

Pesticides Health & Safety



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Introduction

Pesticides have been part of the advance of the human condition since prehistory; however, following the Second World War and the mass commercial production of nitrogen, first as an explosive and then as an inexpensive fertilizer, the relationship between people, pesticides and the environment changed.

With the mass production of fewer, better nurtured, commercial plant types particularly corn and soybeans, rapidly evolving weeds, fungus and mold, and especially insects created special threats to food production. It became both necessary and easier for farmers to apply both fertilizer with synthetically enhanced nitrogen and phosphorus and, sometimes simultaneously, pesticides. Special concerns emerged among public health professionals regarding consequent human ingestion of new and more frequently used pesticides. As an example of the widespread impact many of the nation's underground aquifers begin to test out with consistent background levels of certain pesticides.

There was a call for regulatory controls, such as the food and drug controls which are overseen by established federal agencies. This background level of toxins for pests is a concern to both the government and private health groups. The Environmental Resource Council received funding from several organizations including the EPA, and especially in the Bush Foundation, to try establishing control guidelines for applicators. Direction for physicians also became part of our program and we worked in conjunction with the Minnesota Medical Association to provide pesticide information and guidelines for physicians who are likely to interact with pesticide exposures.

There are three important considerations that dominate how a responsible professional approaches pesticides, whether from a perspective of medicine or application. First, there are rules and limitations to those rules regarding the commercial release of certain pesticides which must be followed. Labeling is important but unlike medical or human food labeling it follows separate rules which can confuse the public and professionals.

Secondly, the production and distribution of pesticides can, and must, move quickly in response to changes in weather and regional or genetic migration of the pests themselves. Given fewer crop types and more of them, this genetic migration or "characteristic drift" can move fast. Pesticide use often needs to move fast to safeguard streams of food and fiber.

Thirdly, the use of pesticides is necessary to secure our food and fiber system.

There have been a number of efforts to limit the use of or to work around pesticides, many of which have been unquestionably successful; however, for much of the world, affordable food is dependent on responsible application of pesticides in conjunction with newer techniques in food production.

ERC appreciates the great support we've had from the National Association of State Directors of Agricultural Departments and especially the Agricultural Extension Services in Maryland, North Dakota, and Minnesota.

What follows are a number of brochures and handouts for applicators that can be reproduced and distributed copyright free. We have worked directly with over 1,000 professional applicators and are convinced that this information will accommodate the working style of the professional applicator. They will also guide the individual working with pesticides for personal use.

We also are providing a guideline for physicians that evolved out of a training program on the toxicity of pesticides for physicians and other health professionals that we developed in conjunction with the Minnesota Medical Association. This document also can be reproduced by permission through contacting the award-winning medical publication, Minnesota Medicine (MMA@mnmed.org).

Finally, we are attaching a short video program on pesticides designed with support from the Bush Foundation which provides a review of working with pesticides in the 21st Century. This video may also be used or reproduced free of copyright.

A scenic landscape with rolling hills, a wooden fence, and a path leading into the distance under a cloudy sky. The foreground shows a wooden fence and a path leading into the distance. The middle ground features rolling hills with patches of green and brown vegetation. The background shows a line of trees and a cloudy sky.

I. Best Practices Document for Professional Applicators

**There's one simple rule
for handling pesticides.**



Use best practices every time.



A

American agriculture and forestry are businesses unlike any other. More than businesses, they are ways of life – networks of families and

friends and communities that not only help one another, but also help feed and house the world.

Yet, for all the good American agriculture and forestry do, they are not without their share of risks – including pesticide handling and application. For example, there are new concerns these days – concerns about the relationship between exposure to pesticides and long-term (chronic) health problems – concerns we need to address now and will need to continue to address for generations to come.

The situation in a nutshell.

Properly handled and applied, pesticides increase yields. They have become essential in mainstream agriculture.

But a growing body of research seems to indicate that applicators who don't use common sense and who don't follow all the precautions may be putting themselves, their families, their neighbors and their communities at greater risk for developing long term health problems, including asthma, cancer, organ damage, chemical hypersensitivity and birth defects.

This brochure lays out the facts and the generally accepted thinking about pesticides. We've written it to be as unbiased and fact-based as possible; to give you the information you

need if you are going to apply a commonsense "Best Practices. Every Time." approach to pesticide application. The goal is to help you make the job as safe as possible, whether you handle and apply pesticides, have a family member who does, or live in an area where people routinely apply pesticides.

Responsible vs. Irresponsible

As a rule, everyone, from pesticide manufacturers to government agencies, health care professionals, applicators' families and friends, and applicators themselves, works hard to make sure pesticides are handled and used responsibly. There are mandatory information classes and licensing tests. There are highly detailed labels and strict government regulations.

But all too often human nature and a variety of other factors can lead to less-than-best practices.

Maybe an applicator who is usually responsible cuts a corner and skips wearing his protective gear because it's too hot, or to save a little time. Or maybe he makes an exception ("just this once") and sprays when the wind speed is above the mandated

Our goals:
Promote "Best Practices."
Reduce potential for long term health problems.



safety level. As busy as farmers and applicators are these days, cutting a corner now and then can seem innocent enough.

There are also applicators who deliberately and consistently cut corners. They don't bother to wear protective gear. They wash pesticide contaminated clothes with the family laundry. They don't follow label instructions, misapply pesticides and/or fail to dispose of them properly.



Over time, cutting corners means increased exposure for the applicator, his family, neighbors, and his greater community.

Intentionally or “just this once,” cutting corners increases exposure over time for the applicator, for his family, neighbors and his greater community. And research seems to link that

increased exposure to increased risk of long term health problems.

Cutting corners and long term health problems.

The possible link.

While some parties contend that “the jury is still out,” a growing body of evidence and research seems to indicate that, over time, there's a link between preventable exposures and long term health issues, including asthma, cancer, organ damage, chemical hypersensitivity and birth defects.

It's hard to “bolt down” the science because long term exposure levels can vary, and different people have different genetic reactions to pesticides. So, it's difficult to say if – or when - any one individual will get sick. Still, research indicates that applicators who don't handle and apply pesticides as prescribed seem to be at greater risk of long term disease.

Expanding communities mean a growing responsibility.

“Rural” is not as rural as it used to be. As cities sprawl into what were rural communities, people who use pesticides face new restrictions, regulations, and responsibilities as do the people who live and work nearby.

Now more than ever, applicators are required by law to handle pesticides responsibly. And neighbors who witness mishandling or misapplication are more and more often alerting authorities. It's a simple trend.

It's common sense: Use Best Practices. Every Time.

Deciding how to work with pesticides is a complex problem, one with roots in agribusiness, ecology, human nature and public health. But with the help of all interested parties – pesticide manufacturers, government agencies, health care professionals, applicators, foresters and farmers and their families, neighbors and communities – we will implement programs and solutions that help foster a commonsense, “Best Practices. Every Time.” mindset. We'll start to eliminate preventable exposures.

An important first step is to simply talk about the problem. Encourage applicators to follow best practice procedures every time they handle or apply pesticides.

Remind them that they have families, friends and communities to protect.

Help them to remember that the precautions that protect an applicator from spills and accidental

exposure might also protect them from long term illnesses.

Tell them that following existing application regulations and guidelines can limit exposure, not just for them, but also for their families, neighbors and communities.

Remember – there's one simple rule to follow: Use best practices. Every time.

Using best practices can't assure you'll avoid pesticide-related long term health problems. But they can help reduce preventable exposures. And research seems to indicate that even low level exposures can lead to long term health problems.



Seven generally-accepted Best Practices

Using best practices cannot assure any individual that he or she will avoid pesticide related long term health problems. But using best practices is a commonsense way to reduce the incidence of preventable exposure, and a growing body of research seems to link these preventable exposures to long term health problems.

1. Read and follow labels - and still be cautious. Take them seriously. The information, requirements and directions provided are there for your safety, as well as the safety of your family and your community. Even after following all directions, treat pesticides with special caution.

2. Use protective clothing and equipment - always. Prevent exposures to skin, lungs, eyes and mouth. This usually involves protective clothing and sometimes respirators, goggles or other gear.

3. Prepare for the unexpected. Whenever you apply pesticides, anticipate potential problems, think in terms of both first aid and unnecessary low level exposures. Remember - research seems to indicate that even minimal occupational exposures and accidents may cause long-term health problems, so consider low dose exposure concerns for applicators and others in any change in operations.

4. Avoid any possible ingestion. Never eat, drink or use tobacco products when you are mixing, loading or applying pesticides. Hand to mouth contact is a common source of low dose exposures to the applicator and others.

5. Wash equipment frequently and clothing separately. Most pesticides products are designed to dissolve with water and a good washing with soap makes special sense. Remember to separate application equipment from other gear when you are finished applying. Never batch pesticide contaminated clothing with your family's clothing for washing. Clean up far away from other people and living areas, and watch where you and pets may track pesticides.

6. Control waste streams and especially avoid exposing children and pregnant women. Control the way you get rid of and store unused pesticides. Follow recommended disposal and storage procedures. Don't contaminate by disposing pesticides via uncontrolled waste streams or unsound storage areas. Focus on keeping any exposure away from children or pregnant women. Children and fetuses are vulnerable to lower doses than adults.

7. Expect tougher enforcement. Neighbors and others have already begun reporting applicators who are not controlling their waste streams and pesticide application procedures. We have more and more people living close to, and recreating near, farming and forestry operations. Those who do not follow best practices not only endanger others, but undermine your professional reputations.



Materials made possible
in part through a grant
from the Bush Foundation.



A scenic landscape featuring rolling hills and a field of crops. In the foreground, a wooden fence runs across the frame, with a gate partially open. The field is divided into sections of green and brown, suggesting different stages of crop growth or harvest. The background shows more hills under a sky with scattered white clouds.

II. Best Practices Brochure For All Applicators



**There's one simple rule
for handling pesticides.
Use best practices
every time.**

American agriculture is a great way of life – a network of families and friends and communities that help one another, and help feed the world. But there are new concerns these days about the relationship between exposure to pesticides and long-term (chronic) health problems – concerns we need to address now and will need to continue to address for generations to come.

The situation in a nutshell.

There's no doubt that pesticides increase yields. They have become essential in mainstream agriculture.

But more and more research seems to indicate that applicators who don't follow all the precautions may be putting themselves, their families, neighbors and communities at greater risk for developing long term health problems - including cancer, organ damage, chemical hypersensitivity and birth defects.

Clearly, it's time for a "Best Practices. Every Time." approach to pesticide application. The goal is to make the job as safe as possible whether you handle and apply pesticides, have a family member who does, or live in an area where people routinely apply pesticides.

Responsible vs. Irresponsible

Everyone knows pesticides should be handled and used responsibly. That's why there are mandatory information classes and licensing tests, and highly detailed labels and strict government regulations.

But human nature can lead to less-than-best practices.

Maybe an applicator cuts a corner and skips wearing his protective gear to save time or because it's too hot. Or maybe he sprays when the wind speed is above the mandated level. It can seem innocent enough.

Or maybe he washed pesticide contaminated clothes with the family laundry. Or doesn't follow label instructions. Or misapplies a pesticide and/or fails to store dispose of it properly.

Cutting corners increases exposure over time for the applicator, his family, his neighbors and his community. And research seems to link that increased exposure to increased risk of long term health problems.

Long term health problems.

A growing body of research appears to indicate that, over time, there's a link between preventable exposure and long term health issues, including cancer, organ damage, chemical hypersensitivity, asthma and birth defects.

Because long term exposure levels can vary, and different people have different immune reactions, it's difficult to say if – or when - any one individual will get sick. Still research seems to indicate that applicators who don't handle and apply pesticides as prescribed put themselves and people around them at greater risk of long term health issues.

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Expanding communities mean a growing responsibility.

As cities and rural communities expand, pesticide applicators face new restrictions, regulations, and responsibilities. So do people who live and work nearby.

Now more than ever, applicators are required by law to handle pesticides responsibly. And those who witness mishandling or misapplication are alerting authorities.

It's common sense: Use Best Practices. Every Time.

It's a complex problem, but with the help of all interested parties we can begin to implement programs and solutions and foster a common sense, "Best Practices. Every Time." mindset.

We can talk about the problem and encourage applicators to follow best practice procedures every time. We can remind them that they have families, friends, and communities to protect.

The same precautions that protect them from spills and accidental exposure just might protect them from long term illnesses. And following existing application regulations and guidelines can limit exposure for them and for everyone around them.

Seven Generally-Accepted Best Practices for applicators

1. Read and follow labels - and still be cautious. Take them seriously. The information, requirements and directions provided are there for your safety, as well as the safety of your family and your community. Even after following all directions, treat pesticides with special caution..

2. Use protective clothing and equipment - always. Prevent exposures to skin, lungs, eyes and mouth. This usually involves protective clothing and sometimes respirators, goggles or other gear.

3. Prepare for the unexpected. Whenever you apply pesticides, anticipate potential problems, think in terms of both first aid and unnecessary low level exposures. Remember - research seems to indicate that even minimal occupational exposures and accidents may cause long-term health problems, so consider low dose exposure concerns for applicators and others in any change in operations.

4. Avoid any possible ingestion. Never eat, drink or use tobacco products when you are mixing, loading or applying pesticides. (Hand to mouth contact is a common source of exposure.)

5. Wash equipment frequently and clothing separately. Most pesticides products are designed to dissolve with water and a good washing with soap makes special sense. Remember to separate application equipment from

other gear when you are finished applying. Never batch pesticide contaminated clothing with your family's clothing for washing. Clean up far away from other people and living areas, and watch where you and pets may track pesticides.

6. Control waste streams and especially avoid exposing children and pregnant women. Control the way you get rid of and store unused pesticides. Follow recommended disposal and storage procedures. Don't contaminate by disposing pesticides via uncontrolled waste streams or unsound storage areas. Focus on keeping any exposure away from children or pregnant women. Children and fetuses are vulnerable to lower doses than adults.

7. Expect tougher enforcement. Neighbors and others have already begun reporting applicators who are not controlling their waste streams and pesticide application procedures. We have more and more people living close to, and recreating near, farming and forestry operations. Those who do not follow best practices not only endanger others, but undermine your professional reputations.



Materials made possible in part through a grant from the Bush Foundation.





III. Pesticides and Long-Term Disease

Successful agriculture, including the responsible use of pesticides, is one of the fundamental components of a healthy population. The safeguards and cautions typically employed to keep pesticide applicators and others separated from preventable high exposures are designed primarily to preclude emergency (acute) health problems. From a health perspective, they accomplish that important task. However, as science and public health have advanced, it has become clear that applicators need to also understand that these safeguards can be effective in minimizing the potential for long-term diseases such as cancer, organ damage, chemical hypersensitivity, asthma, and birth defects. These categories of disease and conditions can potentially result from lower exposures to chemicals than those associated with acute effects, but the same concept of best practices and hygiene promoted through labeling and application guidelines may also minimize possible long-term health concerns.

Pesticides & Long-Term Disease

Causes of “Long-Term” Disease

Nearly every adult knows or has been close to someone affected by a long-term disease, such as cancer. Another profound and lasting toxic outcome is birth defects. While the effects of these diseases and conditions are obvious, their possible relationship to chemical exposure is insufficiently understood, and often misunderstood. This is because health effects sometimes take

years or even decades to manifest, or because some individuals' physiologies are more susceptible to harm, or because we simply don't know what combination of different chemical exposures or lifestyles leads to what level of risk. Regarding long-term disease, where harm is not immediately detected, “better safe than sorry” is the best rule.

Traditional Concerns Regarding Pesticides & Health

Traditionally, concerns about potential human effects from pesticide exposure fall into 2 categories: (1) Acute effects, i.e. injuries from accidents, resulting in unanticipated heavy exposure with immediate consequences (burns, eye damage, rashes, poisoning), where the cause and effect relationship is self-evident. This category is often addressed through government directed labeling, warnings, and training. (2) Effects from ingestion through food or water, where trace doses typically cause exposures so small that health consequences are either nonexistent or beyond our ability to measure. Food and water issues are closely monitored by government agencies, and great

effort is made to assure that pesticide levels ingested through food or potable water are extremely small.

A third category of risk, which is an emerging, important and difficult to quantify area of agricultural science and public health, is long-term effects and/or other non-acute adverse effects, such as allergic and sensitivity reactions, cancer, or birth defects, which may result from consistent, mid-level pesticide exposure over longer periods of time, or a higher, but not necessarily acutely toxic, level of exposure.

Pesticide Exposure and Long-Term Disease

Realistic public health concern regarding long-term disease related to pesticides properly focuses on exposures many times greater than one would expect to find in food or water, yet, many times less than would be expected to cause an immediate, acute health reaction. Our concern is based on observation and research, which has

grown in volume in recent years, associating pesticide exposures with certain cancers or birth defects. These findings are often challenged and impossible to prove definitively, but increasingly, indicators of the connection make it imperative to provide carefully measured warnings and promote cautions to at-risk populations.

Research has shown that applicators who use cautious procedures appear to have less body burdens of pesticides, their constituents and metabolites. One would assume, then, that they would have fewer instances of long-term disease if, in fact, there is a connection. Dose-response relationships between exposure level and effect are generally considered much stronger evidence of a true effect. Several recent studies do seem to indicate a dose-response relationship for some effects. In these studies, applicators who used certain pesticides for a longer period of time (usually measured in years), and/or who may have had higher levels of exposure by virtue of wearing less protective gear,

appear to have higher risk of certain cancers or other long-term effects. Because genetics are thought to play an important role in the development of cancers, birth defects, and other long-term outcomes, the relationship between level of exposure and the subsequent emergence of adverse effects is not a simple one to determine. Nevertheless, while little is understood about this relationship, experts in medicine, toxicology, and agricultural science agree that the same safeguards used to prevent acute harmful exposures need to be diligently employed to minimize non-acute diseases that may also evolve out of preventable exposures.

Prevention

As we have learned more about cancer, birth defects and other long-term diseases or debilitating conditions, it has become clear that exposures to toxic compounds that one cannot immediately detect can potentially cause harm over time. There is consensus and documentation that those who do not use appropriate personal protection, do not control waste streams, pay poor attention to proper safeguards, and do not use proper application methods are at

higher risk of long-term negative consequences. There are indications that applicators' family members who are exposed, presumably through improper handling, also may have a higher level of risk. Based on the nature of many long-term diseases, those generally considered to be more at risk are fetuses, young children, persons with preexisting health problems and/or compromised immune systems, and those with consistent, long-term exposures.

Evolving Health Considerations for Applicators

The principal challenge in addressing a possible relationship between long-term health problems and preventable pesticide exposures is determining the most responsible way to deal with the issue in the face of inherent ambiguity. Because the consequences of these diseases comprise an understandably emotional issue among the public and policy-makers, a necessary balance must be struck between describing a measured

concern and sounding a premature alarm. As research evolves, changes in guidelines for application procedures and personal protection will also evolve. Changes in suggested safeguards, the compounds used and application methods recommended by the pesticide manufacturers, themselves, have almost certainly reduced exposures and made protection easier to achieve. To the extent labeling provides an unjustified

sense of security regarding lower but preventable exposure levels and possible long-term diseases or negative conditions as a consequence, is problematic. Understanding the relationship between labeling and long-term exposures is important. The inherent

costs in terms of time and resources to assure reduced acute exposures should now take into consideration the possible consequences of long-term exposures.

Changes in Approach to Responsibility by Applicators

Enhanced Concern for Following Best Practices

In nearly all situations, safeguards regarding hygiene, personal protection, disposal and application to preclude immediate, acute harm are identical to those that would presumably serve to protect applicators and their families from possible long-term disease. Separation of humans from heavy pesticide exposures through prevention is key, motivated by an understanding that,

although immediate harm is not observed, the possibility of long-term health risk may still exist. Applicators need to appreciate that even pesticides bearing the CAUTION label—reserved for pesticides with the lowest risk of acute effects—might, if exposure is not minimized, cause long-term effects.

Be Sensitive to a More Demanding Community

Particularly as residential and commercial development encroaches upon agricultural and forested areas, applicators must accept that community members and regulators will hold those who apply pesticides to higher and higher stan-

dards. The 21st Century pesticide applicator will have to work to those higher standards or face regulatory, civil, or even criminal justice consequences, beyond potentially harming themselves, their families, and their neighbors.

Be an Active Part of Safeguarding the Public Health

Professional applicators must see themselves as part of the continuum of health care, having under their control the capacity to prevent immediate harm to

themselves, their families, their customers, and the general public, and possibly to reduce the incidence of long-term disease in these communities.

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Pesticides & Health

Protecting applicators,
their families & communities
from long-term disease



Successful agriculture, including the responsible use of pesticides, is one of the fundamental components of a healthy population. The safeguards and cautions typically employed to keep pesticide applicators and others separated from preventable high exposures are designed primarily to preclude emergency (acute) health problems. From a health perspective, these precautions effectively accomplish that important task. It is an added benefit that these safeguards are also likely to minimize the potential for chronic diseases and conditions such as cancer, organ damage, chemical hypersensitivity, asthma, and birth defects. Even though scientific research does not clearly provide direct proof of a cause-and-effect relationship between specific pesticides and particular chronic diseases, it is now thought by experts in agriculture and health that some chronic conditions do result from low level exposures to chemicals such as pesticides. This is especially true with consistent exposure over time. Fortunately, the same best practices and hygienic precautions to prevent acute injury from pesticides achieved through labeling and safe application guidelines along with conscientious environmental controls such as restricting children and pets from areas even after application may also minimize possible long-term adverse health effects.

Pesticides & Long-Term Disease

The Causes of Chronic Disease

Nearly every adult knows or has been close to someone affected by a long-term disease, such as cancer. Scientific research has accumulated evidence to show that certain chemical agents cause birth defects or cancers. There is evidence that certain pesticides may be associated with a higher risk of birth defects. Some studies even suggest that some cancers may be associated with heavy pesticide exposure. Research along these lines is difficult because health effects to pesticides and other chemicals sometimes take years or even decades to manifest, if at all.

While the effects of these diseases and conditions are obvious, their possible relationship to chemical exposure is insufficiently understood, and often misunderstood. Uncertainty results from the fact that some individuals are more susceptible to harm than others. We simply do not know definitively what combination of different chemical exposures, personal characteristics, and lifestyles lead to what levels of risk of chronic diseases. Regarding chronic disease and substances for which harm is not immediately detected, the best rule is “better safe than sorry.”

Concerns Regarding Pesticides & Health

The traditional views about potential human effects from pesticide exposure falls into two categories: 1) Acute effects from unintentional heavy exposures causing immediate adverse health consequences such as burns, eye damage, rashes and poisoning. The cause-and-effect relationship between the pesticide and the damage to health is self evident. Preventing this category of health consequences is addressed through government-directed labeling, warning and training. 2) Possible adverse effects from the long-term ingestion of trace pesticides in food or water. These minute doses cause exposures so small that health consequences are either nonexistent

or beyond our ability to detect. Food and water safety is closely monitored by governmental agencies to assure that pesticides ingested in food and water are extremely small.

A third category of possible health risks associated with pesticides is an emerging, important unified field of agricultural science and public health that focus on such conditions as allergic reactions, hyper-sensitivity conditions, cancers and birth defects. Associations between these conditions and pesticides are increasingly thought to result from consistent, mid-level pesticide ingestion over long periods of time or at higher, but not necessarily acutely toxic doses.

Pesticide Exposure & Chronic Disease

Realistic public health research regarding chronic disease associated with pesticides properly focuses on exposures many times greater than one would expect to find in food or water, yet, many times less than would be expected to cause an immediate, acute adverse

health reaction. The findings of such studies on relationships between pesticides and chronic diseases are often challenged on methodological grounds and are extremely difficult to provide definitive cause-and-effect relationships. Yet indicators of such connections

increasingly make it imperative that leaders in public health and agricultural policy provide carefully measured warnings about the safe use of pesticides and the realistic cautions to be followed by people exposed to them.

Research has shown that applicators who use cautious procedures that decrease the amount and the duration of direct exposure appear to have less body burden of pesticides and their metabolites. One would conclude then that they might have less risk of chronic disease if, in fact, there are connections.

Dose-response relationships between exposure level of a substance and the emergence of a particular effect are generally considered strong evidence of a cause-and-effect relationship. Recent research does seem to indicate a dose-response relationship between pesticide

exposure and some chronic diseases. In these studies, applicators who used certain pesticides for a longer period of time (usually measured in years), and who may have had higher levels of exposure by virtue of wearing less protective gear, appear to have higher risk of certain cancers, birth defects in their children, asthma, and other long-term outcomes. Of course, the relationship between levels of exposure and the subsequent emergence of adverse effects is complex. Nevertheless, while much remains to be learned about these relationships, experts in medicine, toxicology and agricultural science agree that the same safeguards used to prevent acute, harmful exposures need to be employed diligently to minimize chronic diseases that may quite likely evolve out of preventable pesticide exposures.

Prevention of Chronic Disease

As we have learned more about cancer, birth defects and other long-term diseases or debilitating conditions, it is clear that exposures to agents and toxins for which harm cannot immediately be detected can indeed cause harm over time. Examples of such cause-and-effect relationships between toxic substances include well-known substances such as tobacco smoke, asbestos, banned and/or restricted pesticides and certain, now prohibited, industrial chemicals. There is consensus of opinion among agricultural scientists, environmental experts and public health researchers that users of pesticides who do not use appropriate

personal protection, do not control waste streams, do not pay attention to proper safeguards, and do not use proper application methods, are at higher risk of adverse long-term negative health consequences and chronic disease. There are indications that applicators' family members who are exposed, presumably through improper handling, also may have a higher level of long-term adverse health risk. Those considered to be at higher risk are fetuses, children, people with preexisting health problems or compromised immune systems.

Health Considerations for Applicators

The principal challenge in addressing a possible relationship between long-term health problems and preventable pesticide exposures is determining the most responsible way to deal with the issue in

the face of inherent ambiguity. Because chronic diseases such as cancer comprise an understandably emotional issue for everyone a necessary balance must be struck by public policy makers

between measured concern and premature alarm. As research evolves, changes in guidelines for pesticide application and personal protection evolve. Changes in the compounds and application methods made by pesticide manufacturers themselves have almost certainly reduced exposures and made the use of these substances far safer than in the past. Ironically, success in making pesticides safer through effective labeling may have provided an unjustified sense of security among some applicators regarding the safety of lower but preventable exposure

levels and possible consequence of chronic disease. In understanding the relationship between labeling and the prevention of long-term adverse health effects, the inherent costs in time and resources to assure the lowest possible exposures now need to take into consideration the possible consequences of chronic diseases. Less and shorter exposure to all chemicals, including pesticides, via best practices is the only prudent approach for the 21st Century applicator.

Recommendations for Responsible Pesticide Use by Applicators

Be Serious About Always Following Best Practices

In nearly all situations, safeguards regarding hygiene, personal protection, disposal and application to preclude immediate, acute harm are identical to those that would presumably serve to protect applicators and their families from possible long-term disease. The key to preventing acute or chronic health problems with pesticides is to separate humans from toxic pesticide exposures. Although

immediate harm from pesticides is rarely observed, the possibility of long-term health risk is significant enough that even pesticides bearing the CAUTION label—reserved for those with the lowest risk of acute effects—might, if exposure is not minimized, cause long-term effects. Pesticides must be treated with the utmost respect and care.

Be Sensitive to a More Demanding Community

Particularly as residential and commercial development encroaches upon agricultural and forested areas, applicators must accept that community members and regulators will inevitably hold those who apply pesticides to higher and higher standards of safety and responsible use. Beyond potentially harming themselves,

their families and their neighbors, 21st Century pesticide applicators must perform to ever-increasingly higher standards of safe pesticide use. If they don't, they can expect to face regulatory, civil, or even criminal justice consequences.

Be Active in Safeguarding the Public Health

Professional applicators are responsible for protecting and preserving human health. They have under their control the capacity to prevent immediate harm from pesticides to themselves, their families,

their customers and the general public. They also have the opportunity and responsibility of possibly reducing the incidence of chronic diseases in their communities.

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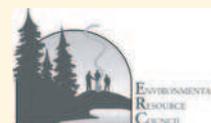
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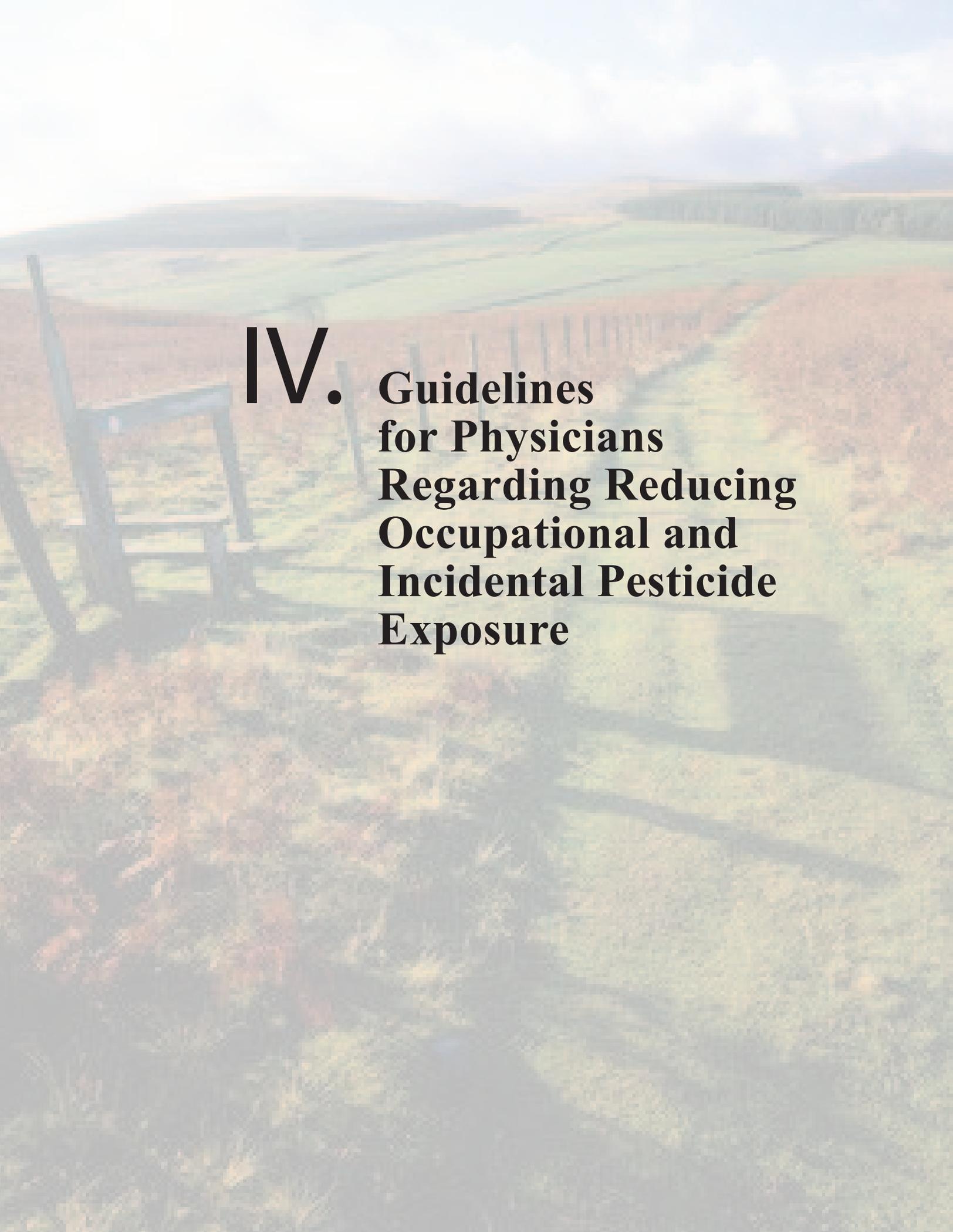
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**IV. Guidelines
for Physicians
Regarding Reducing
Occupational and
Incidental Pesticide
Exposure**

What Physicians Can Do to Reduce Occupational and Incidental Pesticide Exposure

A Guide to Best Practices

By Neal Holtan, M.D., M.P.H., Marion Warwick, M.D., M.P.H., and Bruce Bomier, M.P.H.

ABSTRACT

Residents of rural areas trust their physicians to provide them with accurate, unbiased information about pesticides and the effect they can have on health. Educating patients about using pesticides safely and avoiding contact with them need not be difficult or time-consuming and can be based on universal precautions that are already being practiced in the health care industry. This article discusses the prevalence of pesticide use in the United States, the ways people can be exposed, and several best practices for helping patients reduce their chance of exposure to pesticides that can cause illness.

Studies have shown that the public is concerned about the health effects of pesticide exposure. A focus group and telephone survey conducted in 2002 by the Environmental Resource Council in Anoka, Minnesota, and funded by the Minnesota Institute of Public Health in Mounds View and the Bush Foundation in St. Paul unveiled significant concerns among residents of rural Minnesota about the long-term human health risks of pesticide exposure (unpublished data). Some participants remembered the days, typically before 1970, when there was far less concern about pesticides and their risk to health. Others identified current "bad actors," a few individuals who use pesticides recklessly. A large proportion of respondents, about 75%, were concerned about pesticides as a possible cause of chronic disease, especially cancer, in their families or communities. Survey respondents also overwhelmingly identified physicians and university agricultural extension agents as

the most reliable sources of information about pesticides and human health.

Primary care physicians, especially those practicing in agricultural areas, are in an excellent position to provide their patients with information about pesticide use. Some physicians, however, have shied away from discussing pesticides with their patients because they are unfamiliar with the health effects of pesticide exposures or they are concerned about lack of time to cover yet another prevention topic.

The good news is that pesticide safety education for patients need not be difficult or time-consuming. Physicians are already familiar with a concept that is applicable to pesticide use: universal precautions, the hugely successful set of occupational safety practices that is based on the premise that all body fluids from all patients are potentially dangerous sources of infection. Physicians understand the value of practices such as using protective clothing and equipment, handling body fluids with care and minimizing direct contact with them, and reducing the duration and amount of exposure to body fluids. These same practices can easily be modified to protect workers who use pesticides, particularly those who work as commercial applicators in agricultural settings and are most heavily exposed.

Universal precautions for pesticides similarly rest on the idea that any and all pesticides or chemicals are potentially injurious to human health at any level of exposure. Applying the concept does not require having detailed knowledge about particular pesticides or their potential effects on human health. The focus instead is on employing common-sense measures to protect workers such as using protective

barriers, clothing, and equipment; reducing the duration and amount of exposure; and avoiding unintentional absorption, ingestion, or inhalation of pesticides. Recent research coordinated through the U.S. Public Health Service's Agricultural Health Study has shown that such protective practices in the handling and application of pesticides reduce the constituent body burden of pesticides among the people who apply them and their families.¹

Although applying the universal precautions approach to pesticides does not require extensive knowledge of pesticides, physicians should be aware of basic facts about the prevalence of pesticide exposure and the ways people, including their patients, might be exposed. They should also begin to familiarize themselves with the growing body of research attempting to link disease with pesticide exposure.

Prevalence of Pesticide Exposure

Pesticides are commercial compounds used to kill or otherwise control pests. They include fungicides, insecticides, herbicides, repellants, rodenticides, and disinfectants.² There are several hundred "active" base chemicals that are used in more than 25,000 products registered for use as pesticides in the United States. Inert ingredients are also added to commercial pesticides to render a product safer through dilution, allow for easier application, ensure a longer or shorter period of activity, control the distance a pesticide may travel during application, and make the pesticide more water-soluble for more efficient cleansing of equipment. Surveys by the Environmental Protection Agency (EPA) in the 1990s found that 84% of households in the United States use pesticides.³ Accord-

ing to one survey, an estimated 4 million workers were occupationally exposed to pesticides.⁴ The agricultural industry accounted for the majority of commercial pesticide use (at least 75%), with other use occurring in buildings, food handling facilities, golf courses and parks, athletic fields, and forests.

More than 1 million licensed pesticide applicators are at risk for adverse long-term health effects from acute poisoning and from repeated low- and mid-level exposures.⁴ There is concern that recurring mid-level exposures may lead to long-term, remote health problems such as neurodegenerative diseases, mental health issues, and cancer. Commercial applicators receive mandatory training to become licensed, but to date that training has not included information about long-term health effects of low- or mid-level exposures. Ideally, training will eventually include the promotion of practices to prevent or reduce recurring occupational exposures. In the meantime, physicians can educate patients along these lines and reinforce safety messages. Individuals who don't handle pesticides in their work are still exposed to them through a variety of direct and indirect routes, including the air, groundwater, food, soil, and indoor and outdoor objects.

Air. Pesticides may contaminate the air through aerial spraying, environmental drift, poor containment, and wind, rain, and fog. Proper application methods dramatically limit this unwanted and unintended dispersion.

Water. States closely monitor major aquifers for pesticide contamination, and municipalities test public water systems for pesticides. However, private wells can be a source of exposure for humans, as they are not monitored. Lawn and garden chemicals are also of concern, as they can contaminate groundwater.⁵

Food. Pesticides are found often at trace levels on the surfaces of fruits, vegetables, and other foods. Accumulation of pesticides also occurs in freshwater fish at the top of the food chain. Levels are especially high in bottom-feeding fish or larger fish that eat smaller plants and animals.

Pesticides can accumulate in the tissues of livestock that eat food containing pesticides as well. In addition, terrestrial crops can accumulate pesticides that are in the soil through root uptake or from wind-blown dust that adheres to the crop.

Soil. Repeated application of pesticides can lead to concentrations in soil that leave the land unsuitable for agriculture, thereby jeopardizing the food supply over time.

Indoor and outdoor vectors. Indoor contamination results from air drift or from humans or pets carrying pesticide residue into homes or buildings. Once inside, they bind to carpeting, furniture, draperies, blinds, toys, and other objects. Unlike in the outdoors, residue remains for longer periods because there is no sunlight, rain, or wind to break it down or carry it away. Indoor carpeting, in particular, accumulates high levels of pesticides. The U.S. Agricultural Health Study found that many pesticides are easily traced from commercial use to contamination of indoor areas.¹ Multiple pesticides and other contaminants have been found in dust and ambient air inside homes.⁶ Recent research shows that hygiene and proper management substantially limit household burdens of pesticides.⁷

Children are much more likely to have direct contact with pesticide residue on furniture, carpets, pets, lawns, and toys because they crawl on floors, have extensive hand-to-mouth contact, and wear less clothing to protect them. The U.S. Agricultural Health Study found higher body burdens of pesticides in infants and children compared with adults in the same home.¹ This is significant not only because children are more likely to be exposed to pesticides but also because of the effect a small amount can have on them.

Children are particularly susceptible to adverse effects of pesticide exposures because they absorb more pesticide for their weight than adults, their breathing and metabolic rates are higher than adults', and they have more skin surface relative to their size. They also may be more prone to toxic effects of certain pesticides because their immune systems are less

developed than those of adults.

Health Effects of Pesticide Exposure

Pesticides enter the human body by inhalation, absorption through the skin and eyes, and ingestion through the mouth and gastrointestinal tract. Once absorbed, the pesticides are typically distributed to other parts of the body and, if they are lipid-soluble, stored in body fat.^{5,8,9} Body burdens may increase with repeated exposures and can vary, depending on the individual's health status, medication use, immune status, metabolism, genetics, and interaction with chemicals or food that may result in higher levels of accumulation than expected.

Research has shown that a number of chronic health problems are connected with pesticide exposure:

Skin irritation. Skin is a primary route of exposure, particularly for those who handle, apply, and spray pesticides. The most common adverse effect is contact dermatitis, either direct irritant or the allergic type. Adverse skin effects can become chronic or permanent.¹⁰⁻¹²

Cancers. Cancers of the following organs have been potentially associated with exposures to certain pesticides: brain, lungs, prostate, liver, kidney, bladder, thyroid, skin, nasal sinuses, buccal cavity (mouth), esophagus, stomach, pancreas, colon, rectum, eye, breast, uterus, cervix, blood (leukemia, multiple myeloma), lymph nodes (Hodgkin's lymphoma, non-Hodgkin's lymphoma), and soft tissues (sarcoma). The precise relationship between these cancers and pesticide exposure is not yet understood, and it is currently impossible to confirm or quantify causal relationships. However, research appears to show at least a correlation between exposures to certain pesticides and the development of various cancers.¹³

Conditions of the nervous system. At high doses, pesticides affect both the central and peripheral nervous systems. Several studies have shown a possible relationship between exposure to certain pesticides and Parkinson's disease.^{14,15} Others point to damage to the peripheral ner-

vous system. Reduced motor and sensory nerve conduction velocities have been shown among applicators of organophosphate pesticides as well.^{16,17} Other studies have not shown a direct measurable connection between pesticide exposures and conditions of the nervous system.¹⁸ These inconclusive research findings diminish firm conclusions but support a resolve to reduce exposure to all pesticides.

Mental health conditions. Studies of workers exposed to organophosphates indicate an increased prevalence of depression, stress, and fatigue in comparison with controls.¹⁹ Workers with significant exposures to chlorpyrifos had poor performance on mood-scale tests and neurobehavioral tests.²⁰ Other pesticides have been associated with decreased memory, learning ability, vigilance, and neuropsychiatric test performance. The possible connections between mental health problems and pesticide exposures is a relatively unexplored field of research, but preliminary findings support the goal of reducing occupational pesticide exposures in order to reduce a person's risk.

Poor fetal development. Certain pesticides appear to have negative effects

on embryogenesis and fetal development. Some pregnant women exposed to certain pesticides such as phosphates, carbamates, and halogenated hydrocarbons have a higher prevalence of malformed fetuses (teratogenesis) and fetal morbidity.^{21,22}

Universal Precautions

Pesticide applicators are taught to read and understand the information on product labels written by pesticide manufacturers in conjunction with the Environmental Protection Agency (EPA). These labels generally provide instructions for use and handling as well as warnings about acute exposure and poisoning. They do not include information about possible long-term adverse health effects. The National Institute for Occupational Safety and Health has compiled a searchable database of nearly 3,000 acute cases of exposure to certain pesticides.²³ The EPA provides general descriptions of pesticide types that can provide clues about symptoms to look for after an acute occupational exposure.²⁴

Although connections between low- and mid-level pesticide exposure and the subsequent development of chronic diseases such as cancer have not been conclu-

sively shown, it is thought prudent to minimize exposure to occupational pesticides just in case there is a causal relationship. People who apply pesticides need more information about the importance of limiting these recurring, subacute occupational exposures.²⁵ They may falsely conclude that pesticides are safe because the products are readily available in the marketplace and because the labels on them bear an EPA seal, a precautionary statement, and the logo of a reputable chemical company. In addition, some compounds listed as "inert" on the labels are inert to the pest, rodent, insect, or fungus for which the pesticide is targeted but are not necessarily harmless to humans. Descriptions of inert ingredients are not required on pesticide labels, and the percentage of inert ingredients is typically more than 50% and can exceed 90% of the weight of a pesticide. The labels also do not take into consideration the issue of potentiation or adverse synergies with other exposures or health conditions. Thus, universal precautions help to augment the information found on labels and further protect pesticide users from dangerous exposures.

Use of protective equipment and general good hygiene are the keys to eliminating or reducing pesticide exposure to the skin, lungs, eyes, nose, and mouth. People who apply pesticides should always use protective clothing and equipment, wear long sleeves and pants, wash their hands, and avoid eating, drinking, or using tobacco products while handling them. Pesticide-contaminated equipment needs to be cleaned in an isolated area, and extra care should be taken to prevent tracking of even trace doses of pesticides into the home on clothing or shoes. Clothing used during the application of pesticides should never be included in the general laundry but cleaned separately, preferably outside the home. The effectiveness of taking such precautions with clothing and equipment in order to reduce human exposure to pesticides is mounting.^{7,26-32}

In 2005, the Environmental Resource Council and the Minnesota Institute of Public Health convened a task force of experts in agricultural science, toxicology,

To Learn More

- The Minnesota Medical Association and the Environmental Resource Council are jointly sponsoring the online CME course *Physician Interaction with Patients and Families about Pesticide Exposure*, which is available through June 30, 2011, at www.pesticideeducation.com/course. See the website for more information or contact Bruce Bomier at the Environmental Resource Council, 763/753-9713 or bmbomier@envrc.org. The course can be taken at no cost. If you wish to sign up for 1.5 CME credits, the processing fee is \$25. A brochure for patients is also available for download and distribution at no cost.
- The National Pesticide Information Center has a number of fact sheets on inert ingredients as well as active ingredients found in pesticides. For more information, go to www.npic.orst.edu/npicfact.htm.
- The National Institute for Occupational Safety and Health has compiled a searchable database of nearly 3,000 acute cases of exposure to certain pesticides. To find out more, go to www2.cdc.gov/niosh-sensor-pesticides/search.asp.
- The Environmental Protection Agency provides general information about pesticides and symptom indicators at www.epa.gov/opp00001/about/types.htm.

public health, and medicine and university extension services agents to find ways to promote safe pesticide handling among commercial pesticide applicators and others. They created 7 best-practice messages to convey to applicators. These practices may also be valuable for communicating with patients about how to reduce their exposure to pesticides.

■ Best Practice 1

Read labels and follow directions, but understand the limitations. Pesticide labels are developed through extraordinary effort by the EPA and the chemical companies that produce pesticides. Information about health risks from the inert ingredients contained in pesticides is not required. Thus, in case of a significant acute exposure, the exposed person should bring the label to an emergency room for review by medical personnel. The label will place a pesticide in one of 3 categories: "danger," "warning," or "caution." The word "danger," often associated with the word "poison," is printed in red with a skull and crossbones, indicating that the compound is so highly toxic that ingesting as little as a teaspoon can cause death. "Warning" indicates that a moderately toxic compound can still be fatal or cause significant skin irritation or eye damage. "Caution" means that a larger amount, typically, an ounce to a pint, ingested orally can be fatal. These categories obviously relate to accidental ingestion and not to chronic exposure.

■ Best Practice 2

Use protective clothing and equipment. Stay physically separated from pesticides by using barriers, clothing, goggles, respirators, and other protective equipment. Prevent exposure to skin, lungs, eyes, nose, and mouth by wearing gloves and protective clothing.

■ Best Practice 3

Be prepared for the unexpected and reduce the chance of exposure. Be vigilant in order to prevent accidents while using pesticides. Assess each situation, anticipate unexpected problems, and think about exposures that occur at lower levels than

were previously considered safe. For example, use nozzles that accommodate wind, evaporation, specific gravity, and plant adhesion. Properly calibrate droplet size and pressure in order to avoid overspray. Also, clear the area to be treated of other humans and animals. Do not let young children or pets come in contact with pesticides or inadvertently transport even small amounts into the home.

■ Best Practice 4

Avoid all possible routes of ingestion. Never eat, drink, or use tobacco products when mixing, loading, or applying pesticides. Protect the mouth from contamination. Wash hands frequently, as hand-to-mouth contact is the most common source of ingestion.

■ Best Practice 5

Use proper clean-up methods. When the job is over, wash and decontaminate equipment (including safety equipment) quickly and thoroughly at a location as far away from other people as possible. Never launder pesticide-contaminated clothing with general laundry; wash contaminated clothing in a separate facility if at all possible. Most pesticide products are water-soluble, and a good washing with soap and water in an isolated clean-up area works for equipment, clothing, and people.

■ Best Practice 6

Control dispersion of pesticides and avoid exposing children and pregnant women. Store pesticides in dry, secure containers in areas that are not accessible to children. Follow recommended disposal and clean-up procedures. Do not burn pesticide containers. Be watchful about pesticide drift caused by wind or other environmental factors. And always be aware that children and pregnant women are at greater risk of harm from low-dose pesticide exposures than others in the population.

■ Best Practice 7

Don't bend the rules. Those who do not follow best practices regarding pesticide safety increasingly run the risk of being

reported to regulatory authorities or the criminal justice system. Hikers, bikers, fishermen, and hunters sometimes report people who are not properly applying or storing pesticides. More and more people are moving into areas formerly populated only by farmers, foresters, and other rural residents and have less tolerance for pesticide misuse.

Conclusion

Rural residents place a high level of trust in their physicians' advice about pesticide safety. Physicians with patients who use pesticides can easily and quickly make a difference by promoting universal precautions in handling them. In doing so, physicians not only will help prevent possible long-term adverse health effects among those patients but also can protect the health of their families, neighbors, and communities, as well as the environment. In addition, physicians can contribute tremendous public health and ecological benefits by persuading their patients who administer pesticides to follow responsible standards of care in their work. **MM**

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