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GASES, VAPORS, LIQUIDS, AND DRUGS

By William Popendorf, Ph.D., C.I.H.
Institute of Agricultural Medicine, University of Iowa

INTRODUCTION

A wide range of gaseous and liquid hazards exists in agriculture (Table I).[1,2] Virtually all of the gaseous hazards from which we can anticipate health effects exist in one form or another in general industry.

While we know of their existence in agriculture, only a few of these hazards have been surveyed in farm settings. We do not know how frequently (on the average) farmers are exposed to individual agents. We do not know the range of concentrations of such exposures. We do not know the extent of the health effects except for the occasional severe case report or fatality.

And if we really did know these parameters, we face yet another challenge; how to translate them into "agricultural hygiene," the industrial hygiene paradigm of "anticipation, recognition, evaluation, and control" learned in general industry over the past 50 years. As we begin to apply this paradigm, another challenge is to understand the limitations of rote transferral of this paradigm from general industry to agriculture without also understanding its nature and its culture.

This presentation will begin with a review of some of these agents, their sources on the farm, and some of the limitations of the traditional hierarchy of controlling these hazards either at their source, along the pathway of the exposure route, or at the receiver (in this case the farmer or farm worker). A discussion of health effects will be minimized except for agents that are by-and-large unique to agriculture.

Table I. Typical Toxic Agricultural Liquids, Gases, and Vapors.

Ammonia	from urine, urea, and anhydrous
Carbon dioxide	animal respiration and combustion
Carbon monoxide	combustion sources
Hydrogen sulfide	manure gas
Nitrogen dioxide	from fresh silage
Oxygen Depletion	asphyxiation in confined spaces
Pesticides	primarily dermal absorption hazards except fumigants
Welding	fumes and gases
Fuel storage	leaks and fires
Fuel and waste oil	skin cancers and dermatitis
Liquified Propane [LP] gas	fires
Liquified anhydrous ammonia	dermal injury

DEFINITIONS

I feel obliged to define a few terms and concepts ingrained into industrial hygiene folklore. The first (Figure 1) is the paradigm of anticipation, recognition, evaluation, and control. Historically, this process began with the recognition of adverse health effects existent within a working population.

- **Anticipation** is the prospective application of dose-response knowledge generated either in the laboratory or in other industries.
- **Recognition** requires the commitment of farmers, interested farm groups, and governmental agencies to survey both the farming environment and the health status of farmers.
- **Evaluation** must develop new ways to interpret surveillance data from the farm setting for the agricultural population.
- **Control** includes not only "hazard communication" but also modified sources and interruptions in the pathways of exposure before the farmer, with or without personal protection, is dosed.

Figure 1. The Agricultural Hygiene Paradigm.

Today, we can anticipate (and hopefully avoid) adverse health effects based on toxicology or prior experiences in other work settings. To evaluate the degree of risk, we have developed a system of "performance based" exposure limits guidelines (guidelines called Threshold Limit Values [TLVs] and their regulatory equivalents called Permissible Exposure Limits [PELs]), the goal of which is to prevent adverse health effects by keeping exposures and doses to acceptable low levels without specifying the method or "work practices" to achieve those levels.

The second is a concept that adverse health effects are the culmination of an often-complex chain of events beginning with the agent emanating into the working environment from a sometimes nebulous source and traveling through a physical pathway to create either an airborne, dermal, or even oral dose; the dose is generally dependant upon the duration of exposure and the degree of personal protection being used by the worker; the agent may act at the site of contact or be absorbed into the body and be transported to some biological target organ where it acts toxicologically to create a clinically identifiable effect.

Over the years, a hierarchy of control options has been inculcated into the profession whereby controlling the source is the preferred option, controlling the pathway between the source and worker is the second option, and controlling the receiver is the third and least preferred option. Hygienists believe that respirators or other forms of personal protective equipment are not a quick cure-all, contrary to popular belief. And even when they are recommended, good practice dictates (and OSHA now requires) that the respirator should be selected based on the measured level of exposure.

GASES AND VAPORS

The following history of silo gas is representative of the fragmented progression of anticipation, recognition, evaluation, and control of a potentially common agricultural health hazard.

Occupational hazards associated with silo gas were first reported in 1914 via case studies of four fatalities of farmers working in and among their freshly filled silos. Their deaths were attributed to carbon dioxide (CO_2).[3]

It was not until the 1950's (30 to 40 years later) that investigations revealed the presence and importance of nitrogen dioxide (NO_2).[4-6] The major portion of toxic NO_2 appears to be produced from organic nitrates, aggravated by the addition of heavy nitrate fertilizer and/or drought conditions.[6]

The process of NO_2 production begins within hours of ensilage, peaks in three to seven days, but may last for up to two weeks. Levels of NO_2 as high as 200 ppm have been reported seven days after filling;[6,7] this is well over its current TLV of 3 ppm (with a 5 ppm STEL).

Our broad understanding of the magnitude and frequency of this hazard is limited by a lack of systematic environmental surveillance and poor reporting of farm injuries and fatalities. Our understanding of its overall impact on the health of farmers is further limited by the difficulty in diagnosing nonfatal cases of the disease due to the multiple and usually latent phases of its clinical manifestations.[8-10] Thus, the severe and fatal cases of silo fillers' disease that are reported probably represent the tip of the proverbial iceberg.

A few systematic surveys have recently been made of chronic gaseous hazards in modern semi-enclosed animal production buildings. Mulhausen[11] found that air quality in poultry barns frequently exceeded exposure limits of 25 ppm for ammonia (NH_3) during fall and winter and sometimes even exceeded its STEL of 35 ppm; H_2S was undetected. Donham *et al.*[12,13] surveyed similar swine barns and found 50 percent exceeded the TLC for ammonia; many of these buildings also exceeded the TLC for CO_2, H_2S, and CO (from un-vented space heaters).

Source: urine (urea)-wet floors, slats, gutters, etc.

Anticipated Health Hazards:

Irritating to eyes, nose, trachea (wet body parts) ..... 10-15 ppm

TLV = recommended exposure limit (for gas) ..... 25 ppm

Absorbed into an aerosol may provoke bronchitis, asthma, or other pulmonary effects ..... <20 ppm

Figure 2. Ammonia (NH_3).

At these concentrations, ammonia by itself would only be a strong irritant to the eyes, nose, and throat. However, in both poultry and swine farm settings, it may be important to consider the simultaneous presence of both ammonia and organic dust aerosols at levels often in excess of 5 mg/m^3. The hypothesis here is that the pulmonary damage caused by ammonia could be considerably greater if the gas were adsorbed onto a respirable-sized aerosol (Figure 2).

In addition to hydrogen sulfide, mercaptans and organic acids (such as methyl and ethyl-mercaptan, carbonyl-sulfide, skatole, and propionic, butyric, and valeric acids) have been identified in the gases emanating from the anaerobic decay of manure typically stored in a pit under most

hog and some dairy barns.[14-15] It should be acknowledged that under normal barn conditions, hydrogen sulfide is not at levels of great health concern (Figure 3).[12,13]

Source: anaerobic manure digestion

Anticipated Health Hazards:

Threshold of odor detection	0.1-0.2 ppm
Offensive odor	3-5 ppm
TLV = recommended exposure limit	10 ppm
Olfactory paralysis (cannot be smelled)	25-100 ppm
Serious eye injury (gas eye)	50-100 ppm
Bronchitis (dry cough)	100-150 ppm
Pneumonitis and pulmonary edema	200-500 ppm
Rapid respiratory arrest (death)	>1000 ppm

Figure 3. Hydrogen Sulfide (H_2S).

However, when the manure is agitated prior to pump-out to be returned to the fields as fertilizer, it is rapidly released into the air above the frothing liquid.[15-19] During agitation, the author has measured levels of H_2S as high as 300 ppm at pig breathing height and 1500 ppm in the pit (Figure 4).

- Methyl-mercaptan
- Ethyl-mercaptan
- Carbonyl-sulfide
- Skatole
- Propionic acid
- Butyric acid
- Valeric acid

Figure 4. Mercaptans and Organic Acids Associated with Hydrogen Sulfide from Manure.

Manure gas deaths often involve multiple victims during futile rescue attempts.[17,20] As was the case with silo gas, manure gas deaths even as recently as 1989 are sometimes mis-diagnosed as asphyxiation from methane.[20]

Control of agricultural respiratory hazards should rely first on reduction at the source, second on ventilation or some other physical barrier to its movement, and third on personal protection. Control of the source of most of the above agents will require further research before the process of gas generation is sufficiently understood to be reduced or avoided.

High rates of ventilation of farm shops or animal confinement building is often resisted by operators who prefer to conserve heat in cold winter climates, and if too much ventilation were installed without consideration of make-up air requirements, high levels of CO could be drawn back down heater exhaust vents (Figure 5).

Source: improperly adjusted heaters or no make-up air

Anticipated Health Hazards:

TLV = recommended exposure limit	50 ppm
Induces spontaneous abortions in swine	100-150 ppm
Asphyxiation dependent upon duration of exposure	(2-3 hours at 500 ppm) <15 mins >2000 ppm

Figure 5. Carbon Monoxide (CO).

As in any other industry, the use of respirators should be considered a temporary and supplemental protection. In agriculture there are no trained persons available to assist in the selection, fit, or maintenance of respirators. Thus, when purchased at all, respirators are selected

without knowledge of measured levels of exposure and often without even the benefit of an adequate "work practices" evaluation as shall be discussed below.

LIQUIDS

Pesticides are formulated as solids (such as granules and wettable powders), liquids, and gases and vapors (mostly fumigants). Pesticides can present a hazard to applicators,[21-23] to harvesters re-entering a sprayed field,[24,25] and to rural residents via air, water, and even food contamination.[26-28]

Table II. Major Groups of Field-Use Agricultural Pesticides.

	Common Commercial Names
INSECTICIDES	
Organophospates	Counter, Parathion, Guthion, Lorsban, Rabon
Carbamate	Temik, Furidan, Lannate, Sevin
Organochlorines	Dieldrin, Lindane, Chlordane
HERBICIDES	
Phenoxy-aliphatic acids	2,4-D, 2,4,5-T, Trioxone
Bipyridyis	Paraquat, Diquat
Triazines	Atrasine, Blasex, AAtrex
OTHER/MISCELLANEOUS	
Thiocarbamates (fungicides)	Thiram, AAtack, Mabam, Maneb, Zineb
Arsenicals (herbicides)	Paris Green, Cacodylic acid
Acentanilides (herbicides)	Alachlor, Lasso, Ramrod
Dicarboximides (fungicides)	Difolitan, Captan
Dinitrotoluidine (herbicides)	Amex, Prowl, Treflan

Toxicologically, the major field-use pesticides can be broken down into six major chemical groups shown in Table II. Most of these agricultural chemicals present dermal hazards either from absorption directly through intact skin and/or from dermatitis. Some of these insecticides are also used indoors, especially in greenhouses were exposure is often higher.

There are two additional groups of non-field agricultural chemicals: one is fumigants (such as phosphine [usually aluminum phosphide or Phostoxin] or a volatile organic like carbon disulfide or ethylene dichloride) used in produce storage areas, and the other is disinfectants (such as chlorine, quaternary ammonia compounds, organic iodides, and cresol-based compounds) used in indoor animal production facilities.[2] Certain of these chemicals present respiratory hazards particularly when used in combinations; other of these liquid chemicals present a risk of contact or an allergic dermatitis.[30]

While a review of pesticide toxicities is being presented separately, they are presented here because they demonstrate an approach to anticipation, recognition, evaluation, and control quite different from general industry. Some level of anticipation was available from the time of registration, but much of that interest was directed toward consumers rather than users who are exposed at much higher levels.

Given that starting point, it is unfortunate that the recognition of hazards to users has often been a protracted process, in some ways no better than the history of many chemicals used in general industry. However, evaluation of exposure, when it finally started to be conducted, was not site nor user specific but was conducted in response to more recent EPA pesticide registration requirements.

EPA then promulgated what amounts to a "use practices standard" in the form of

label instructions, which specify the ways the chemical can be safely and legally used. The implication is that if all users follow these instructions, exposure will be sufficiently low to prevent adverse health effects. This process contrasts sharply with general industry where employers are expected to "assure a workplace free from recognized hazards."

Controls under these circumstances have also differed from general industry. It can be argued that the registration process is itself a form of controlling the source, screening out chemicals deemed too hazardous for agricultural use and restricting certain others to "licensed users."

In that sense, a form of hazard communication was adopted by agriculture a little before general industry. However, the EPA registration and labelling process has yet to address the machinery controlling the pathway of exposure.

When it comes to personal protection, control has for a long time been misdirected at airborne versus the dermal route of exposure; and those respiratory controls which are specified, were established without a decision logic common to general industry for over 30 years[31,32]. I am happy to report that EPA is currently developing a respirator selection decision logic at least consistent with a "use practices standard."

One might ask why a "use practices standard" versus a "performance standard" approach used in agriculture. The one asking the question must not be a farmer.

Even if the administrative and support structure were in place to conduct on-site monitoring at each farm or "place of employment," the activities, working environments, and chemical exposure levels in most agricultural settings vary sufficiently by season, day, and even by hour as to make such measurements moot, which is not to say that measurements and even performance standards have no place in agriculture.

For instance, work in animal production facilities is amenable to the application of traditional TLVs, environmental monitoring, and respirator selection criteria. "Use practice standards" have their own limitations; they must account for many variables, thus often making them overly restrictive conducive to low compliance. It remains a challenge for the future to define the conditions favoring either form of standard or to determine if either is even adequate.

The other category of agricultural chemicals is fertilizers. Anhydrous ammonia is the most heavily used fertilizer in production agriculture. Anhydrous ammonia is hazardous to the skin and especially to the eyes because it is highly hygroscopic, highly caustic, and extremely cold (-28°F under pressure).

Almost any eye contact with this chemical will result in permanent blindness.[33] Inhaling high concentrations of ammonia can result is severe damage to the upper respiratory tract, resulting in bronchiectasis as a possible sequela.[34]

Most of the occupational injuries from anhydrous ammonia occur because of faulty couplings, bleeder valves, shut-off valves, broken hoses, or plugged applicator tips. In addition to an established program of preventive maintenance, a pro-active hazard communication for both commercial and private applicators is essential to establish consistent wearing of eye protec-

Table III. Skin Conditions of Agricultural Workers (adapted from reference 2).

Classification of Skin Condition	Agents (examples)
Irritant contact dermatitis	ammonia fertilizers
	animal feed additives
	vegetable crops and bulb plants
	insecticides, herbicides, and fumigants
Allergic contact dermatitis	herbicides and insecticides
	antibiotic feed additives
	plants
Photo-contact dermatitis	creosota
	feed additive
	plants containing furocoumarins
Sun-induced dermatoses	sunlight
Infectious dermatoses	cattle, swine, and sheep
Heat-induced dermatoses	moist and hot environments
Arthropod-induced dermatoses	chiggers, bees, and wasps

tion and ensuring the availability of clean water to flush eyes and skin in case of contact.

In addition to their fire hazard and intrinsic toxicity, many of the liquids involved in agriculture can produce dermatitis (Table III). Compared to other occupational groups, farmers have a proportionately higher prevalence of skin diseases.[35,36]

Irritant contact dermatitis is perhaps the most common type of agricultural dermatoses.[35-39] Irritant substances are ubiquitous and include ammonia fertilizers, several pesticides, soaps, petroleum products, and solvents. Avoidance schemes must include work practices to eliminate or reduce exposure to the most irritative substances and/or the use of personal protection equipment.

Allergic contact dermatitis is typified by poison ivy or poison oak reactions. These are exquisite sensitizers as are certain herbicides and pesticides.[2] These reactions are more difficult to control, because susceptible farmers are exquisitely sensitive to very small amounts of offending liquids.

VETERINARY DRUGS

Veterinary drugs are broadly divided into two classes of biologicals and antibiotics (Table IV). Biologicals are made from living products to enhance the immunity of an animal to a specific infectious disease or diseases.

Users of biologicals are at risk of either accidental inoculation or splashing the product into the eyes, mucous membrane, or broken skin. Users at risk include not only veterinarians and their assistants, but also farmers, ranchers, and their employees, except for certain diseases for which a government-regulated control program is in effect (e.g., brucellosis, rabies, pseudorabies).[2]

The most frequent reports of occupational illnesses associated with biologicals involve veterinarians, whether splashing brucellosis strain 19 in their eyes or accidental inoculating themselves. Symptoms may include infection, inflammation, severe localized swelling and pain, and/or an allergic reaction. The infection mimics the acute infection seen from acquisition of the disease directly from either cattle or swine. Disability may last for days to weeks in the worst cases.[40]

Table IV. Veterinary Drugs Potentially Hazardous to Users.

Biologicals
Brucellosis strain 19
Newcastle disease vaccine
Contagious exthyma (orf) vaccine
Jhone's disease bacterin
Escherichia coli bacterins
Erysipelas vaccines
Antibiotics
Penicillin
Tetracycline
Sulfamethazine
Erythromycin
Virginiamycin

Other products that have been associated with occupational illnesses include Newcastle disease vaccine, contagious ecthyma vaccine, Jhone's disease bacterin, *Escherichia coli* bacterins, and erysipelas vaccines. Newcastle disease and contagious ecthyma (orf) vaccines are live products used in chickens and sheep, respectively.

Workers may contaminate their eyes with Newcastle vaccine as it is being applied inside poultry buildings via a nebulizer, resulting in a moderate conjunctivitis with influenza-like systemic symptoms. Orf vaccine can cause the same pox-like lesions at the site of inoculation as a naturally acquired infection.

Both of these diseases are self-limited and disability will only last for a few days, unless the orf lesions are numerous.[41,42] Injuries induced by the bacterins for Jhone's and *E. Coli*, and by most erysipelas vaccines are limited to the inflammatory response induced by the adjuvants.

Control of these hazards again resides largely in "use practice standards," good animal handling techniques and facilities to prevent the uncontrolled and untimely movements of stressed animals.[43] The use of pneumatic syringes, lock-on needle hubs, and multiple dose syringes will also help reduce injuries.

Eye protection is indicated in many instances. A full-face respirator is recommended while aerosolizing vaccines such as Newcastle, but the other components of a full respirator program are rarely instituted.

Antibiotics are products derived or synthesized from living organisms, mainly mold species of the genus *streptomyces*. Antibiotics are used to treat infectious diseases therapeutically or to improve the rate of gain and feed efficiency in cattle, swine, and poultry.

Again not only veterinarians but also livestock producers and feed manufactures and formulators are exposed to these agents via aerosols of antibiotic-containing feeds within livestock buildings or via aerosols or direct contact while preparing feeds either on the farm or in feed manufacturing plants. The two main occupational hazards are allergic reactions and the development of antibiotic-resistant infections.

The main products used as feed additives include penicillin, tetracycline, sulfamethazine, erythromycin, and virginiamycin. These same products plus many more are used therapeutically. Penicillin is the primary agent that may induce an allergic reaction manifest in the form of a skin reaction from direct contact, or

possibly a systemic reaction from inhalation or inoculation.

A variety of these agents may induce development of resistant organisms in the gut flora of exposed individuals. In one case, a severe resistant salmonellosis was traced to animal contact by people who were treated with antibiotics for a condition unrelated to salmonella.[44]

Again the importance of antibiotics as an agricultural health hazard is unknown either in terms the frequency or the magnitude of exposure levels or health effects. It seems that the evaluation of risk from antibiotics is amenable to air sampling and the development of "performance" oriented exposure guidelines.

Control should strive toward removing as feed additives those antibiotics used for humans and rotating the use of those still added. Other prudent control measures where antibiotics are used include enclosing feed formulating, grinding, mixing, and storing operations, and utilizing general dust control procedures in small feeding operations, supplemented by dust masks.

CONCLUSIONS

The industrial hygiene paradigm of "anticipation, recognition, evaluation, and control" can, in principle, be applied to agriculture with the following translations:

1. Anticipation of health and safety hazards in agriculture can be accomplished with the prospective application of dose-response knowledge generated either in the laboratory or in other industries.

2. Recognizing health and safety hazards in agriculture requires the interest and commitment of farmers, farmer groups, local community organizations, manufactures, and governmental agencies to survey both the farming environment and the health status of farmers.

3. Evaluation of health and safety hazards in agriculture can in most cases use existing surveillance technologies, but new ways must be developed to interpret surveillance data from settings for farmers.

4. Controlling health and safety hazards in agriculture must go beyond "hazard communication" to modify the sources and interrupt the pathways of exposure before the farmer, with or without personal protection, is dosed.

Organizationally, the hazards from gases, liquids, vapors, and veterinary drugs are not uncontrollable. By and large, we can anticipate the health effects of individual agents, and we know how to measure both the agents and their effects in a population.

We have not utilized these skills in agriculture as yet, probably both because of the cost of surveillance studies in such a scattered and diverse population and because of the perception that "agriculture" was not interested in someone intervening in their affairs. We are at the dawn of the age where the interest and funds are being put into agricultural health and safety.

I hope that in our rush to study and improve the statistics upon which future preventive health and safety decisions will be made, we do not lose sight of agriculture as way of life. Kelley Donham and I recently have been referring to agricultural hygiene as the application on farms of industrial hygiene principles learned in general industry.[2]

We like to think (with tongue in cheek) that agricultural hygiene is a growing opportunity. The open question is, is it going to be easier to train industrial hygienists about farming than it will be to train farmers to be agricultural hygienists?□

REFERENCES

1. W. Popendorf, K.J. Donham, D.N. Easton, and J. Silk. A synopsis of Agricultural Respiratory Hazards. *American Industrial Hygiene Association Journal*. 46(3): 154-161, (1985).

2. W. Popendorf and K.J. Donham: Agricultural Hygiene. Chapter 19 in *Patty's Industrial Hygiene*. 4th Edition, pages 575-608, J. Wiley & Son, NY 1991.

3. E.R. Hayhusrt and E. Scott, Four Cases of Sudden Death in a Silo. *JAMA* 63:1570-1572, (1914).

4. R.R. Grayson, Silage Gas Poisoning: Nitrogen Dioxide Pneumonia, a New Disease in Agricultural Workers. *Ann. Int. Med.*, 45:393-408, (1956).

5. T. Lowry and L.M. Schuman. Silo-filler's Disease: A Syndrome Caused by Nitrogen Dioxide. *JAMA* 162:153-160 (1956).

6. W.H. Peterson, R.H. Burris, S. Rameshchandra, and H.N. Little. Production of Toxic Gas (Nitrogen Dioxides) in Silage Making. Agric and Food Chem, 6:121-126, (1958).

7. B.T. Commins, F.J. Raveney, and M.W. Jesson. Toxic Gases in Tower Silos." *Ann. Occupational Hygiene* 14:275-283, (1971).

8. R.J. Ramirez and A.R. Dowell. Silo Filler's Disease: Nitrogen dioxide-induced Lung Injury. Long-term Follow-up and Review of the Literature. *Ann. Intern. Med.* 74:569-576, (1971).

9. E.G. Scott and W.B. Hunt. Silo-filler's Disease. *Chest* 63:701-706, (1973).

10. E.D. Horvath, G.A. do Pico, and R.A. Barbee et al. Nitrogen dioxide-induced pulmonary disease. *Journal of Occupational Medicine*. 20:103-110, (1978).

11. J.R. Mulhausen, E.E. McJilotn, P.T. Redig, K.A. Janni. Aspergillus and Other Human Respiratory Disease Agents in Turkey Confinement Houses. *American Industrial Hygiene Association Journal*. 48(11):894-899, (1987).

12. K.J. Donham, M. Rubino, T.D. Thedell, J. Kammermeyer, Potential Health Hazards to Agricultural Workers in Swine Confinement Buildings. *Journal of Occupational Medicine*. 19(6):383-387, (1977).

13. K.J. Donham, M. Rubino, T.D. Thedell, J. Kammermeyer. Ambient Levels of Selected Gases Inside Swine Confinement Buildings. *American Industrial Hygiene Association Journal*. 46:658-661, (1985).

14. J.A. Merkel, T.E. Hazen, and J.R. Miner. Identification of Gases in a Confinement Swine Building Environment. *Trans. ASAE*. 12:310-315 (1969).

15. W.C. Banwart and J.M. Brenner. Identification of Sulfur Gases Evolved from Animal Manures. *Journal of Environmental Quality*. 4(3):363-366, (1975).

16. D.L. Morses, M.A. Woodbury. Death Caused by Fermenting Manure. *Journal of the American Medical Association*. 245(1):63-64, (1981).

17. K.J. Donham, L.W. Knapp, R. Monson, K. Gustafson. Acute Toxic Exposure to Gases From Liquid Manure. *Journal of Occupational Medicine*. 24(2):142-145, (1982).

18. S.R. Hagley, D. L. South. Fatal Inhalation Of Liquid Manure Gas. *Medical Journal of Australia*. 2:459-460, (1983).

19. A. Phelps. The Hidden Hazard. *Hog Farm Management*. 25(4):38-39, 1988.

20. Anonymous. Fatalities Attributed to Methane Asphyxia in Manure Waste Pits - Ohio, Michigan, 1989. *MMWR*, 38(33):j583-586, (1989).

21. H.N. Nigg and J.H. Stamper. Exposure of Spray Applicators and Mixer-Loaders to Chlorobenzilate Miticide in Florida Citrus Groves. *Arch. Environmental Contamination Toxicology*. 12:477-482, (1983).

22. J.M. Devine, G.B. Kinoshita, R.P. Peterson and G. L. Picard. Farm Worker Exposure to Terbufos [phosphorodithioic acid] during Planting Operations of Corn. *Arch. Environmental Contamination Toxicology*. 15:113-119, (1986).

23. W. Popendorf. Mechanisms of Clothing Exposure and Dermal Dosing during Spray Application. In: *Performance of Protective Clothing: Second Symposium*. ed. by S.Z. Mandsorf, R. Sager, and A.P. Nielsen. Amer. Soc. for Testing and Materials. Phil. PA, 611-624, (1988).

24. W. Popendorf and J.T. Leffingwell. Regulating OP Pesticide Residues for Farmworker Protection. *Residues Reviews*. 82:125-201, (1982).

25. H.N. Nigg, J.H. Stamper, R.M. Queen. The Development And Use Of A Universal Model to Predict Tree Crop Harvester Pesticide Exposure. *American Industrial Hygiene Association Journal*. 45(3):182-186, (1984).

26. J. Maybank, K. Yoskida, and R. Grover. Spray drift from agricultural pesticide applications. *J. Air Pollution Control Association*. 28:1009-1014, (1978).

27. National Research Council. *Regulating Pesticides in Food*, National Academy Press, Washington, DC, (1987).

28. D. Fairchild. *Ground Water Quality and Agricultural Practices*. Lewis Publishers, Inc., Chelsea, MI (1987).

29. J.H. Stamper, H.N. Nigg, W.D. Mahon, A.P. Nielsen, M.D. Royer. Pesticide Exposure to Greenhouse Foggers. *Chemosphere*. 17(5):1007-1023, (1988).

30. R.L. Zuehlke. Common cutaneous problems in agricultural work. In: *Proceedings of Conference on Agricultural Health and Safety*. Society of Occupational and Environmental Health, Environmental Sciences Laboratory, 100th Street and Fifth Avenue, NY, pp. 54-67, (1975).

31. F.A. Patty. *Industrial Hygiene and Toxicology*. 2nd Edition. Pages 352-354, Interscience Publishers, NY (1958).

32. N.J. Bollinger and R.H. Schutz. *Guide to Industrial Respiratory Protection*. DHHS (NIOSH) Publ. 87-116, (1987).

33. S. Helmers, F.H. Top, and L.W. Knapp. Ammonia Injuries in Agriculture. *J. Iowa Med. Society.* 61(5):271-280 (1971).

34. I. Kass, N. Zamel, C.A. Dobry, and M. Holzer. Bronchiectasis following ammonia burns of the respiratory tract: A review of two cases. *Chest*, 62:282-285, (1972).

35. D. Hogan and P. Lane. Dermatologic Disorders in Agriculture. *Occupational Medicine: State of the Art Reviews*, I:285-300, (1986).

36. C.L. Wand. The Problem of Skin Diseases in Industry. Washington D.C., Office of Occupational Safety and Health Statistics, U.S. Department of Labor, U.S. Government Printing Office, (1978).

37. R.M. Caplan. Cutaneous hazards posed by agricultural chemicals. *Journal of the Iowa Medical Society*, 59(4):295-299, (1969).

38. D. Burrown. Contact dermatitis in animal feed mill workers. *British Journal of Dermatology*, 92:167-170, (1975).

39. R.D. Peachey. Skin hazards in farming. *British Journal of Dermatology*, 105(Supp.21):45-50, (1981).

40. W.W. Spink. The Significance of Bacterial Hypersensitivity in Human Brucellosis; Studies on Infection due to Strain 19. Brucella Abortus. 47:861-873, (1957).

41. A.H. Keeney and M.C. Hunter. Human infection with Newcastle virus of fowls. *Archives of Opthalmology*. 44:573-580, (1950).

42. U.W. Leavell, Jr., M.S. McNamara, R. Muelling, et al. Orf-Report of 19 human cases with clinical and pathological observations. *JAMA*, 204:109-116, (1968).

43. T. Grandin. *Animal Handling and Farm Animal Behavior*. Veterinary Clinics of North America: Food Animal Practice, 3:324-336, (1987).

44. R.W. Lyons, C.L. Samples, H.N. DeSilva et al. An Epidemic of Resistant Salmonella in a Nursery-Animal-to-Human Spread. *JAMA* 243:546-547, (1980).

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MIGRANT WORKERS' PERSPECTIVE

By E. Roberta Ryder, B.A.
Executive Director, National Migrant Resource Program, Inc.

I am coming to you from Buffalo, New York, where I have been for six days participating in the National Migrant Conference, which is a joint group with migrant education, migrant health, migrant head-start, and migrant labor. So, I am running a little ragged here in my throat, and I ask you to bear with me for just a little while.

NATIONAL MIGRANT HEALTH PROGRAM

I am going to give you a brief synopsis of the organization that I work with because I think there are some resources there that some of you might be interested in. The National Migrant Resource Program is located in Austin, Texas. It has been there for almost 20 years.

We act as a resource not just to migrant health centers but to any other interested parties around the country. We are a private, non-profit corporation. We have a newsletter, a directory, and a number of publications, perhaps the most exciting of which is one that was just completed by Dr. (inaudible) who is an epidemiologist with Mercer University in Georgia.

I am going to read you one sentence out of this report. It is an analysis of migrant farmworkers in the midwestern stream. He says, "The results of this study are significant, shocking, and convincing. The findings are based on a sample of migrant and seasonal farmworkers living and working in the U.S., yet their demographic patterns, socioeconomic conditions, lifestyle characteristics, and disease categories reflect agrarian third-world conditions rather than those of the most powerful and affluent nation in the world."

This monograph is available for all of you if you want to contact me. Our name is listed in the back of the roster of participants.

I come from a farming background. I am the daughter of a farmer, and I am also the ex-wife of a farmer.

I have been a health center administrator and worked with migrant farmworkers since I got out of college in 1972. I would also like to let you know that we are doing—if any of you have an interest in it we would like to hear from you—some work with EPA on expert meetings on the topics of children and pesticides and on biological monitoring alternatives.

COMMENTS ON PAPERS

I am going to go directly to the presentations that were made yesterday. I would like to state that of the four, some of them were more directly applicable to migrant farmworkers than others. Even the one that was least directly applicable, i.e., Dr. Popendorf's presentation on gases, liquids, vapors, and veterinary drugs, contained significant concepts that are very valuable when applied to the field of mi-

grant health. I speak particularly of his paradigm of anticipation, recognition, evaluation, and control.

The other concept that he presented was that adverse health effects are the culmination of an often complex chain of events beginning with a nebulous source and traveling through a physical pathway. This concept is very important, especially if you think for the moment of the father of a farmworker family, say 50 years old, who comes into a clinic with chronic headaches, gastric problems, or dermatitis.

We cannot figure out what the problem is. How do we determine what series of events or exposures led him to this state? After 40 years of exposure, traveling in maybe one or two streams, a multiplicity of states, and working with a range of crops that go from apples to mushrooms to zucchini — what kinds of exposures has he had? Certainly the case is complex beyond that of the grower, the farmer, who stays on one farm, one piece of property, over a 40- to 60-year span of time.

We do not know what the chronic effects of low-level continuous exposure are, but because we do not know, we sometimes hide our heads in the sand and pretend that they are not problems, much like we did with cigarette smoking 20 years ago. Good judgment and common sense advised us that smoking was not healthy.

To touch on Dr. Popendorf's theory, we could anticipate potential problems, we could recognize the questionability of putting such a substance in our bodies, but yet for economic and political reasons we got stuck on evaluation before we could move on to control. Are we going to wait until we can prove, irrefutably, that exposure to chemical and biological substances is hazardous to the health of farmworkers, farmers, and consumers before we use this God-given good judgment and anticipate or recognize the danger and take action?

You might wonder why I mentioned the consumer here. Those of us who work in migrant health believe that the migrant farmworker and the farmer are, in essence, the "canaries." Do you all know what I mean by that concept? The indicator of risks that are shared with the consumer.

I speak here not only of chemical hazards but of biological exposure. A colleague of mine testified before a joint session of the Congress in the early years when we were trying to promulgate the field sanitation regulations which, by the way, were only finally passed in 1987. He said, "Just tell me, sir, exactly what amount of fecal matter present on a strawberry is a tolerable level."

All of the presentations touched on issues which are of significant impact to farmworkers. I would like to run through that list briefly with you at this time.

We spoke of infectious diseases for which farmworkers are at high risk, because of their working and crowded living conditions. TB, STD, HIV, parasites, gastroenteritis, Salmonella, Shigella, hepatitis A, UTI's, and respiratory infections—all of them very clearly problems that we see in the farmworker population. One of the reasons that I referred you to Dr. (inaudible) study is that he does an analysis of the frequency of these diagnoses in this study.

Dr. Von Essen spoke to us of airborne dust. Certainly hypersensitivity pneumonitis is less of a problem with the migrant farmworker population, since only

small numbers of them work in dairy or grain operations. I have a foster child who lives with me and is 20 years old. I have known Danny since he was three, and I had him in day care in southwest Michigan.

He is the child of a farmworker family that is home-based in the Little Rock or Batesville, Arkansas area. When they are not migrating north, they work in the poultry industry. Danny, at the tender age of 20, has chronic bronchitis from having been in and out of the poultry settings and the freezers of the processing plant. This is clearly a problem, but in less significant numbers than the larger portion of the population that works primarily in fruits and vegetables.

I would like to draw attention to the fact that for farmworkers, we are talking about chemical and biological exposures, but there are a number of other hazards that people often do not think about as being agriculturally or occupationally related. For example, automobile accidents with farmworkers who are traveling 1,200 miles up and down the stream in cars that I would not drive 200 miles in are significantly related to occupational employment.

I would like to go to Dr. Blair's presentation. It is most exciting to me in that it takes a very honest approach to the difficulties in assessing the chronic effects of acute exposure. Certainly clusters of cancer among farmers which cannot be explained for other reasons are alarming enough to motivate us to anticipate and recognize the problem so that we can then control it. Let us not get bogged down in the assessment, or we will lose all of our canaries.

What are the solutions? Certainly there are some laws on the books which need to be fully implemented. I had originally jotted down the word "enforced," and I crossed that out and used the word "implemented," because, quite frankly, our enforcement is not working.

We have people here from OSHA. Someone asked me a question just before the conference started as to how things were going with OSHA in Texas. Enforcement does not happen.

Specifically, the laws that are on the books include such things as field sanitation, use of child safety restraints in automobiles, minimum wage, and re-entry times, but these are not always observed. Then there are other laws that have yet to be promulgated.

I speak specifically here of the loopholes in current laws, which exempt migrant and seasonal farmworkers and farmers from basic worker protection standards afforded to all other workers and child labor laws which do the same. There is movement towards promulgating both of those at this time. One of my colleagues, Dr. Paul Monahan who is sitting in the back row, has information on each of those. The group within migrant health that takes a strong advocacy role is the migrant clinicians' network, and I believe he has copies of the position papers on both of those laws.

Currently worker protection standards within the Environmental Protection Agency are bogged down in a political morass where they have been for years. They need to get out of the red border status and be promulgated.

Once this is achieved, they merit careful, independent, academic evaluation from professionals like yourself with an eye to modifications. Let us push now to get them on the books because if we try to inject modifications at this time into the political process, I am afraid we will never have the standards.

Is it really acceptable that such a large portion of our population be relegated to the edge for the duration of their lives?

Unfortunately, laws alone are not going to improve conditions for farmworkers. I would like to propose to you that farmworkers and farmers are literally in the same field—or boat as you might say—not only when it comes to exposures, but economically and politically.

It is very clearly recognized that farm and farmworker families have lived their lives on the edge between survival and destitution for at least the last 10 years. Many farm families have lost that struggle through suicide and bankruptcy. We do not see, visibly, tangibly, the demise occurring in the numbers of the farmworker population because there has always been another family to take the place of one that settles out. So we can not quantify it for farmworkers the way we can for farmers.

The theory of the hierarchy of need tells us that safety, shelter, and nourishment are the three basic needs of any human, and that without assurance of them, self-actualization will not occur. Is it really acceptable that such a large portion of our population be relegated to the edge for the duration of their lives?

Sometimes the farmworker's plight is erroneously blamed on the farmer or on the laziness of the farmworker. So who do we blame for the farmer's plight?

I blame the ignorance, selfishness and greed of the consumer and all of the middlemen in the food production system. Perhaps where humanitarianism and altruism are not strong enough to create change, consumer self-concern may.

We can certainly look at the examples of Alar in the Pacific Northwest, the consumer reaction, and the practice of its use among growers. We can look at the European Economic Community and the purchase of beef with steroids. We can look at the safe tuna model for examples of where consumer pressure has certainly brought about change. We know that it is a powerful entity.

RECOMMENDATIONS

I have 10 recommendations:

1. I would like to suggest that it is very important that we continue to mainstream farmer and farmworker issues, especially in arenas such as these, and I would like to volunteer to be one of several linkages that can help to bring participants— participation of migrant farmworkers themselves to sit and be a part of your negotiations. Not all farmworkers are monolingual, and several of them are very outspoken in English as well as Spanish.

2. Enforce protection standards where they exist.

3. Promulgate laws where necessary.

4. Educate both farmers and farmworkers as to the risks that they face.

5. Educate the consumer and the general public.

6. The academic world needs to feel free to speak out about the risks, even where proof does not exist. Let good judgment prevail.

7. Promote economic market changes that assure that farmers and farmworkers receive a decent wage or profit for their work, because truly it is the economic market that drives the situation. In this manner, both farmers and farmworkers can be pushed back from the edge where they currently teeter.

8. Recognize the difference between farm families and huge, multi-level, diversified agribusiness, which is making a profit, and decide where our values lie and promulgate and implement legislation accordingly.

9. Anticipate that the Free Trade Agreement between the United States and Mexico is going to blow us all out of the water, at least for the first five years, and then recognize that the short-run, political solutions and protections must be put in place in order to protect not only the farmer and the farmworker but the consumer, in that we do not control the use of toxic substances in Mexico.

10. Just as it took Surgeon General Koop's audacity to challenge the economic and political bastions of the tobacco industry and to state that cigarettes smoking is hazardous to our health, so too can Dr. Novello have the audacity, as a pediatrician and a woman and, I dare say probably a mother, to speak out on behalf of the hazards faced by our farming community.□

QUESTIONS

Anonymous: You used the term "blow us out of the water," on the Free Trade Agreement. Could you clarify that?

Roberta Ryder: The question is, What do I mean by "blow us out of the water" on the Free Trade Agreement? I have a sense that the long-term benefits of the Free Trade Agreement are going to be of significant value to this country and so, therefore, I personally am not opposed to it, but when you look at the fact that the production of a watermelon, for example, basically costs the same in Mexico as it does in the United States with the exception of the labor factor, what we are going to find is that the importation of agriculture into the United States will be far more prevalent than it is right now.

We will also find that some of the larger, healthier farms are going to actually move into Mexico, and there will be others who cannot sustain that kind of change that will go under. That is the impact on the farm.

For the farmworker, what we are going to find is that there are a number of second-generation agricultural farmworkers that have been here in the United States traveling along all of the streams, that are truly America's working poor. They are not a welfare population, and they are not going to have work. That is going to be a burden on American society just as it is in our inner city areas where we have large welfare populations.

I do not think that it is going to have a significant impact on the cost of produce for us as the consumer, but I do think that it will actually cut, pull the rug out from under our feet on, any of the consumer safety protections that have been put in place to control the use of certain substances because, in Mexico, things

like DDT are still being used quite frequently without any control at all. We are going to be consuming that produce.

Anonymous: To come back to the local level, how do we educate our migrant workers on all these things that are going on... (inaudible).

Roberta Ryder: The only way that I know of is through outreach. Our clinics have gone from being very basic, simple, community-level organizations to somewhat more sophisticated—nicer buildings, better trained doctors, and in the process, what we find is that we are not reaching the farmworkers.

As our health centers have become more and more a part of the industry and our highly trained physicians sit in the clinic and wait for the patients to come to them, we are reaching smaller and smaller numbers of the total population. We know—and dollar resources are clearly the issue here—that the only way to reach them is through outreach, through use of lay rich people, employment of the best and the brightest of the migrant farmworkers themselves, and through paraprofessionals and mid-level practitioners to go out into the labor camps and the housing, the colonias in the Valley of Texas, and take care of the basic level things. I am speaking in health, because that is the field that I am most familiar with, but I think you can apply that to education whether it is health education or safety education.

Anonymous: Can you get that through, say, migrant clinics?

Roberta Ryder: You definitely can. Migrant clinics have the expertise and the know-how. They have the models. Right now what they are lacking is the resources, and they are committed to health education and worker protection status.

Anonymous: Do you have a list of migrant clinics?

Roberta Ryder: The question is, "Do I have a list of migrant clinics?" I have a directory that is produced out of our office in Austin, Texas, and that is available free of charge. It includes all of the grantees funded through the Federal Department of Health and Human Services and each of their satellites, including names of the health professionals that work in them and the services that are provided. Included in that directory is also a list of pediatricians around the country who are members of the American Academy of Pediatrics who provide services to farmworkers on a volunteer basis.

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A FOUNDATION'S PERSPECTIVE

By Gene F. Graham, M.S.
Assistant Program Director, W.K. Kellogg Foundation

Dr. Kelley J. Donham: The next speaker is a person who I had the privilege of meeting just a little over a year ago, he revealed to me this morning that he got an infection once from one of his animals and since that time I think he has become quite a leader and promoter, very much so, in the whole area of agricultural health and safety. Gene Graham was born on a farm. I guess you have to have that stamp of approval, almost, to be here. If we keep this up, we are going to have so many people up here doing this stuff and not farming maybe we will not have to worry about those problems anymore, but . . . we need to keep in mind and perspective who we are working for and what we are trying to do. Anyway, Gene was born on a dairy farm in Michigan, a little ways north of Lansing. His project, perhaps more of a hobby than an actual economic unit on the farm, was pure-bred sheep. Gene went to Michigan State University and got a degree in education and specifically agribusiness and natural resources education and went to work in real life in a high school, in Laingsburg, Michigan, as an agricultural instructor, until 1989. He then went to work for the Kellogg Foundation in Battle Creek. Starting about one year ago, Gene was the stimulant to get an agricultural health and safety initiative going within Kellogg, which has helped to move this whole process along in a very big way. So, without further ado, I would like to introduce Gene Graham:

I do not know whether to say thank you to Kelley Donham or not. This morning I was asked to give a foundation's perspective on the papers and presentations that were made yesterday. As Kelley has suggested, it probably is easier for me to give a layperson's perspective.

In a sense, I hope to give a community perspective, and quite frankly, a perspective of a young midwestern farm youth and one from my involvement in agriculture as a farmer. In fact, I continue to farm today and had the opportunity in 1989 to purchase a farm in Michigan and continue to be involved there.

Although my bias and experience and exposure to the issues of agricultural health and safety clearly lie on the safety side, I will talk about that in just a minute. I first want to clear up Kelley's story. As Kelley mentioned, one day while shearing sheep on the farm, I contracted orf virus. It was the first time that I had come to grips with some of the relationships between agriculture and health, although I had read about and understood, at least at a very rudimentary level, some of the potential that health issues in agriculture pose.

I think, though, that what stirred me more was a series of experiences as I grew up in a very rural community, as Kelley said, not far from Michigan's capital, in Ingham County, Michigan. I think about two very good friends, Ron and Steve, who, in separate tractor accidents, were either killed while working on a farm or while driving a farm tractor down the road.

One, in fact, was struck by a car and killed. I also think about Gary, who, as a sophomore in high school, had a full chopper box roll onto him. He lost his left leg just above the knee.

I think about Sarah, in probably the most devastating experience that I could ever imagine, who walked too close to a sickle bar mower and lost both her feet. Somehow, in the miracle of what has gone on in health care in this country, Sarah had both feet successfully reattached. As one of the presenters alluded to yesterday, when you are in some of those situations, you do not look up at the doctor and say, "How much is it going to cost?"

Also, when I was a graduate student at Michigan State University, I remember very specifically, a good friend got stuck by a needle with animal vaccine, for the third time in his young life, and died within just a few hours of that experience. I think about five members of a family, in an accident that many of you heard about in Michigan's Upper Peninsula, where one after another each individual attempted a rescue from an underground manure pit and all five lost their lives.

Just last year, in the school district where I grew up, in a small rural community, the local people went through the pain of one suffocation/asphyxiation in an upright grain silo and a second accident where a young man lost his legs and a big share of his future as the result of a sweep auger in the bottom of a grain bin. So, all of these experiences wear and bear on my mind as I think about these issues and what we heard about yesterday.

With respect to a foundation's perspective, the foundation that I represent is not one that is very typical or traditional. It is one that says as its motto, "The application of knowledge to the problems of people." So that does not qualify me very well to stand today and reflect about the presentations that were made yesterday.

For the Kellogg Foundation, it is an issue of the complimentary relationship between research and community intervention, where each bears directly on the other. It is a fundamental and naive belief that models and demonstrations can be established which will, at some point, affect policy even at a very local or regional level. It is the application of knowledge for community intervention.

A foundation can only bring limited resources to this or any other important issue. It cannot do work by itself. In fact, foundations have no role except to contribute some pieces to the equation of research, surveillance, education, and intervention.

For the Kellogg Foundation in Battle Creek, Michigan, this work represents an opportunity to bring financial resources, networking, and an expectation of innovation. In our particular initiative, the expectations include collaborative, comprehensive, responsive, intensive, continuous, cost-effective (however that can be measured), creative, and effective programs at a community level.

COMBINED FACTORS OF RISK

As I reflect on the presentations which were made yesterday, I will only talk about where I see some potential next steps in relationship to what I heard. First, I would address an issue that was raised regarding combined factors of risk. The context of this issue could include factors outside of agriculture, such as cigarette smoking, which complicates our understanding of agricultural risk for exposure to the lungs.

Another example which was given yesterday was the case of two pesticides and what equations are appropriate, and what

do the results of the equations really mean? Have we got that figured out in a scientific and meaningful way?

A final example that I would give, and I think this may be a midwestern perspective, is the combination of wood smoke and a livestock confinement building. These are conditions and circumstances which exist on farms today. These are things at a community level which are very relevant; that young people and adults, in rural communities, who work and live on farms and tend to get exposed to more than one pesticide, to more than one type of animal confinement, to more than one risk must face a combination of occupationally and non-occupationally related risks.

ADDITIONAL STUDIES

Secondly, I want to comment on the suggestion of additional studies. Yesterday Dr. Blair suggested a study of farmers. He said, perhaps a massive study which would be long-term in nature, of 100,000 farmers.

I said to myself, Who? Who are we in American agriculture? What 100,000 farmers are we?

The question generates out of my concern for a regional and locally diverse agriculture. Clearly, American agriculture is a regionally diverse agriculture. We all understand that fact. Moreover, the context of any one particular region is based on farming systems and farming practices, which are locally diverse.

In fact, as I move to that and think about exposure to risk, farming practices and farming systems come back again to the forefront and cause me to reflect in a second way, by thinking about a reduction of exposure to risk. Certainly our rural neighbors knew 30 years ago that when one generation on the farm grew up severely asthmatic, they had to design and develop different ways to harvest and feed forage on our community dairy farms.

These are things at a community level which are very relevant; that young people and adults, in rural communities, who work and live on farms and tend to get exposed to more than one pesticide, to more than one type of animal confinement, to more than one risk must face a combination of occupationally and non-occupationally related risks.

Today, I think that we need to refocus on those efforts, and how we reduce risk in a meaningful way with respect to forage and grain handling, feeding systems, and milking systems. Why is it that some of us went to milking parlors as opposed to staying with our stall or stanchion barns? The examples, in the context of any regional production system and the diversity of local production strategies and production techniques, are all there.

ECONOMIC INCENTIVE

A third factor, one with which I was especially impressed this morning as I listened and reflected in the plenary session, is one of economic incentive. As we think about the very traditional models of prevention and assistance in agricultural health and safety, we historically depended on enforcement, education, and engineering. I am still convinced, even as I read the policy statements and voluntary equipment standards proposed in this country, that there must be economic in-

centives in order for agricultural producers to change practice and in order for them to be able to provide leadership for their workers to change practice.

ETHNIC AND CULTURAL DIVERSITY

The fourth area that I raise as a concern is the ethnic and cultural diversity of the prospective target population. This morning I listened as Dr. Pamela Elkind talked about the worker acceptance levels of yellow gloves versus black gloves.

I was saddened, as two of my fellow conference participants looked at each other in disbelief as to say, "This is silly," and I said to myself that it does not seem silly to me. On Saturday morning, while I am watching cartoons, I put on my yellow house work gloves and polish my shoes, because I do not want shoe polish all over my hands.

The issue of cultural sensitivity is relevant though. I do not wear those yellow gloves in front of anybody else.

I want to challenge you all about how it is that we can 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.

It seems to me that there are learning style differences, cultural sensitivities, a need for the reduction of cultural barriers, and need of a more comprehensive understanding of the referent values and attitudes for various cultural populations involved in American agriculture. Traditionally these groups have been, at best, slighted and, at worst, alienated. I am terrifically disappointed that with the exception of Bobbi Ryder and a few others who are here, very few migrant and seasonal workers or workers' representatives are present.

I am saddened that this meeting was scheduled on top of a national meeting which deals more specifically with the issues of migrant and seasonal labor. I want to challenge you all about how it is that we can 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. At a very philosophical level, in this great American experiment and interesting American fabric, we have a great opportunity.

Some would say that we are not up to this challenge, yet we, as Americans, have established so many new ideas and institutions in our desire to find better ways. I would point to the Land Grant system, which established that technical and scientific education was important for the whole populace, as opposed to only the wealthy or the gentry in this country.

I would point to the whole system of public school education, which has a fundamentally different meaning in this country than in others and, in the development of, and now our transition away from, the one-room schoolhouse. I say to myself and to you, let us not lose our perspective or sight of our opportunity for innovation in this area.

In fact, let me restate this challenge differently. Less than 50 percent of the participants in this meeting represent those issues concerning non-owner operators,

those who either are unpaid workers or who are paid what are clearly substandard wages and live in substandard conditions across the country, then we have done a less than adequate job in identifying the issues. There must be enfranchisement of all people in this country involved in agricultural production, or we will not have addressed the issues of agricultural health and safety in an adequate and meaningful way.

LESSONS FROM OTHER INTERVENTIONS

Fifth, I would say that there are lessons from other safety and health interventions, lessons which I did not hear referenced enough and which I am still curious about. These include seat belts, child restraints, helmets, and smoking laws.

Please do not misunderstand me. I am not an advocate of additional levels of regulation, but I do think that there needs to be a balance between research, regulation, surveillance, education and behavioral change, and improved service delivery. I strongly believe that there are models from the progress made in the areas of cigarette smoking, in helmet use, in seat belt use, and as was raised yesterday by Dr. Popendorf, in the process and sequence of industrial hygiene, and how science can be applied to American agriculture.

SURVEILLANCE SYSTEMS

Finally, and in closing, a sixth area that I would raise is that of surveillance systems. I continue to be very frustrated about our lack of a comprehensive and unified surveillance system. This is especially challenging for someone who is a relatively new entrant, as an individual, into the field of agricultural safety and health. I have been very frustrated while working with others to conceptualize systems that will eventually serve populations at the local level.

It is very clear to me that in a society that is losing its grasp on the availability of resources and on where we should put resources, we will have the opportunity to invest only in those programs and places where we know interventions are effective. Presently, we do not even have a system of baseline surveillance data that is uniformly agreed upon.

Even so, I hold out hope. I hold out hope for evolution in the NIOSH or other related programs as was mentioned yesterday, in the surveillance system that is being developed here in Iowa. I hold out hope for what others have done on a state-by-state basis, and for what more traditional safety organizations have done to document injury in agriculture in this country.

I am convinced that we have not achieved even the very basic goal of accurate injury and illness data yet. We need to continue to work towards this goal so that we can measure the eventual effectiveness of interventions.

Well, that brings me to the closure of my remarks. For me the priority is community intervention. Yesterday was a phenomenal experience for me to again listen as some of the health issues in agriculture were raised, issues which it is difficult to become familiar with, based on their chronic nature as opposed to their traumatic nature.

In sharing a closing thought, it seems to me that as a nation we are more con-

cerned than ever about the protection of the resource base upon which American agriculture is built. As evidenced by some of the speakers in this morning's plenary session, we have developed a greater concern for the issues of land and water management as reflected in agriculture.

These concerns cross all levels: local, state, regional, and national. As I reflect on the issues of sustainability, and I believe that this renewed importance on the wise use and protection of our resource base is important, I ask myself, can the challenge posed by the greater protection of all workers in American agriculture, and in the prevention of occupationally related injury and illness merit any less attention, as an issue for the sustainability of our great agricultural system? My answer, and hopefully, our common answer must be that the protection of human resources in agriculture is an area of critical importance.□

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A CLINICAL PERSPECTIVE

By Dean T. Stueland, M.D.
Medical Director, National Farm Medicine Center

I am going to come at this primarily from the point of view of a clinician and with that I would like to make two quick comments to Bobbi Ryder. One of the things about someone who spends first six days in Buffalo and then three days here in Des Moines is that she cannot be accused of exactly seeking the garden spots of the country.

The second thing is you have a sore throat and headaches. Why do you not take two aspirin? If you take good care of your cold, it will be over in seven days; if you do not, it will last a week.

I have three parts to my presentation. The first is some of the difficulties that I believe a clinician in practice experiences when trying to deal with the farming population and, specifically, some issues that were discussed yesterday. Second, I want to look at some of the specific things that were in each of the presentations. Third, I want to make some short recommendations.

DIFFICULTIES IN CLINICAL PRACTICE

As a physician, one of the real issues clearly is what I would call a cultural gap between the clinicians and most of their clients, or patients in this case. We often have to learn, so to speak, a language that is different from what we would ordinarily speak.

As an example, I can even report—and it is nice of Kelley to speak as well as he did of the Marshfield Center—but I can give a report of my own colleagues having some difficulty in confusing silo gas exposure—that is, nitrogen dioxide—from organic toxic dust syndrome or hypersensitivity pneumonitis. The point, of course, as was pointed out well yesterday, is they occur at two completely different times.

They both can occur in silos. They have different settings. Prognostically they are worlds apart. But, in point of fact, when a physician sees someone short of breath who has just been in a silo, he says, "Well, I suspect this is silo gas exposure," when, of course, especially if it is in the spring, it is not.

The same thing might go on when we get to talk about more specific exposures. I know one of the things that we think we should do is encourage patients, that is the farmers in this case, to know the exposures that they have endured and be able to speak to them with some intelligence, and I think that is very good.

On the other hand, I can tell you as a practicing clinician, everybody has all kinds of strange exposures which they believe they have incurred, and it is often difficult to sort out fact and fancy. Although these are worthwhile recommendations, it just is not as easy as it may seem.

Another thing we often talk about is the age of machinery and its poor repair. But we need to recognize that change in farming practices actually occurs quite rapidly and so those of us who left the farm at say 18 or 20 have to recognize that things are being done significantly differently now than they were then.

This is especially true if we deal with the issue of chemicals. I think if you look at, for example, the information on the back of a pesticide bag and so on, it is all there. It strikes me about as useless as a PDR and nobody gives you any idea what is important and what is unimportant; the information is basically confusing.

Finally, I want to point out that I think there is some sort of a feeling that farmer and farm groups are in some sense not particularly cooperative. I think we all recognize they want to work and want to get back to work.

There is always a tendency in any society to blame the victim, and that is clearly the case here as well—and especially, as we've pointed out already, certain sub-groups are especially difficult in the sense of not being able to communicate to us well. For example, migrant families have already been spoken of, and likewise certain secluded groups that tend to be in agriculture.

Locally we have such groups as Amish; obviously they speak English with us. For example, as was pointed out in Dr. Currier's discussion, they may not have the simple vaccinations that we expect most people to have had.

Second, I want to speak about difficulties, for the physician, in some of the diagnostic methods. When you go through, for example, some infectious disease, you will see references to serologic methods.

Serologic studies are very good in telling you what has transformed from previously negative to positive and they give you some indication of what is occurring in the population, but in terms of a specific patient, you usually only get a diagnosis after the fact. So if we can develop diagnostic studies that are more specific to disease, we certainly can aid the clinician a great deal.

In that regard, I would like to comment on the issue of pesticides and viruses and the relationship to cancers that are well recognized. There is probably not a great deal of difference from a clinician's point of view as to the etiology of the cancer, unless we know something about preclinical diagnosis or screening methods and can make recommendations in that regard.

Clearly, recommendations with regard to screening at least certain populations have been fairly effective. If we can make those sorts of recommendations—that is, who should be screened, how often, and by what method, or if there are some preclinical diagnostic methods, who is at risk—I think we have come a long way.

As I have said, the diagnosis of the cancer probably is not a particularly difficult issue for the clinician, as treatment protocols are well publicized. The issue of preclinical diagnosis remains an issue which may have social as well as medical implications.

Third, I think you have to recognize that most practicing clinicians do not have a great deal of public health or preventive medicine orientation. We are taught, and I probably more than most as I practice primarily emergency medicine, how to deal

with things on an acute basis. We have a very strong fix in terms of how to treat and the need to treat. That is a real problem.

It is relevant, for example, if you look at such things as control of hypertension or control of cholesterol. Here you have a number and an intervention that you can follow.

It fits very well into the treatment model because you can pick a disease by definition, have an effective treatment, and perhaps alter the patient's risk. But for most of these things that we are talking about, that is not true.

The issues then with regard to prevention and exposure are sometimes dissatisfying to both the physician and the patient who find that there is no delivery of what they consider to be health care even though treatment may be very effective.

In that regard, I would just like to say a couple of words about surveillance. I think that many times it is useful to have clinical cooperation with surveillance methods. I want to just suggest that there are three things that one needs to recognize in terms of deriving cooperation from physicians in surveillance methods.

▸ First, we clinicians are very good at saying we are busy. Believe it! If you do not believe it, just ask our families. So, you have got to come on—even if it isn't true—and say, "I understand you are busy."

▸ Second, it is looked at as an intrusion. Since there is a perception that there is already too much intrusion, you need to make the point that that is not the intent.

▸ Third, if you point out that this is likely to be useful, then it is going to go a long way. Of course, in point of fact, I think most clinicians are very interested in providing very good useful information to help prevent problems. I think most clinicians are found to be fairly cooperative.

▸ Fourth is the issue of knowledge base. It is important to remember that when we talk about medical practice, we emphasize the word "practice." Over a period of time one develops a skill of being able to recognize and do certain things particularly well and other things less well.

Even with a well-developed left brain, there is only a certain amount of information that can stay anywhere near the forefront. Even in a rural practice, the agricultural illnesses are going to be only a small portion of the overall practice. So something needs to be done to keep that information in the forefront.

We had here yesterday four very good experts who spoke very well, and very clearly, and very lucidly to the issues that were raised. But for a particular physician in a typical family practice, these are all going to be blurred together and have to be dealt with simultaneously. There need to be some ways to get this information to the clinician in ways that are more palatable.

One of the things people talk a great deal about are data and information banks. I have not particularly observed that my colleagues are very quick in researching those for care of a specific patient.

As an example, I just want to talk briefly about the issue of cellulitis related to needle sticks or puncture wounds, which may occur in barns or areas where antibiotics are used frequently. There are

several people who will speak to the observation that the bacteria that are contaminating those wounds, when they develop infection, are multiply resistant—much different from the usual bacteria that clinicians have been told to expect in a skin infection. As far as I can see, we do not yet have a science to predict what those bacteria are going to be nor what antibiotics should be given to treat such an infection.

Finally, in terms of problems, it makes no sense to speak to the issue of agricultural problems in medical practice without speaking to the issue of the whole rural health care delivery problem, itself. Clearly, at the present time, the infrastructure is being challenged in many ways.

As was alluded to yesterday, rural hospitals are being significantly threatened. Someone suggested that 25 percent are in difficult straits. That is after 10 percent have already left the practice. Although we understand the need to reformat and downsize, I think it is also important to remember that at the present time, and I want to emphasize "the present time," hospitals are usually the key to the medical community. Hospitals do not necessarily have to be the basis for a rural medical community, but that does mean we are going to talk about a different model.

The rural health practitioner generally feels that he has a lack of support, that he has difficulty probably with his professional life and education, and that the working poor are a particularly difficult problem in terms of finances. Rural populations in general have more than their share of working poor, as has already been pointed out in this session. Agricultural groups probably have even a higher representation.

ISSUES RAISED IN THE PRESENTATIONS

Next, I would like to speak to specific issues that I think were raised in each of the four talks, and hope here I will be a bit more provocative.

The first difficulty is talking about the differentiation between hypersensitivity pneumonitis and toxic organic dust syndrome. The differential diagnosis is clearly important prognostically and perhaps even clinically, but it is actually, I think, much more difficult than it appears. If one knows a specific allergen that is expected in a specific region, then a very useful test, of course, is the presence or absence of that precipitant. At least that tells you whether that specific patient is at risk.

On the other hand, the differentiations based on a chest x-ray, which I think many times can be clinically quite subtle, or arterial blood gases which usually are borderline, can be very difficult. So, when you are trying to tell the patient whether this is an important exposure or not, whether the prognosis is difficult or not, I find is not as easy as it would appear. I guess I would appreciate it if Dr. Von Essen could speak to that a little bit at the end.

There is also an issue of acute and chronic bronchitis. Although we recognize that such things as buildings, particularly confinement buildings, are a risk, it is unclear to me what difference that makes in terms of clinical practice except from prevention. I am unsure if you know of specific antibiotics or specific treatment or prevention protocols that would apply in a particular exposure.

Finally, I agree with the point that there seems to be a relationship between organic toxic dust syndrome and asthma; at least many people seem to feel that is true from an empirical or episodic point-of-view, but I am not sure if there is exactly science or statistics to support that, and I am not sure if that is a clinically relevant issue or not.

Next I want to speak to some of the infectious disease issues. First, I want to commend Dr. Currier for stressing the problem of the migrant farmworker who has the whole family at risk because of living conditions.

I might point out that it would be unwise to speak of sexually transmitted disease as occupational exposure. But that does stress the importance of recognizing the whole family and the environment as part of the agricultural business. The risks are not just that of work but also of the living environment. This, of course, applies in a large measure to the non-migrant farmer as well.

I believe food-borne illnesses are primarily an issue in the rural environment in general. I think it is an increasing problem, and I am not sure if you have specific suggestions in that regard or not. Clearly one issue is knowledge. For example, the physician assistant with whom I work can regularly diagnose giardiasis because we see it so frequently. Again, it is not necessarily an agricultural problem; it seems to be rural in general.

I also appreciate the emphasis on populations at risk, especially the elderly and the children. I want to emphasize with regard to the infectious diseases that the new practices lead to new problems, or sometimes resurfacing of old problems. It is good to keep before the clinician how things are changing in agricultural practice, because it is going to change in their practice as well.

Next, I want to discuss pesticides. It is probably appropriate that the discussion of acute pesticide exposure was largely ignored because it is probably better recognized in practice anyway. At any rate, it is actually, from a statistical point of view, not a big part of anyone's particular practice; I am not making any points about that.

With regards to chronic effects, I would like to ask for more information. First is in regard to neurologic symptoms. It seems to me that in a clinical practice, one hears this issue asked about a great deal, not only by the agricultural worker or family but the people across the fence from them.

Please remember, that even in the most rural of communities, close to half of the people are just rural dwellers and not agricultural farmers or workers. Neurologic symptoms tend to be vague. They tend to be similar, whatever the cause. There seem to be ineffective interventions, and the prognosis seems to be very difficult to ascertain. So any further information that we can get in that regard, and especially good diagnostic studies, I think would be very helpful.

With regard to cancer, I concur with by Dr. Blair, also alluded to earlier, that the farmer may well be the "canary" or the test animal for cancer in our society. We are seeing an increase in many cancers, and so this is very relevant information.

I think the idea of synergism between chemicals is basically a given. For example, there is the farming practice of

applying two herbicides for a specific weed where it is recognized that plants are developing resistance. If they need to use synergism against the pests, I suspect that synergism applies to the unfortunate victims as well.

Finally, looking at the issue of gases and vapors, one of the difficulties that I have as a clinician is obtaining good, adequate measurements. That is not necessarily because of the fact that there are not good industrial hygiene methods, but we have to appeal to people like those in Iowa to turn out these people much more quickly and with an agricultural background. Clearly we need that kind of consultation.

> 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.

A specific problem is the allergic responses to some of these substances such as pesticides, antibiotics, or whatever chemical you wish. Both farmers and clinicians need to recognize that many of these are sensitizers, so the chemical that has not been a problem in the past may become one in the future; at least clinically that appears to be the case. Otherwise, the farmer and clinician tend to dismiss the idea that a particular chemical may be the problem.

Second, I want to speak to the issue of antibiotics again. My bias is that a big part of the problem with feeding antibiotics to animals is not residual antibiotics in the animal, but the change of the local environment in which the animal is present. Perhaps these antibiotics may be an allergen, especially for the farmer, and not necessarily for the person ingesting the food.

I think it is good that Dr. Popendorf pointed out that the manure gas is, for example, something that needs to be understood much better by clinicians. For example, the case in the Upper Peninsula of Michigan to which Mr. Graham referred was reported in some sources as methane poisoning. Although methane was undoubtedly present, I agree with Dr. Popendorf that the most likely agent was hydrogen sulfide.

The relevance is in emergency medical practice. Hydrogen sulfide, if you are going to treat it, should be treated with the nitrates in the cyanide kit; whereas if you are dealing with methane, it is primarily an issue of oxygenation and ventilation, which does not necessarily need specific treatment.

RECOMMENDATIONS

Finally, I would like to close with just five recommendations.

1. We need to work to help the clinician and, therefore, the farmer on specific diagnostic methods and treatment methods for agricultural problems. If there are specific treatments that should be different for different types of agricultural exposure, we need to know those.

2. We need to look much better at the issue of promulgation of this information as reference works. 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. Because of the distance typically between

the clinician and the farmer, that will not happen without specific efforts.

3. We need to increase the status of such entities as state and local health departments and industrial hygiene and provide adequate resources for them to respond to the clinical needs of farmers.

4. We need to deal with the issue of the rural medical infrastructure in general. If the rural medical infrastructure is in difficulty, then these agricultural health problems cannot be addressed well.

5. One of the things that I find personally important—and I think many of my colleagues would agree—is the positive aspects of medical practice in the rural, and especially agricultural, communities. The patients generally are very appreciative of the care they get. They are very willing to go into rehabilitation. In fact, most clinicians complain that rural patients want to go back to work before they are well.□