general duty) with the inherent danger of the equipment, you have an increased potential for trauma . . . Research on roll-over protection on older tractors should continue.

— Dr. Thomas L. Bean
Safety Leader, Ohio Cooperative Extension Service
Ohio State University

Dr. Bean stressed the need to install ROPS on farm tractors . . . "ROPS is a proven intervention strategy. Why can we not implement it?" Is the problem the cost, the infrastructure, the regulation, or the legal system?

— Penn A. Peters
Project Leader
U.S. Forest Service

In the late 1950's and early 1960's, extensive research and development work was done by the industry to establish the efficacy of ROPS designs for the kinds of tractor overturns that can occur in normal farming and road transport. Manufacturers began supplying ROPS commercially in the late 1960's. The experience in both the United States and Europe has proven ROPS to be an effective safety device.

There is a need for additional research on small tractors' ROPS. The standard "protective zone" around the tractor operator, which controls the size of the ROPS envelope, was defined on the basis of the ergonomic data that existed in the 1950's and 1960's. The zone remains essentially unchanged today. The Equipment Manufacturers Institute (EMI) sponsored a literature review of the different protective zones used for the design of several kinds of vehicles, including aircraft, automobiles, racing cars, farm equipment, construction equipment, and mining equipment. This study, which was performed by Triodyne, Inc. of Skokie, Illinois, has been completed. Publication will be through both the Society of Automotive Engineers (SAE) and the American Society of Agricultural Engineers (ASAE) before the end of 1991. The basic conclusion of the Triodyne study was that it did not appear, from the kinds of systems that are in place, that sufficient research had been done that could serve as the basis for making the protective zone of a ROPS, as specified by current standards, for smaller for small tractors. Small tractors are often used in low overhead clearance settings—in vineyards, orchards, storage buildings, and machine sheds.

The higher the profile of a ROPS relative to an overhead object such as a tree branch, the greater the likelihood that a farmer will not want to equip a tractor with ROPS or, if there is one on a tractor, to keep it in place. Clearly, there is potential safety value in making the ROPS as compact as possible without compromising protection in the event of a tip-over. As Murray Madsen mentioned in his presentation, one approach to addressing this situation is to make ROPS that can be raised or lowered. They telescope or fold down for temporary use in the lowered position under low clearance conditions. There are some companies that have such ROPS on the market today. Industry's research capabilities concerning ROPS are limited to mechanical and structural aspects. There is little more to be done there with the exception of the small tractor ROPS.

Accident data identify tractor roll-overs as the leading cause of machinery-related death on the farm. Therefore, perhaps the most pressing challenge for behavioral researchers and health professionals is to find an effective way to ensure, short of compulsory measures such as regulation, that ROPS are installed and kept on tractors. EMI believes that behavioral research in this area holds promise of effecting a substantial reduction in roll-over injury and fatality rates. The starting point for such research, we submit, may be recognition that over one million of the approximately 3.6 million agricultural tractors in use today in the United States do have ROPS on them. There are over one million farmers who chose to equip their tractors with ROPS when they purchased them. The question should be asked how these farmers arrived at their decision to equip the tractors with ROPS. Was it because of the Occupational Safety and Health Administration's (OSHA) rule? Was it because manufacturers were able to package the ROPS in a cab that was noise-insulated and isolated from vibration of the tractor? It provided air conditioning, heating, and stereo; i.e., it was made so attractive in other respects that the farmer was willing to pay for the ROPS cab.

Or were there other factors? The key to getting ROPS on the over-2.5 million tractors that do not now have them may indeed be found by examining the factors in the decisions of the approximately one million farmers who did decide to equip their tractors with ROPS. The third essential criterion is that a safety device must not by its presence, introduce different risks that would not exist without it. Murray Madsen referred to a study that showed that some accidents occurred because of an operator presence-type device.

I am reminded of a situation that existed several years ago when OSHA, with all good intent, promulgated its ROPS rule for agriculture. As it turned out, there were some small tractors that had backhoes mounted to the three-point hitch, with a separate seat for the operator affixed to the backhoe frame behind the tractor. Without the ROPS there was not any problem. It was discovered that when a ROPS was installed on a tractor with the threepoint-hitch-mounted backhoe, a crush point between the elevating backhoe boom and the rigid ROPS structure was created. A number of fatalities occurred because of that condition. The solution was to do away with the three-point-hitch-mounted backhoe or redesign the ROPS or both. A combination of these measures was implemented through various field rework programs to eliminate the hazard. When tractor ROPS were being developed, manufacturers' test programs included actual roll-overs of tractors with experimental ROPS designs at different attitudes and speeds. There is a need, in many cases, to verify that a new safety feature will be acceptable to the farmer. — John H. Crowley
Director of Safety Programs
Equipment Manufacturers Institute

It has been learned in recent times that attitude measures do not correspond with behavioral criterions. The early attitudinal studies would evaluate a very general behavioral statement. An example of this would be when evaluating the potential purchase of ROPS on a tractor a subject

might be asked to evaluate a statement such as, "Roll-over protective structures are _____." A more appropriate evaluative statement for predicting ROPS purchasing behavior would be to ask farmers their attitude toward buying roll-over protective structures. The attitude question would look as follows: "My buying a roll-over protective structure in the next two years for one of my non-ROPS equipped tractors is _____." The attitudinal question must match the corresponding behavioral criterion in terms of 1) action, 2) target, 3) context, and 4) time. In the previous example the action was "my buying," the target was "ROPS for one of my (the subject) non-ROPS equipped tractors," the context was "general," and time was "within the next two years."

In summary, there may be a substantial difference between people's attitudes toward objects (in this example, ROPS) and people's attitudes toward behaviors associated with objects (in this example, buying ROPS). To predict behavior, this distinction is crucial. An example of an issue that might benefit from Theory of Reasoned Action type of analysis would be the installing of ROPS on tractors. Tractor roll-overs are a major factor in farm work- related deaths. It is well known that if a tractor has a ROPS it almost eliminates the death potential in a tractor roll-over incident. But only about 30 percent of the farm tractors in the United States have a ROPS. Thus, at issue is what it would take to persuade farm tractor owners to install a ROPS on non-ROPS tractors. There have been significant educational programs to promote the purchase of ROPS among farm tractor owners. But there has been no significant increase in the retrofitting of ROPS on non-ROPS equipped tractors. If an analysis was conducted among US farm tractor operators utilizing the Theory of Reasoned Action, one could learn what intervention initiatives would be necessary to effect a significant change in this behavior. For example, it could be learned how much if anything farmers would be willing to spend for a ROPS, their general perception of the need for ROPS on their tractors, tractor use problems that they may encounter with ROPS, and so on. This type of information would provide focus for initiatives to deal with this issue rather than using the traditional "shotgun" approach of trying anything and seeing if it works.

— Dr. Robert Aherin
Professor, Department of Agricultural Engineering
University of Illinois

▸ RESPECT PEOPLE WHILE CONTROLLING THE PROBLEMS.

Again, economic realities make choices very difficult. Take for example, ROPS protection. Most farmers know the dangers and would willingly retrofit their tractors, but there is economic reality.

— Ellen G. Widess
Director of Health and Safety Policy, Children's Advocacy Institute
Center for Public Interest Law

"I think I am going to invest in (it) whatever it costs," although I did hear myself saying to my husband last night, "Honey, we have got to buy roll-over bars." That is on the agenda. But we, with other income, can probably do that; but I know people who are borrowing money to put bread on the table.

— Judith Bortner Heffernan
Executive Director of Heartland Network for Town and Rural Ministries
University of Missouri-Columbia

I heard one presenter say that her family was going to buy the roll-over protective device for their tractor. I encourage her to follow through on this commitment.

— Dr. Rice C. Leach
Chief of Staff, Office of the Surgeon General

When we looked at the tractor roll-over problem with Marshfield, we decided that there was no need for further research on the problem. What we decided we needed was a way to help farmers who wanted to retrofit older tractors with roll bars or other roll-over protective devices to find those

"ROPS," as they are called. So we asked Marshfield to develop and publish a catalog of all American manufacturers of "ROPS," all products they produce and what make of tractor, model of tractor, and year of tractor they will build. Then Marshfield sent the catalog to all extension agents in the country, so it is available where it is needed. Producing that catalog is not the best step we could take as a society. As we have seen in the slide on the Swedish experience, the best step we could take would be to require "ROPS." But as an Office, it was the best we could do.

— Jeffrey Human
Director, Office of Rural Health Policy
U.S. Public Health Service

We have also seen ROPS development and the recent development of retractable or foldable ROPS for those essential applications where you must go into a building that is shorter — not as tall as your tractor's ROPS. I would also say to those of you who wonder about ROPS that since 1985 virtually every tractor produced has been sold with a ROPS on it or right at the fingertips. Since 1970, virtually every tractor could have a ROPS put on it, and some have since 1960. Consider, for example, how to convince the owner of a 30-year-old tractor worth, at most, $1,000, to put a $500 ROPS on it. The University of Illinois, NIOSH, and the University of Iowa are doing research to help find some of those kinds of answers. A ROPS that provides protection and still meets the needs of users under limbs, vines, and rafters holds promise. It is likely that this kind of roll-over protection will produce more acceptable designs for the user. Perhaps it may not produce as much protection as users have become accustomed to with larger or more conventional roll-over protective structures. Is there an opportunity for validating acceptable ROPS for more compact tractors?

— Murray Madsen
Product Safety Engineer for Agricultural Equipment
Deere and Company

There are also recommendations aimed at reducing specific hazards, such as the danger of injury or death in tractor roll-over or from moving machinery parts . . . OSHA also reviews existing standards that apply to agriculture, such as the ROPS standard. We look at whether these standards should be modified to reflect changing conditions in the United States, in the world, and in the industry. We need your help, though, on reviewing and modifying these standards, if we are to have good, common-sense safety standards. In another area, a member of our staff has been comparing the new standard on ROPS for tractors and other vehicles, which was adopted by SAE, to the existing OSHA standard. We have received design and test data from American tractor manufacturers and others. We have made a preliminary conclusion that the new SAE standard is equal to or exceeds the current OSHA standard and, therefore, is acceptable to the agency. A final decision on this will be made shortly. Hopefully, this will make it easier for American farm equipment manufacturers to compete in the European market.

— Cynthia Douglass
Deputy Assistant Secretary of Labor
U.S. Occupational Safety and Health Administration

▸ UNDERSTAND "THE SYSTEM" IN ORDER TO CONTROL THE PROBLEMS.

Look no further than the agriculture-implement lobby here today. This lobby has blocked roll-over protection in this country for 30 years with knee-jerk, protective, self-interested arguments that continue to allow farmworkers to die in this country, out of their narrow interest. That is wrong. The reason that it happened is not because we have not done enough scientific research to document the problem.

— Craig Merrilees
Director, Consumer Pesticide Project

ROPS for tractors and tractor seat-belt use could prevent the majority of tractor-related deaths. Virtually all new tractors sold in the United States have ROPS . . . Because of the relatively long life of tractors, most agricultural tractors in use do not have ROPS in place. Nearly half of the approximately 400 tractor-related deaths that occur each year in this nation involve roll-overs. How do we ensure that the older tractors and machines without these modern safety features get retrofitted with modern safety features when feasible or get taken out of use? The issue of how such updating and retrofitting is practical presents a significant challenge . . . Although more research and more data are needed to direct intervention, we know certain health and safety precautions work; ROPS work.

— Dr. Myron D. Johnsrud
Administrator, Extension Service
U.S. Department of Agriculture

Perhaps the best example of passive controls is ROPS.

— Dr. David S. Pratt
Director, New York Center for Agricultural Medicine and Health
Cooperstown, NY

There are some issues, the ROPS issue is the most typical one, that we can approach from a national perspective.

— Dr. Dennis Murphy
Professor, Penn State University

The committee divided itself into working groups to develop suggestions and recommendations in the areas of training, and also in the needs for standards like ROPS and machine guarding. In 1972, the full committee recommended its first standard. They recommended that we do a ROPS rule for farm tractors. The first agricultural standard that OSHA issued under its normal rule-making was the ROPS standard. We proposed that back in 1975, we finalized it in 1975, and it became effective in October, 1976. It dealt with all farm tractors made after October, 1976; they had to be equipped with the ROPS. The standard is based on the ASAE Standard, J11-94. The complete text of that Standard was put into the OSHA standard.

Even though tractors were required to have ROPS, we continue to see deaths of tractor operators from roll-overs. We have seen seat belts cut off or cut out; seat belts were not used in several roll-over deaths. Obviously, we have not seen the results that the Swedes have achieved with their standardization efforts. OSHA wants to see its standard evaluated. We want to see this standard looked at very thoroughly to see why it is not working. What can we do to modify it, to make it work, to become more effective? We know that seat belts are considered by many farmers and farmworkers as a hassle in hooking and unhooking, especially when you have to get off the tractor a number of times. The new ASAE Standard, J21-9.4, is a revision of this effort. We have said publicly that the standard is acceptable in meeting our ROPS standard that we require here. We have done that administratively. The International Standards Organization (ISO) is also involved in writing standards for ROPS, and the ISO Standards 5700 and 34-63 are additional new ROPS standards. Our ROPS standard is not as stringent as theirs. In our opinion, if you have a ROPS design that meets all the tests of the ISO Standards, that will be acceptable in meeting the OSHA Standard as well.

— Thomas H. Seymour
Fire Protection Engineer, Directorate of Safety Standards
U.S. Occupational Safety and Health Administration

Due to engineering advances in the last three decades, farm equipment manufacturers have incorporated more safety devices on their equipment. Integral rotary shields for power take-off shafts and roll-over protective structures for tractors have been two major accomplishments in making farm machinery more user-safe. Since tractor roll-overs are involved in a large portion of agricultural fatalities, elimination of this type of incident alone would cause the death rate on

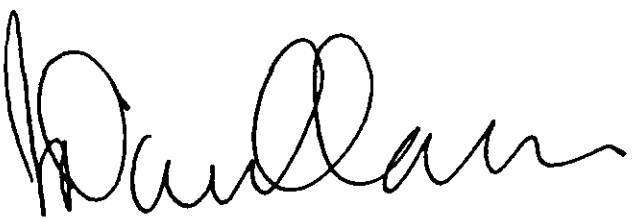
American farms to plunge. But farmers themselves must make the commitment to run a safe operation. When they see the dangers and learn the advantage, safety happens. In Nebraska, for example, university safety experts have conducted 450 tractor roll-over demonstrations since 1970 to convince farmers of the dangers. About 23,000 young people were trained in tractor safety. There have been two known fatalities in this group. The national average for a group that size would be five deaths.

— Merlin Plagge
President, Iowa Farm Bureau

In conclusion, I wish to thank CAPT Melvin L. Myers for his hard work in planning and managing both the Surgeon General's Conference on Agricultural Safety and Health and the production of these *Papers and Proceedings*. I also wish to thank the rapporteurs, CAPT Robert F. Herrick, CAPT Stephen A. Olenchock, Mr. John R. Myers, CDR John E. Parker, and Dr. David L. Hard, who assisted with the concurrent sessions and the editing of the papers presented at those sessions.

I wish to thank Ms. Katherine Wilson who coordinated the poster and video tape session and reviewed the abstracts from those posters for this publication. Many others who helped to make this Conference a success are named in the acknowledgements of this document.

But most of all, it was the work of the 540 participants at this Conference who made it a success through honest engagement with the issues and interaction with others. Their names are listed by their respective state near the end of this document. My thanks to all for making this Conference a splendid success in our national movement to improve the safety and health of agricultural workers and their families.□



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PAPERS AND PROCEEDINGS

of the

SURGEON GENERAL'S CONFERENCE ON

AGRICULTURAL SAFETY AND HEALTH

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Public Law 101-517

April 30 - May 3, 1991
Des Moines, Iowa

Convened by

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Centers for Disease Control
National Institute for Occupational Safety and Health

September 1992

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Publication Dissemination, DSDTT
National Institute for Occupational Safety and Health
4676 Columbia Parkway
Cincinnati, Ohio 45226
FAX (513) 533-8573

U.S. Department of Commerce
National Technical Information Services
Springfield, VA 22161
NTIS PB 93-114890/$77.00 or A/06

Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402
GPO 017-033-00463-3

DHHS (NIOSH) PUBLICATION NUMBER 92-105

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