

## CHAPTER 14

### ***WARNINGS: HAZARD CONTROL METHODS FOR CAREGIVERS AND CHILDREN***

MICHAEL J. KALSHER AND MICHAEL S. WOGALTER

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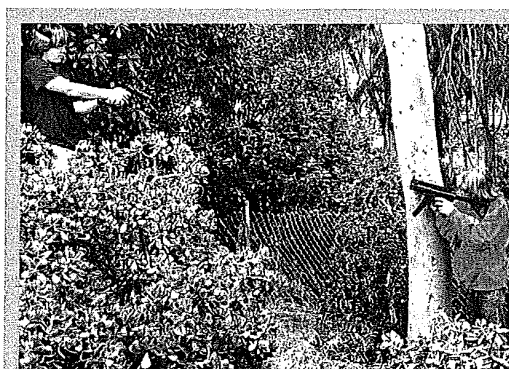
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## INTRODUCTION

Injury prevention is especially important for young children. They have not developed cognitive abilities, which may be necessary both to appreciate the magnitude of the hazards they encounter and to know how to avoid them (Figure 14.1). Parents and other caregivers should take appropriate action to protect young children from hazards. This may not occur for various reasons:

- People differ. Caregivers and the extent of care they give will differ, too.
- People rely on their own experiences. By seeing through the looking glasses of their experiences, caregivers may not be attuned to how a child sees the same thing.
- People may be overconfident. As a child matures and extends his or her abilities, the parents may believe he or she is capable of appropriately dealing with situations or common consumer products.
- Children behave in unexpected ways. Caregivers may falsely believe their children are better equipped to deal effectively with hazardous situations than is actually warranted (Hiebert and Adams, 1987).

Examples of hazards inside the home
Cleaning supplies
Medicines
Kitchen appliances
Electrical outlets
Toys
Weapons



**Figure 14.1a** (Alison Vredenburgh)



**Figure 14.1b** (Kalsher & Assoc. LLC)

Examples of hazards present inside and outside the home. As shown here, products and situations both inside and outside the home can be dangerous. The problem, of course, is that many children do not view these products or situations as dangerous. Manufacturers and caregivers can both play important roles in helping to reduce childhood injuries.

## HIDDEN HAZARDS

As consumer products become progressively more complex, it becomes increasingly difficult to identify product hazards. When products have "hidden" hazards (see Box 14.1), manufacturers bear a responsibility for warning caregivers (Figure 14.2).

Unintentional injuries are a significant cause of death and injury for children. Of these, motor-vehicle accidents and drowning are the leading causes of death among children (CPSC, 2002a; 2000a). Many children are also severely injured or killed following exposure to household chemicals, nursery products, toys, and playground equipment as shown in Table 14.1.

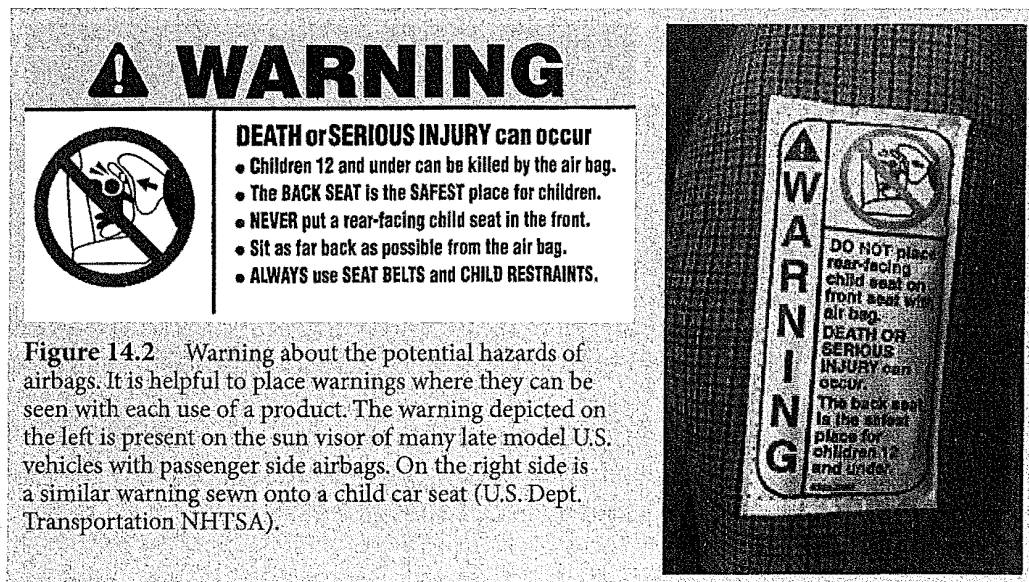
Reported injuries and deaths do not always list a cause or the exact circumstances surrounding these events. The injury statistics cited in Table 14.1 may actually underestimate their occurrence. Threats to children's safety clearly pose a significant problem.

**Table 14.1** Injuries and Deaths among Children under the Age of 5 in the United States from Commonly Used Products

Products	Child Injuries
Poisoning	>1 million
Toy-Related Products	212,400
Playground Equipment	200,000
Nursery Products	69,500

**BOX 14.1** EXAMPLES OF "HIDDEN HAZARDS"

<b>Airbags</b>	During the 1990s, the passenger-side airbags in many vehicles presented a hidden hazard to small children. At that time, it was not possible to discern the hazards of passenger-side airbags just by looking at vehicle's dashboard. Many consumers did not know, for example, that the air bags in many cars at that time deployed at rates exceeding 100 mph, which can cause serious injury or death if a person sits too close to the vehicle's dashboard at the time of a crash. As this danger became evident, manufacturers redesigned the airbag systems and placed warnings on vehicle sun-visors and on child-restraint systems.
<b>Child Safety Seats</b>	Many caregivers do not understand they must anchor these devices properly to the vehicle's seat belt system for them to be effective in a crash.
<b>Window Blinds</b>	Caregivers may not realize the cord that raises and lowers the blinds can wrap around a child's neck and choke them. Some kinds of window blinds can even cause lead poisoning.



## **CONTROLLING HAZARDS**

### **MANUFACTURERS**

To control hazards, caregivers must first identify possible sources of risk and then take active steps to control or eliminate them. *Hazard analysis* is a step-by-step approach to identify hazards.

The term *hazard* refers to any part of a product or activity that might lead to injury.

Manufacturers use hazard analysis to evaluate foreseeable uses and misuses of their product in order to identify and eliminate possible hazards. This analysis could include data from government, trade association and company databases, news reports, and legal documents from cases involving injuries resulting from the use or exposure to consumer products. Analysis can also draw on expert predictions from health professionals, chemists, engineers, and human factors professionals about the risks these products pose to users.

Unfortunately, some manufacturers may perform this analysis in a cursory fashion without considering the human factors involved. Moreover, they may fail to recognize dangers associated with products and their uses as they relates to children. Without insight about children's capabilities and limitations, hazard analyses performed by manufacturers may fail to uncover some important potential dangers to children.

### **CAREGIVERS**

Parents and caregivers can conduct their own hazard analysis of products and environments.

Therefore, parents and other caregivers should not rely solely on manufacturers to identify and resolve all of the potential hazards associated with the products they produce. Instead, they need to establish consistent procedures for evaluating products and environments to identify hazards and take active steps to eliminate them. Caregivers can use a less-structured approach to systematically identify and eliminate hazards.

For example, caregivers could observe children using the product in their own environment. Observant adult caregivers ordinarily carry out this process informally or "on the fly," to detect potential hazards that could harm their children. Because households and the people who live in them differ in many ways, these environments may also contain unique combinations of hazards.

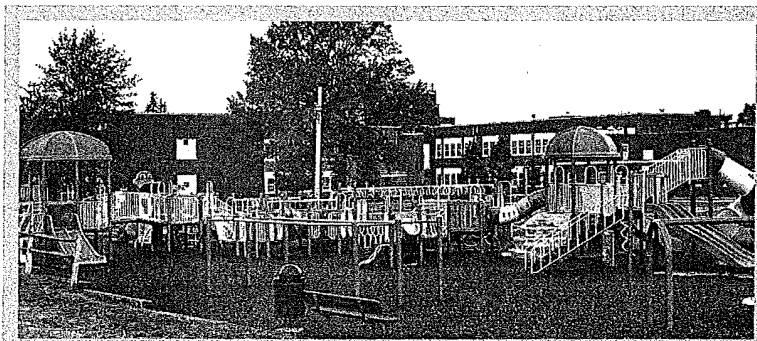
Caregivers need, therefore, to carry out more formalized hazard analyses of their homes and environments in which their children live and play (including childcare facilities and schools) in order to detect potential hazards. By regularly identifying and correcting hazards in their homes and elsewhere, caregivers can take a major step toward protecting their children (Figure 14.3).

To protect their children, caregivers should:

- think about past "close calls" and potential future situations that might be hazardous. They should then think about the factors that were, or could have been, responsible for each "near-miss."
- try to predict future scenarios where children might get hurt. Although there are probably an infinite number of ways that a child could be injured, the caregiver should try to make as many "educated guesses" as they can.

### Warnings: hazard control methods for caregivers and children

- seek information from outside sources:
  - Professionals such as teachers, physicians, and other health-care providers can serve as a source of information about hazards and they themselves should conduct the hazard audits.
  - Government agencies such as the U.S. Consumer Product Safety Commission (CPSC) systematically collect data on products that have harmed children in past incidents. Other similar organizations are also knowledgeable about additional aspects of safety and much of this information is increasingly available on the Internet.
  - Childcare books may contain sections about household hazards or be devoted primarily to this topic.



**Figure 14.3** (Kalsher & Assoc. LLC)

Playgrounds may be a potential threat to child safety. Parents and other caregivers need to establish consistent procedures for evaluating products and environments to identify potential hazards. Even equipment designed for children, such as the playground equipment depicted in the photo above, may pose a danger to very young children or children allowed to play on the equipment without proper adult supervision.

### HAZARD CONTROL HIERARCHY

Once hazards are identified, how should caregivers deal with them? The *hazard-control hierarchy* offers a useful framework to guide hazard-related decisions that manufacturers, government agencies, and caregivers can use (The three basic steps are shown in Box 14.2).

When none of the steps comprising the hazard control hierarchy is likely to work effectively, a fourth step might be to remove the product from the marketplace entirely; for example, to issue a recall or to ban its sale. In instances in which a product has multiple hazards, all of the first three strategies may be used, but they are ordinarily applied in the same ordered sequence (e.g., Sanders and McCormick, 1993; Laughery and Hammond, 1999).

This hierarchy is ordinarily most useful to manufacturers who create and sell products and to government agencies that issue regulations to protect the public. However, it also offers strategies that caregivers may find relevant in their role as “protectors” of their children.

#### BOX 14.2 STRATEGY FOR ELIMINATING HAZARDS

##### Basic Hazard Control Hierarchy

1. Design out hazards.
2. Guard against hazards that cannot be prevented with design.
3. Warn about hazards that cannot be eliminated with design or guarding or both.

## ELIMINATE HAZARDS WITH DESIGN

The primary and most fundamental method of hazard control is to eliminate the hazards through design. This is particularly important for products that children will use or otherwise contact. A good product design is one of the most effective ways to reduce injury potential. Here hazards are designed out before the product is offered for sale (refer to Box 14.3).

Unfortunately, it is not always possible to eliminate the hazards of certain products without affecting its intended function and performance (refer to Box 14.4). For example, it is not possible to eliminate all of the hazards associated with certain chemical solvents, knives, or power tools without reducing their usefulness. When one cannot eliminate or design out the hazard, there are other strategies. We will discuss these strategies in more detail later in this chapter.

<b>BOX 14.3 ALTERNATIVE DESIGNS THAT ACCOMPLISH A GOAL WHILE ELIMINATING THE HAZARD</b>	
<b>Steam Vaporizers</b>	
<b>Product Use</b>	Caretakers use steam vaporizers to relieve children's breathing difficulties when they have a cold or similar illness. Placing vaporizers near children brings the treatment closer to the child.
<b>Potential Problem</b>	The heating elements produce hot vapor. It is possible that a young child might touch a hot component of the vaporizer or the steam coming from it.
<b>Alternative Designs</b>	<ul style="list-style-type: none"> <li>• Menthol–eucalyptus pads to ease breathing.</li> <li>• “Cool-mist” humidifiers produce a fine spray and disperse vapor by moving air over or through a wick immersed in water.</li> </ul>

Most households contain a wide variety of cleaning agents, many of which can be harmful to children. For these products, manufacturers might consider replacing a hazardous ingredient in a cleaning mixture with a safer alternative that is similarly effective. Obviously, this requires that there are good alternatives available and a market of caregivers willing to purchase them if they are made available.

Clearly, the primary role of a caregiver is not to redesign products. However, caregivers can still take an active role in preventing injury to their children by exercising caution before allowing them to participate in certain activities (e.g., paintball), to play with certain toys (e.g., those with choking hazards), or to visit the homes of playmates that may contain unacceptable sources of risk (e.g., homes containing unsecured firearms or other dangerous products).

<b>BOX 14.4 IT CAN BE DIFFICULT TO ELIMINATE A HAZARD COMPLETELY</b>	
<b>Lead Paint</b>	
<b>Problem</b>	Young children who eat lead-based paint or inhale lead dust can experience a variety of severe, permanent health-related problems. Elevated levels of lead can result in learning disabilities, behavioral problems, mental retardation, and in extreme cases, death.
<b>Goal</b>	Eliminate lead-based paint in residential settings.
<b>Proponent</b>	U.S. Environmental Protection Agency (EPA) and other organizations.
<b>Description of Results</b>	Prior to the EPA's 1978 ban on lead-based paints, approximately 3–4 million U.S. children had elevated levels of lead in their blood. After the wide-scale introduction of safer paints, the number of children with elevated levels of lead dropped dramatically (EPA, 2004).
<b>Complications</b>	Total elimination of lead paint in residences did not occur because many older buildings contain layers and layers of old lead paint. Removal of lead paint is a hazardous process and can cause injury if workers or others ingest paint chips or breathe lead dust in the air. Professionals must remove the lead-based paint and the home must be evacuated during the removal process.



## ELIMINATE HAZARDS THROUGH GUARDING

For hazards that cannot be designed out, the next best hazard control strategy is to guard against contact with the hazard. There are several forms of guarding. The enclosures around most electronic components are examples of hardware guarding. The “dead-man” switch that shuts off the power when a lawn mower handle is released is an example of procedural guarding. Requiring a prescription for drugs and limiting who can use them is an example of expert-referent guarding. There are many examples of guarding to prevent children from coming into contact with potential hazards.

**CHILD-RESISTANT CAPS:** One example of guarding is the use of child-resistant caps to prevent children from consuming certain medicines or coming into contact with other types of toxic materials (e.g., cleaning products). Several examples of child-resistant caps are shown in Figure 14.4.

Using child-resistant caps reduces the risk of a child inappropriately consuming the product. According to the CPSC, packaging can be called “child resistant” only if testing confirms that the packaging is sufficiently difficult for children to open, yet reasonably easy for adults to open (CPSC, 1995). According to the CPSC, *sufficiently difficult* is based on criteria in which testing of the packaging shows that no more than 15% of children under the age of 5 are able to open the package in fewer than 5 minutes and only 20% are able to open the package in under 10 minutes.

The CPSC first started requiring child-resistant caps in 1974. Since that time, child-resistant packaging of potentially dangerous household chemicals has been an effective guard against accidental poisoning and overdoses and has saved many children’s lives (PSC, 2002b; Rodgers, 2002).

However, though child-resistant caps can be an effective deterrent, products so equipped are not “childproof.” Children can open child-resistant caps if the caps are not replaced properly; the safety mechanism only works when it is properly secured. Since these caps tend to be more difficult to open by older adults and disabled persons, they may also pose a hazard to children when such a person fails to close the cap securely or puts the contents (e.g., pills or other potentially harmful materials) into another, easier-to-open, container.

Child-resistant packaging can lead to unintended consequences—for example, well-meaning adult caregivers may assume that secured caps make them safe and leave them within reach of children. In other words, while child-resistant packaging can substantially reduce the likelihood of injury, the potential for harm still exists. Child-resistant caps thus show that guards may be only partially effective in controlling hazards.



Figure 14.4 (Kaliber & Assoc LLC)  
Child-resistant caps: An example of guarding. Child-resistant caps decrease the chances that children will contact or consume products that could be hazardous, such as medicines or house-cleaning solutions.

**MEDICATION DELIVERY AIDS:** Devices that assist caregivers in serving a proper dosage of medication to their children also illustrate guarding. For example, pouring aids slow the flow of liquid products and measured dose delivery systems deliver a set volume of liquid each time a set procedure is completed.

One children's mouthwash (ACT, a Johnson & Johnson product) comes in a plastic bottle with a metered dosing dispenser on top (please refer to Figure 14.5). When the bottle is squeezed, the liquid rises through a tube in the center of the bottle and fills the dosing cup on top, which is marked with a fill line. The liquid can then be poured directly into the mouth or into a separate cup. Each time, 10 ml of liquid is delivered, which reduces the risk of overdose should a child inadvertently swallow the mouthwash.

A measured-dose drug delivery system may have several features. One (*NonSpil*, Taro Pharmaceuticals) comes with a specially designed dosage teaspoon that reduces the chances that caregivers will administer too much medicine (Figure 14.6). The gel-like consistency of the product also resists spilling even if the spoon is turned upside down. This is a problem because caregivers can easily spill an unknown portion of a dose of medication and then end up giving the child more medicine to compensate. Unfortunately, when this happens, caregivers frequently give the child more medicine than was lost. By making sure the medicine cannot be spilled in the first place, the product design reduces the risk of overdose.

It is important to note that neither pouring aids nor measured-dose delivery systems completely eliminate the potential for overdose. However, they do reduce the severity of harm by limiting exposure.



**Figure 14.5** (Kalsher & Assoc. LLC)  
ACT Mouthwash is an example of a metered dosing dispenser. Metered dosing dispensers, such as the one illustrated above, help to prevent children from consuming too much of a product.



**Figure 14.6** (Kalsher & Assoc. LLC)  
Spill-resistant medicines are a useful tool for preventing drug overdose. Drug delivery systems that reduce spillage can help parents and other caregivers avoid giving too much medicine to their children.

**ENGINEERING DESIGN:** A different approach to hazard control is to engineer a way to keep children away from the hazardous materials. As an example, consider a product discussed in the preceding section: steam vaporizers. To keep children away from the burning steam, vaporizers possibly could include an elongated steam vent and a screen over the area where the steam is emitted. This added guard could prevent contact with the



steam without much reduction of the vaporizer's effectiveness in humidifying the surrounding air. Again guarding does not eliminate the hazard entirely because there is still the possibility that the humidifier could be knocked over and burn a child if not placed in an out-of-reach location. Indeed the elongated vent could actually increase the likelihood of this kind of accident.

**HOUSEHOLD CHEMICAL CONTAINERS:** A final example of guarding involves a very different method of prevention. Colorful containers and pleasant odors may attract children to household chemical containers. Adding an extremely bitter taste, such as Bitrex (Macfarlan Smith), to household chemicals by manufacturers may help to avoid some severe poisonings. Children tend to spit it out before they consume much of it because it tastes bad (Jacob, 2003).

**GUARDING AND CAREGIVERS:** Although manufacturers can use the guarding methods above, caregivers have other forms of guarding to limit exposure to an existing hazard. Caregivers can conduct hazard analyses or safety audits in their home and other places their children might visit. In so doing, caregivers should:

- remove hazardous items. Place known hazardous items—such as household cleaners, other toxic materials, tools, equipment, and power cords—in areas such as locked cabinets away from a child's reach.
- avoid creating new hazards. Take care not to create hazards when using or storing items, such as placing hazardous chemicals in cabinets above a stove or oven upon which a child might attempt to climb.
- create and maintain safety zones. Use fencing, guards, or other barriers to prevent children from coming into contact with known hazards, such as stairways and pools.

Caregivers can help to reduce the chances of injuries at home by taking active steps to keep dangerous products out of reach of young children.

In this and the previous sections, we have considered two of the three approaches of the hazard control hierarchy: *design* and *guarding*. If hazards cannot be eliminated through these two methods, the next step in the hierarchy is to warn.

If design, guarding, and warning do not resolve the problem, the only remaining alternative may be to terminate sales and recall the product. For example, in January 1994, the CPSC issued a safety alert cautioning parents not to use soft bedding products in their infants' cribs. Several infants had been found dead, having suffocated by being placed on their stomach with their face, nose, and mouth covered by the bedding. The CPSC issued the safety alert after an investigation revealed that none of the traditional approaches to injury control—design, guarding, and warning—would ensure injury prevention (CPSC, 1994). Fortunately, all manufacturers of infant cushions voluntarily agreed to recall these products and cease future production of them.

Likewise, with certain products, such as those with small parts that pose a choking hazard, caregivers may refrain from purchasing them; place them in out-of-reach locations; or remove them from their home entirely. These possible actions are akin to the first two steps of the hazard control hierarchy; they remove the hazard or guard against the hazard by preventing children from having any contact with the hazard.

## **WARNINGS AS AN INJURY PREVENTION TOOL**

Warnings have three main purposes (e.g., Wogalter and Laughery, 2005).

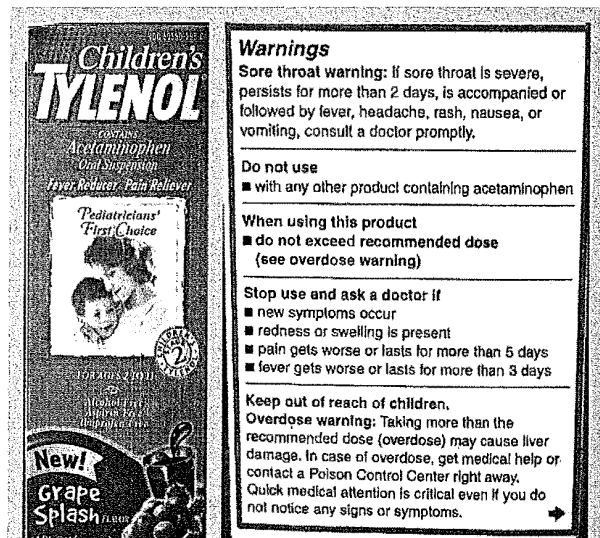
1. To communicate safety-related information so that people can make better, more informed decisions regarding safety issues
2. To persuade persons to perform safe behaviors that help to reduce or prevent injury and health problems
3. To remind individuals who may already know the hazards but may not be consciously aware of them at the time that knowledge is necessary. In other words, they can serve to cue pre-existing knowledge

Warnings come in a variety of forms, including signs, labels, product inserts and manuals, tags, audio and videotapes, and face-to-face verbal statements. In fact, safety professionals tend to think of warnings as a broad area of communications. They use the concept of *warning systems*, a term used to convey the idea that safety information is conveyed most effectively through multiple, overlapping components using a variety of media, formats, and messages.

As shown in Figure 14.7, the warning system for children's pain relievers (e.g., Children's Tylenol™, McNeil) typically includes printed warning statements on the product packaging and container that address the most serious hazards posed by the product. More detailed information is presented in a printed package insert. The warning system for these products may also include warnings in print advertisements, in television and radio commercials, and on the Internet.

As illustrated by this example, the individual components of a warning system may differ in content or purpose. Some components capture attention and direct the person to another component containing detailed hazard information. Outside packaging may give general information to serve primarily in assisting purchase decisions. Similarly, different components may be intended for different target audiences. For example, some components of a warning system for prescription drugs may be directed to the prescribing pediatrician (e.g., information contained in the Physicians Desk Reference or PDR); other components may target the pharmacist who fills the prescription and others may target parents who will ultimately administer the medicine to the child. The systems approach to warnings helps to ensure that different end-users in different situations receive the safety information most relevant to them.

It is important to note that while product warnings—or warning systems—can be used as injury prevention tools, they should never be used to replace other hazard control efforts such as hazard elimination and effective guarding.



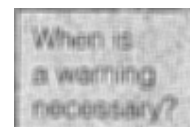
**Figure 14.7** (Kalsher & Assoc. LLC)  
Warnings presented on the product packaging of Children's Tylenol™. Manufacturers should place the most important warning information directly on the product container and its packaging. More detailed information can be provided through other means, including package inserts and through the mass media.

## HOW TO MAKE EFFECTIVE WARNINGS

This section reviews some basic principles for designing effective warnings. It considers the context in which warnings are used and then presents guidance on their format and content. When applying these principles, consider the following:

- a. When to warn
- b. Where and how to warn
- c. How to prioritize warnings
- d. Whom to warn

**WHEN TO WARN:** In general, a warning is necessary if one or more of the following exist:



- A significant hazard is present
- The hazard is not open and obvious
- The hazard, its potential consequence, and the actions needed to avoid it are unknown to the people who are likely to be exposed
- A reminder would help to ensure awareness of the hazard at the proper time

According to case law in the U.S., manufacturers have a duty to warn about hazards associated with both the foreseeable uses—and foreseeable misuses—of their products. Manufacturers must analyze their products for hazards and keep-up on the state of knowledge that relates to their products. In other words, manufacturers are expected to be in a superior position with respect to knowledge about their products (Madden, 1999; 2006).

Consumers (and certainly children) are not expected to have the extent of knowledge that manufacturers have about their own products and if hazards associated with these products are not completely designed out or guarded against, manufacturers have an obligation to adequately warn consumers about those hazards. According to the doctrine of strict liability in the U.S. (American Law Institute, 1998), if a product needs instructions or warnings to operate safely, but the product lacks adequate instructions and warnings, then the product can be considered defective.

**WHERE AND HOW TO WARN:** The best place for product warnings is usually directly on the product where users will notice them (Figure 14.8). People generally expect warnings to be on or near hazards they describe (Wogalter et al., 1991). Where there is not enough space to include all relevant safety related information, some hazard information may appear in accompanying materials—such as packaging and inserts.

Lack of space is not the only consideration that may lead a manufacturer to decide against placing warnings directly on a product. It may not be practical or may interfere with the use of the product as illustrated the baby-bottle tooth decay example presented in Box 14.5.



**Figures 14.8** (Valerie Rice)

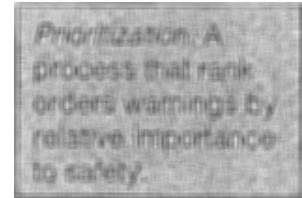
Warning placement is an important consideration. Although there is little room on a bicycle for warnings, here the manufacturer manages to include a few. Systematic testing could determine whether the messages are effective and whether they are the correct selection of message. The owner's manual probably includes other warnings.

<b>BOX 14.5 BABY BOTTLES AND TOOTH DECAY</b>	
The Problem	<p>Baby-bottle tooth decay is the only severe dental disease common in children under 3 years of age (CPSC, 2000). It occurs when liquids containing carbohydrates such as milk, juice, or formula interact with normal mouth bacteria, which ferment the sugars and convert them to acids. The acid then etches the tooth enamel with prolonged contact.</p> <p>Children should not drink sweetened drinks too frequently or leave them in their mouths for too long. It is especially harmful for children to fall asleep while drinking sweet drinks.</p>
Who Gives the Warning?	Baby-bottle manufacturers place warnings on the packaging and in instructional materials that accompany the product.
Why Not Place the Warning on the Bottle?	Caregivers sterilize baby bottles exposing them to heat and moisture. Warning labels would be likely to come off the bottle over time.
<b>Other Considerations</b>	
Sources of Information	Caregivers can receive information about baby-bottle tooth decay from a variety of sources (e.g., pediatrician, nurses, and baby books).
Severity of Injury	The potential injury (tooth decay of primary teeth) is not life threatening and the likelihood of long-term physical injury is small since permanent teeth do not erupt until later. However, expensive dental care and social stigma associated with unattractive teeth during early formative years are potential outcomes.

**HOW TO PRIORITIZE WARNINGS:** All relevant warnings may not fit directly on a product due to lack of space or number of potential hazards. Trying to fit information about too many hazards onto a product could make the most important warnings difficult to notice and read.

In this case, manufacturers must decide:

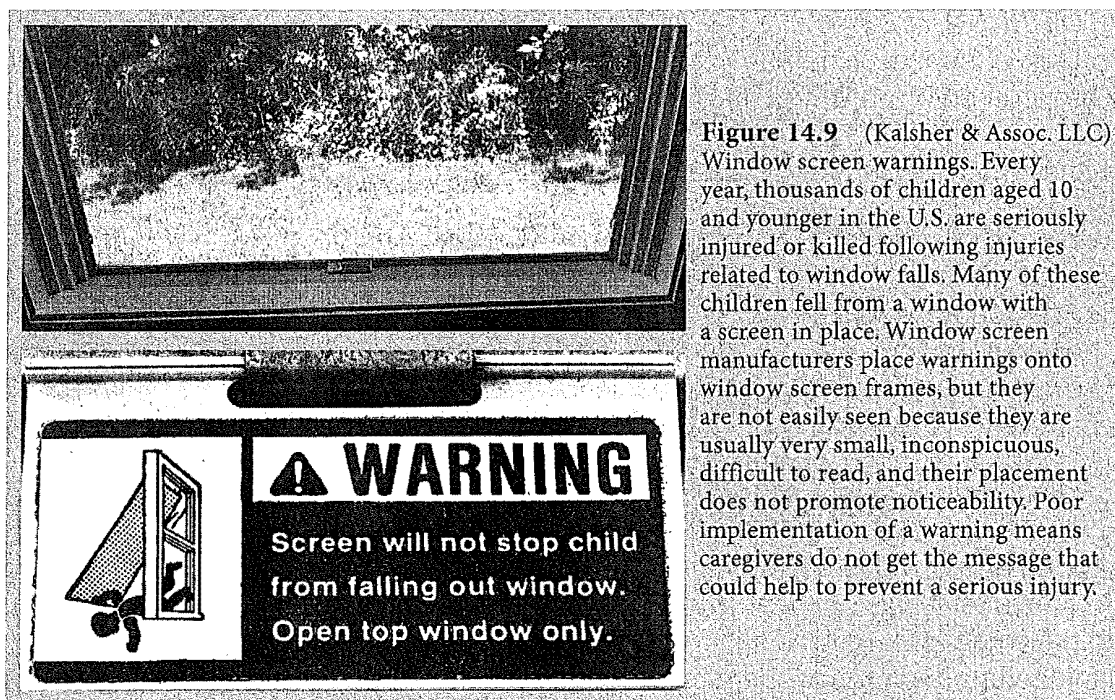
- which information to include directly on the product or container and which information to place elsewhere (e.g., in accompanying materials)
- how to sequence the information
- how much prominence to give a particular warning component relative to others



A hazard analysis or safety audit creates a list of hazards that manufacturers use for a process called *prioritization*. A warning about a hazard that is known and understood or one that is open and obvious should have relatively low priority. In contrast, a warning about a hazard that is relatively unknown (to persons at risk) that has the potential for severe injury should have relatively high priority.

Manufacturers cannot assume the types of hazards apparent and known by adults will be obvious to children—or even that adult caregivers will realize children may not understand a particular hazard. To illustrate this last point, consider the hazards associated with window screens (Box 14.6 and Figure 14.9). The window screens used for most homes are relatively inexpensive and have a mechanism that holds it onto window frames quite

BOX 14.6 WINDOW SCREENS IN US HOMES	
<b>Problem</b>	The mechanism that holds window screens into the window frame (in most newer U.S. homes) is quite weak.
<b>Adult Understanding</b>	Most adults know why it is important to avoid leaning on window screens (i.e., because of the risk of falling out of the window).
<b>Children's Understanding</b>	Young children do not understand the weakness of the screen attachment and may not even understand the risk of falling in any circumstance.
<b>Result</b>	Every year, over 4000 U.S. children aged 10 and younger are seen in emergency rooms for injuries related to window falls. Many of these children fell from a window with a screen in place. Each year approximately 12 children die, as a result (OHSU, 2004).
<b>Potential Solutions</b>	
<b>Design</b>	Use stronger window screen attachments.
<b>Guard</b>	Use window guards to limit how far the window will open. In the case of double-hung windows, allow only the upper portion to slide fully open.
<b>Warnings</b>	Window-screen manufacturers place warnings onto window screen frames. These warnings tell caregivers that children can be seriously injured.
<b>Problem</b>	Warnings are present but are not easily seen by caregivers. This is because the warnings are usually very small, inconspicuous, difficult to read, and their placement does not promote noticeability.
<b>Bottom Line</b>	Poor implementation of a warning means caregivers do not get the message that could help to prevent a serious injury.



weakly. Although most adults know why it is important to avoid leaning on window screens, young children may not. Every year, there are numerous reports of young children being seriously injured or killed after falling out of upper story windows in which the screen pops out. Solutions to this problem include using stronger window screen attachments, window guards that limit the extent to which the window can be opened and in the case of double-hung windows, allowing only the upper portion to slide fully open. Warnings can also be used, but only if they meet specific effectiveness criteria; they should be noticeable, understandable to the target audience, produce accurate beliefs about the nature of the hazard and the magnitude of the potential consequences, and motivate consumers to exercise appropriate precautionary behavior.

Many manufacturers do not consider the special characteristics and limitations of children when they design products or the warnings that accompany them. They apparently also fail to consider that caregivers may not fully appreciate the level of risk their product poses for children who may use or otherwise come into contact with it. Indeed, many manufacturers merely include the innocuous statement “Keep out of reach of children.”

Several factors should be considered when prioritizing hazard warnings (Vigilante and Wogalter, 1997a,b), including:

- likelihood of injury
- severity of injury
- knowledge of the user
- overall importance

Apart from hazards that are unknown and have a high likelihood of producing an injury or that the injury can be particularly severe, manufacturers should also consider practical considerations. Sometimes, space limitations (e.g., a small label) or time limitations (e.g., a 30 second television advertisement) do not permit them to address all hazards. Warnings for



hazards with higher priority should be placed in the most conspicuous locations—usually on the product itself—and possess features and characteristics that make it more likely users will notice it. Lower priority warnings might be placed in secondary components, such as in package inserts or manuals.

Manufacturers should be wary of placing warnings only in a product manual. The reason is that, as a method of hazard control, the effectiveness of warnings in product manuals can be quite limited. Low priority warnings may end up being one of a long list of items in a product manual that many people do not read thoroughly (Mehlenbacher et al., 2002). For these reasons (and others), it is usually preferable to place relevant warnings directly on the product whenever it is feasible to do so. However, accomplishing this goal sometimes requires the use of alternate label designs (e.g., peel-off labels, tags) to increase the available surface space (e.g., Wogalter and Young, 1994). Formatting also becomes more critical in this context as better formatting can help make the labeled information easier to grasp. We will discuss formatting in detail later in this chapter.

Since manufacturers may not always include a complete listing of the hazards associated with their products directly on the labeling, caregivers should take care to read any materials that accompany products very carefully and seek out additional sources (e.g., CPSC alerts).

**WHOM TO WARN:** In general, warnings should either address people exposed to the hazard or those in the best position to do something about it. People in the best position to provide assistance—such as caretakers—may not themselves be directly at risk. Some examples include warnings about the choking hazards posed by certain foods and toys (see Figure 14.10) and the side effects and contraindications of children's medicines.

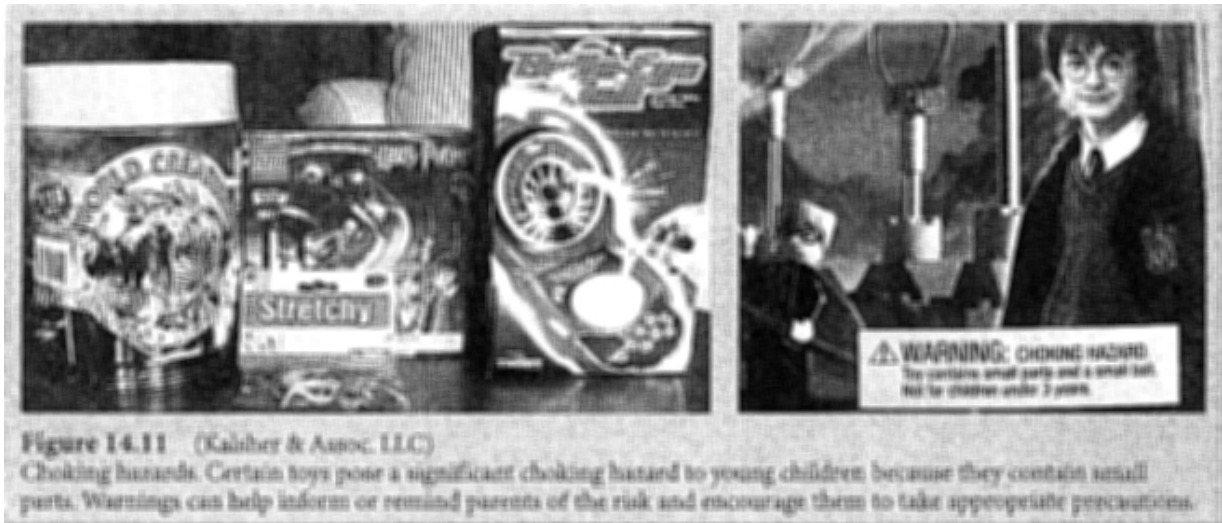
Since 1994, the Child Safety Protection Act (CSPA) has required that toys intended for children between the ages of 3 and 6 years that contain small parts include an explicit choke hazard warning, such as the ones depicted in Figure 14.11.

Warnings for many of these types of hazards are directed to adult caregivers. Therefore, it is critical that characteristics of the target audience or receivers of the warnings be taken into account in their design (Laughery and Hammond, 1999). Sometimes older children are able to assist in their own protection.

The warning pictogram depicted at right started to appear on toy package labels in 1995 in European Union countries. It warns that the toy is unsuitable for children under 3 years. The pictogram was designed with the intent of avoiding the need to use many languages on the packaging (Aakerboom et al., 1995; Van Duijne et al., 2006). Similar warning labels are required for other toys that present a choking hazard to small children, including small balls, marbles, and balloons.



**Figure 14.10** Toy safety pictogram. The prohibition symbol (circle slash) is red.



### ANSI Z535.4 WARNING DESIGN GUIDELINES

The American National Standards Institute's Z535.4 standard is a set of minimum guidelines for the design of warning labels in the United States (ANSI, 2002).

According to these guidelines, product safety labels should communicate:

- the nature or type of hazard (e.g., shock, cut, burn)
- the seriousness of the hazard
- the likely consequence(s) of coming into contact with the hazard
- how to avoid the hazard

#### ANSI Z535.4

The guidelines for warnings change when new information becomes available. They were first published in 1991, but were based on earlier guidelines (FMC, 1978; Westinghouse, 1981). The standard was revised in 1998 and again in 2002.

BOX 14.7 ANSI Z535.4 GUIDELINES FOR SIGNAL WORDS ON WARNING LABELS		
Signal Word	Warning Indication	Colors
DANGER	An imminently hazardous situation, which <i>will</i> result in death or serious injury, if not avoided. For the most extreme situations.	White letters against a red background
WARNING	A potentially hazardous situation that <i>could</i> result in death or serious injury, if not avoided.	Black letters on an orange background
CAUTION	A potentially hazardous situation that may result in minor or moderate injury, if not avoided. Can also alert against unsafe practices.	Black letters on a yellow background

A sample ANSI-style warning is presented in Figure 14.12. The warning conveys the seriousness of the hazard (i.e., drowning) with a signal word printed in a separate panel. All letters of the signal word should be capitalized and the size of the font should be 50% larger than all other information presented on the warning label. The ANSI guidelines recommend the use of the following three signal words—DANGER, WARNING, or CAUTION—to convey high to low levels of hazard, respectively. Although many people do not know the intended difference between WARNING and CAUTION, most adult, English-speaking users appreciate that both denote a somewhat lower degree of hazard as compared to DANGER (e.g., Wogalter and Silver, 1990, 1995). ANSI Z535 also recommends the use of comprehensible pictorial symbols.

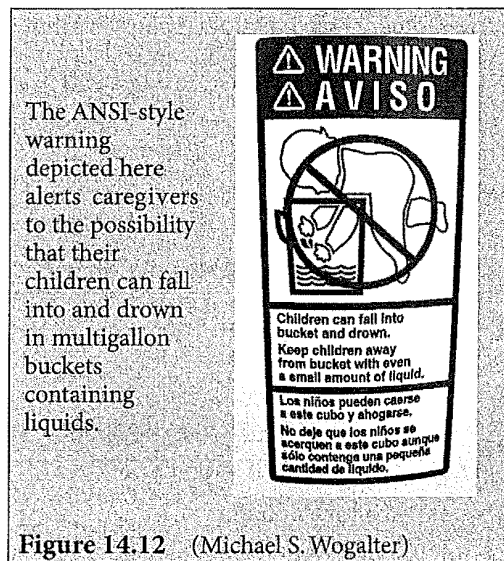


Figure 14.12 (Michael S. Wogalter)

#### ADDITIONAL WARNING DESIGN GUIDELINES

Although ANSI standards provide a good starting point for designing effective warnings, there are other sources of guidelines available, albeit in a more diffuse form. Helpful tips are available in the extensive body of research on warnings or in specific regulations.

Table 14.2 presents a set of guidelines regarding the format and content of components that comprise product warnings. These recommendations may be useful in increasing warning effectiveness in terms of conspicuity, comprehension, and compliance (ANSI, 2002; Laughery et al., 1994; Wogalter, 2006; Wogalter et al., 1999).

Warning Component	Table 14.2 Warning Design Guidelines
<b>Format</b>	<ul style="list-style-type: none"> <li>• Warning must be large enough to be seen and read by the intended audience.</li> <li>• Left-justify text.</li> <li>• Consistently position component elements.</li> <li>• Orient messages to read from left to right.</li> <li>• List the most important warning statements first.</li> <li>• Use bullet lists, indenting, and white space to organize and communicate points or steps.</li> </ul>
<b>Signal Words</b>	<ul style="list-style-type: none"> <li>• Place alert symbols in front of the signal words. The alert symbol is a triangle enclosing an exclamation point.</li> <li>• <i>Danger</i>—Indicates an immediately hazardous situation that will result in death or serious injury if not avoided; use only in extreme situations. Print in white with a red background.</li> <li>• <i>Warning</i>—Indicates a potentially hazardous situation that may lead to death or serious injury if not avoided. Print in black with an orange background.</li> <li>• <i>Caution</i>—Indicates a potentially hazardous situation that may result in minor or moderate injury. Can also alert against unsafe practices. Print it in black on a yellow background.</li> <li>• <i>Notice</i>—Important, nonhazard information. Only use this signal word to inform users. It is not for hazardous situations. Print in blue on a white background.</li> </ul>
<b>Message Wording</b>	<ul style="list-style-type: none"> <li>• Messages should include:               <ol style="list-style-type: none"> <li>1. hazard information</li> <li>2. instructions on how to avoid the hazard</li> <li>3. consequences of failing to comply with the warning</li> </ol> </li> <li>• Be explicit—tell the reader exactly what to do or not do.</li> <li>• Use concrete rather than abstract wording.</li> <li>• Use as little text as necessary to convey the message clearly.</li> <li>• Use short statements rather than long complicated ones.</li> <li>• Use short and familiar words.</li> <li>• Avoid using abbreviations that the intended population may not understand.</li> <li>• Use active rather than passive voice.</li> <li>• Avoid using words or statements that might have multiple interpretations.</li> <li>• Evaluate or test the message with a target-audience sample.</li> </ul>
<b>Pictorial Symbols</b>	<ul style="list-style-type: none"> <li>• Use symbols that have been evaluated via comprehension testing.</li> <li>• Don't use symbols that are likely to generate confusion.</li> <li>• Use bold figures that have sufficient detail to communicate the message effectively.</li> <li>• Components of the symbol should be legible by persons in the target audience and at expected reading distances.</li> </ul>
<b>Font</b>	<ul style="list-style-type: none"> <li>• Use mixed case letters. Avoid all caps except for signal words or to emphasize specific words.</li> <li>• Use simple and familiar fonts.</li> <li>• Use sans serif fonts (Arial, Helvetica, etc.) for signal words and large size print.</li> <li>• Use serif (Times, Times New Roman, etc.) fonts for smaller type sizes.</li> <li>• Characters should be thick and bold and should not be crowded or spaced awkwardly.</li> </ul>

**INTERNATIONAL ORGANIZATION FOR STANDARDIZATION AND AMERICAN NATIONAL STANDARDS INSTITUTE:** The leading standard organization for the design of safety labels, signs, colors, and symbols outside of the U.S. is the International Organization for Standardization (ISO). The ISO standards relevant to the design of warnings are ISO 3864 and ISO 9186. ISO 3864 specifies international standards for safety labels. ISO 9186 describes test methods for assessing the comprehensibility of graphical symbols.

One of the most substantial differences between American National Standards Institute (ANSI)-style and ISO-style warnings concerns the use of text. Current ISO standards recommend graphical symbols—*not* text—in safety warnings. According to ISO, using text to convey hazard information can pose problems for people who are unable read the language in which the text is written. ANSI allows a symbol to be substituted for all or a portion of a text-based safety message, as long as the symbol has been tested and meets specific criteria: 85% comprehension with fewer than 5% critical confusions (misunderstandings of the intended meaning). If a symbol is substituted for all or a portion of a text message, ANSI still requires the use of a signal word (DANGER, WARNING, CAUTION) to communicate the hazard's level of seriousness. If a text message is used, ANSI recommends that the message describes the hazard, consequences, and instructions for how to avoid injury (e.g., use personal protective equipment).

The existence of more than one set of standards and guidelines can lead to conflicting recommendations. Although there are ongoing efforts to harmonize the ANSI and ISO standards, manufacturers must make the ultimate decisions regarding the design of warnings for their product.

### **WARNINGS THAT TARGET CHILDREN**

As children get older, they develop a larger repertoire of cognitive abilities and can understand hazardous situations and product warnings. However, warnings intended for young children must be designed differently than those aimed at older children or adults.

Most guidelines tend to focus on warnings that target adults because:

- a. adults bear primary responsibility for their children's safety
- b. very young children lack cognitive abilities to understand the ramifications of a warning and even older children have significant variability in cognitive abilities across ages and within age groups (Nixon et al., 1980)
- c. adults purchase most products for children and use warnings to guide their purchasing decisions

Nevertheless, well-designed, understandable warnings may assist caregivers to keep children safe. For example, Figure 14.13 shows example signs indicating to drivers of motor vehicles that children may be playing in the area. The danger is that younger children may enter the street without looking for oncoming vehicles. Usually signs like these are placed in residential areas because children commonly play in yards adjacent to streets.

Such signs would not be expected in business districts and major freeways. Signs like these serve as a reminder to drivers to be mindful that children may be in the area, but certainly drivers should realize the potential of children playing in other areas where no signs are posted. Similarly, airbag warning stickers in the U.S. state that children 12 and under are at risk of death and serious injury when sitting in a passenger position fitted with an airbag. Obviously, this sticker would not communicate to an infant, but most 8–12-year-olds



Figure 14.13 (Michael S. Wogalter)  
*Children At Play signs. Signs like these are posted to indicate that children may be playing in the area and may enter a street without looking.*

are capable of reading it. The mere presence of the warning sticker may help to bolster the caregiver's authority when they ask children to sit in the back seat.

Developing several different versions of a warning—or a warning with multiple components—can help to accommodate different age groups and ability differences present within an age group.

### DESIGNING WARNINGS FOR CHILDREN

Designers of warnings for children need to consider their unique strengths and limitations. They also need to recognize that children vary considerably across a wide range of dimensions, including their level of maturity. This is true with children even within a relatively narrow age range. As a result, it is critical that designers take steps to systematically evaluate warnings developed for children with a representative target group to ensure these materials exert the intended effects.

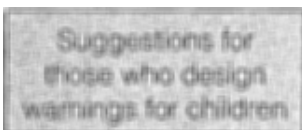
The mere presence of warnings, as opposed to their absence, could have unintended effects on children (Schneider, 1977). That is, some research suggests that some kinds of warnings in some kinds of situations may actually have a “boomerang” effect on children engaging in risky behaviors (Bushman and Stack, 1996). Similarly, some children may be especially attracted to items or activities they view as “forbidden fruit,” particularly if they see an older sibling or adult using the item—for example, an inappropriate movie or video game (Bushman and Stack, 1996; Handelsman and Parent, 1995). In these situations, some older children may view product warnings as messages that restrict their personal freedom as opposed to sources of information that can help them make better decisions. As a result, they may be inclined to respond in a manner inconsistent with the warning (e.g., Brehm, 1966). As Resnick (2006) describes, adolescents are frequently attracted to the warnings associated with certain music labels, movies, and TV shows (e.g., Christenson, 1992).





**Figure 14.14** (Kalsher & Assoc. LLC)  
Product packaging similarity and safety. Children may have difficulty distinguishing certain household chemicals from consumable foods and beverages because of similarities in the product's appearance and packaging. As shown in this photo, the degree of similarity in the appearance of edible and nonedible products varies considerably.

Warnings may produce unintended effects if they are misunderstood. For example, children may not avoid poisonous substances labeled with the skull and crossbones symbol if they do not know it is intended to mean "poison." Children may also be mistakenly attracted to dangerous products due to characteristics of the product's packaging including color, the container's shape (see, for example, Wogalter et al., 1997), and the presence of symbols or other characteristics. Pediatricians and poison control specialists note that young children are often poisoned when they mistake dangerous chemicals and their packaging for consumable foods and beverages (Ustinova, 2004). For instance, citrus-scented chlorine bleach may be mistaken for orange juice; blue cleaning fluid for a similarly colored sports drink; and powdered cleanser for parmesan cheese (see Figure 14.14). Similar types of errors might also occur with adults who cannot read the warning text due to insufficient language skill.



Since relatively little is known about how to design warnings for younger children, any warning that targets children should be evaluated thoroughly. Yet, some guidelines for adult populations (e.g., Table 14.2) —with the appropriate cautions—may apply:

- *Use unambiguous language.* For older children and adolescents, warnings probably should include explicit language (e.g., "*Cigarettes Kill: One in every 3 smokers will die from smoking!*"). Warnings that do not have explicit language (e.g., "*Surgeon General's Warning: Quitting Smoking Now Greatly Reduces Risk to Your Health*") are less effective (Krugman et al., 1994).
- *Make warnings "stand out."* Warnings should generally incorporate formatting characteristics such as bright colors and the use of contrast to capture children's attention. However, it is important to avoid labeling characteristics that may draw younger children to hazardous products or lead them to believe that the product is safer than it really is (e.g., color pictures; cartoon characters).

- *Evaluate the warnings.* Manufacturers should systematically examine the warnings associated with their product to determine if they are achieving the intended goal of hazard control and not exerting any harmful effects (e.g., attracting children to potential hazards rather than deterring them from the hazards). Since evaluation is such a critical step in hazard control, we provide more information about evaluating warnings later in this chapter.

Some of the most effective warnings come from a child's caregivers. Sharp rebukes (e.g., "Don't touch that!") issued by parents to their children can be effective vehicles for preventing injury. Although very young children may not understand the reasons for a scolding, they quickly learn what they can and cannot touch especially when an admonition is paired with other safe, parent-imposed consequences (e.g., timeout; praise for safe behavior when it occurs).

Fortunately, as children mature, they increasingly learn and begin to understand why some "things" may be unsafe. In general, warnings should (cue or) convey information about the hazard, likely consequences (and their severity), and instructions on how to avoid injury. We believe there is some merit to using this format as a framework for teaching children about safety. In other words, caregivers can take the basic information from well-designed warning labels and "translate" it to their children.

As children get older and gain more experience with potentially hazardous products and situations, caregivers might also enlist their participation in developing and implementing procedures for conducting home safety audits and reporting emergencies.

## PICTORIAL SYMBOLS

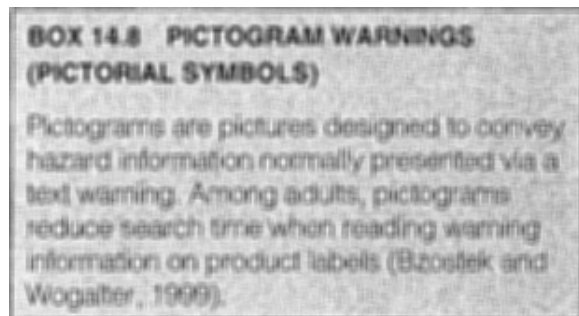
The best approach for conveying hazard information to very young children may be pictorial symbols or *pictograms* (Department of Trade and Industry, 1999; see Box 14.8).

Since some pictograms and the concepts they represent can be quite abstract, caregivers should explain the meaning of relevant pictograms to children so they will be able to avoid the respective hazards on their own. That is, children who are familiar with a pictorial are more likely to understand and comply than children who are not (DeLoache, 1991).

Mr. Yuk is a pictograph designed to prevent accidental poisoning of young children.\*

Research settings have shown some pictorials are effective in conveying information to children as young as 30 months of age (DeLoache and Burns, 1994). However, the true effectiveness of pictorials with children is unknown because laboratory settings lack the types of distractions ordinarily present in everyday life.

An example of a pictograph developed for use directly with small children is Mr. Yuk. The Pittsburgh Poison Center at Children's Hospital of Pittsburgh created Mr. Yuk in 1971 to educate children and adults about poison prevention and to promote poison awareness. His image appears on bright green stickers that are to be placed on containers of poisonous substances. The idea is that with training, children learn to avoid products labeled with the Mr. Yuk stickers. However, tests of the effectiveness of Mr. Yuk stickers have produced mixed results (Ferguson et al., 1982; Oderda and Klein-Schwartz, 1985).



\* Obtain stickers by sending a self-addressed stamped business size envelope to Mr. Yuk c/o Pittsburgh Poison Center, Children's Hospital of Pittsburgh, 3705 Fifth Avenue, Pittsburgh, PA 15213-2583, U.S.A.

Designers must carefully test pictorials to determine whether children notice, comprehend and comply with the warning's directive (ANSI, 2002; ISO, 1988). For example, as we noted previously, children who are not told otherwise may interpret the ubiquitous skull and crossbones pictograph (Figure 14.15) to mean “pirate food” (Schneider, 1977).

This simple example highlights the importance of careful tests of symbols or warnings for children. By ensuring that symbols communicate their meanings effectively, testing reduces the chances that children will misunderstand their meaning and as a result be injured. Parents can also play an important role by teaching their children that the skull and crossbones symbol is sometimes used to indicate poison.

**Figure 14.15** The Skull and Crossbones Pictorial. Children may misinterpret some pictographs, such as the skull and crossbones symbol depicted here. This highlights the need for careful testing of this and other pictographs before use on hazardous products.



### ALTERNATIVE WARNING METHODS

Warnings should focus on more than a child's visual and language comprehension capabilities. Olfactory and auditory warnings can also convey hazard information to children who might not otherwise be reached by written or pictorial warnings. Children who have difficulty reading or interpreting pictorial symbols may benefit from warnings they can hear, taste, or smell.

- *Sound.* Some warnings work by emitting a loud sound, such as a fire alarm.
- *Taste.* Adding a bitter taste to household chemicals not only guards against but also warns about the hazard.
- *Smell.* Utility companies use a similar approach, adding an odor to otherwise odorless natural gas to warn people of the presence of a gas leak.

Odors can also alert children to the presence of other types of hazards, such as by adding undesirable odors to potentially poisonous products. Children are fairly good at determining whether something is edible based on its odor (Wijk and Cain, 1994). For this reason, manufacturers should avoid pleasant odors, such as “fresh” or “lemon scented.” If used, manufacturers should also add other methods of guarding or warning, such as child resistant caps, bitter taste, and unattractive container labels.

Advances in technology have made it possible to develop voice warnings to alert children to potentially hazardous situations. Inexpensive voice chips and digitized sound processor technology could be used in novel ways to create effective warnings for children. Speech-based warnings can sometimes be more effective than print-based warnings (Wogalter et al., 1993; Wogalter and Young, 1991)—particularly with very young children who comprehend spoken language before they can produce or read it.



**Figure 14.16** (Michael S. Wogalter) New technologies have given rise to the development of alternative approaches to warnings, such as the recordable smoke detector depicted here. Careful testing can highlight the strengths—and limitations—of these products.

Manufacturers must make sure the target group understands not only the warning words but also the entire intended message. Manufacturers also need to determine the conditions in which speech-based warnings will work. For example, *recordable smoke alarms* (Figure 14.16) allow a caregiver to record a message (e.g., "Get up! There's a fire!") that plays when the device's alarm sounds.

## EDUCATING CHILDREN ABOUT HAZARDS

### Individual

Education is an important injury prevention tool that can help caregivers and children appreciate hazards. We have already mentioned using the ANSI components to tell older children more fully about hazards, consequences, and instructions on how to avoid hazards. Commonly, verbal warnings from parents or teachers educate children—especially very young children—by conveying important safety rules (Peterson and Saldana, 1996; Zeece and Crase, 1982). Parents' and teachers' views of safety are therefore especially strong determinants of a child's ability to recognize and respond appropriately to hazards they encounter (Uchiyama and Ito, 1999).

### Group

Public education also informs children and their parents about safety. Individuals and groups can receive specific safety-related instruction via presentations or handouts. Teachers often use multiple methods of conveying information to children in their classes, including safety videos, visits to or from subject-matter experts (firefighters, police, emergency medical technicians) and safety-related activities (e.g., safety-oriented coloring books, development of home-safety checklists for their parents, and school-based emergency drills).

### Large Scale Programs

Large-scale hazard implementation involves more than just education. It can include safety prevention programs at community, state, or national levels. Box 14.9 shows a list of potential components in a large-scale program focusing on child car seats.

Additional examples are provided in the sections that follow.

*Mr. Yuk.* The Pittsburgh Poison Center devised a large-scale educational program with their symbol, Mr. Yuk. Caregivers teach their children about hazards at home by placing Mr. Yuk stickers on various products (e.g., poisonous chemicals) and other potentially dangerous objects (e.g., electrical outlets). Then, each time the child attempts to touch anything with Mr. Yuk on it, they receive a mild scolding (e.g., "Don't touch that!"). Children soon learn not to touch dangerous objects.

### BOX 14.9 CHILD CAR SEATS

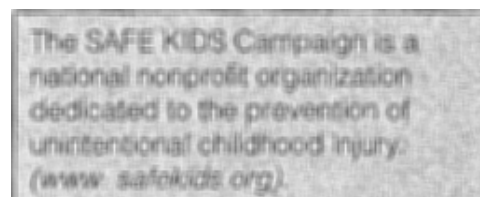
A safety program on children's car seats could contain a variety of educational products and demonstrations, for adults and for children, such as:

- banners across busy streets announcing *Car Seat Safety Week*
- news briefs in the local media
- fliers from daycares and schools sent home to parents
- demonstrations on how to install child safety seats in vehicles for parents and teaching children about bicycle safety by having them bring their bicycles and helmets in for inspection during a "bike parade"
- distribution of coupons for financial savings on purchases of car seats
- a school visit by a local policeman who talks about safety
- instruction to children about how to fasten their own seat belts. Have older children measure themselves to see if they should be in a youth car seat or not.

Problems with the Mr. Yuk program:

- Caregivers must remember to attach Mr. Yuk stickers. Mr. Yuk would be a more effective poison prevention tool if all manufacturers of potentially dangerous household chemicals placed cautionary pictorials on their products prior to sale.
- Once children learn to avoid products that contain the sticker, they may falsely assume that other products are safe.
- If children contact an object labeled with Mr. Yuk and do not experience a negative consequence, they may falsely conclude that doing so in the future—perhaps with a more dangerous product—is okay. Nevertheless, it is usually better to use warnings than not to if the product is poisonous to children.

*Safe Kids.* The National Safe Kids Campaign illustrates a media-based safety program designed to educate caregivers about potential dangers to children (Tamburro et al., 2002). Using multimedia such as television and other advertising to convey hazard information has the benefit of reaching a wider audience than simply using a warning label or sign.



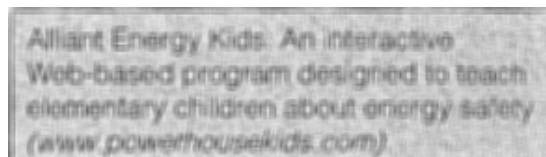
The National SAFE KIDS coalition develops injury prevention strategies and conducts public outreach and awareness campaigns throughout the United States.

The spokesperson who delivers safety-related information can have a significant effect on adult consumers and their children. It is important to select a spokesperson who the audience considers relevant when conveying messages via the mass media (Wogalter et al., 1997). A physician, school principal, well-known celebrity, or other authority figure may facilitate credibility and believability of hazard-related messages.

*Energy Kids.* Mass media programs such as the National Safe Kids campaign and *Energy Kids* employ the Internet to disseminate safety-related information. Alliant Energy, an energy holding company in Madison, Wisconsin, created *Energy Kids* to teach children about energy safety and conservation ([www.powerhousekids.com](http://www.powerhousekids.com)).

*Energy Kids* is an interactive Web-based program that targets children in third and fourth grades. Currently, the *Energy Kids* program has three modules that address electrical safety, natural gas safety, and storm safety respectively. As students use a computer mouse to move the cursor over different rooms of a house, a relevant safety-related message pops up when the cursor moves over a potential hazard. Each module is designed to complement a classroom presentation by a guest speaker.

*Self-help materials.* Self-help and related education materials written for new parents can also provide a great deal of information on a wide variety of topics, including childcare, health, and safety. Many childcare books offer extensive reviews of common hazards present in homes and other settings (e.g., playgrounds).



Unfortunately, this information may only reach parents who are more highly educated and motivated to search for safety-related information concerning their children.

Fortunately, many parents receive free safety information packets from hospitals and birthing class instructors, as well as through product promotions. Some hospitals have in-room televisions with programs relevant to child safety for mothers who have just given birth.

In summary, there are numerous child safety resources available to children and their caregivers. The best way to ensure child safety is probably through a combination of warnings, prevention programs, and educational materials.

### **TESTING WARNING EFFECTIVENESS**

Although guidelines for warning design are a useful first step, developing effective warnings does not stop there. Testing with a target population can help ensure effectiveness.

Many designers think they know when particular warning designs work and then find the target users interpret the entire design differently during testing. For example, warnings that are effective with adults might have very different results with children.

#### **Comprehension and Behavioral Testing**

Two major types of testing are *comprehension* and *behavioral* testing. *Comprehension* testing helps determine if members of the target audience understand the textual and pictorial warning components. ANSI and ISO have developed guidelines for testing

the comprehension of pictorial symbols.

It is important to evaluate warnings and warning components (e.g., symbols) before use (Kalsher et al., 2000). Well-designed pictorial symbols can communicate hazards effectively to consumers with varied educational and cultural backgrounds. Pictorial symbols are especially valuable when combined with verbal warnings and instructions (e.g., Soujourner and Wogalter, 1997).

Just as well-designed pictorials can contribute significantly to the effectiveness of a warning, poorly designed symbols can result in dangerous comprehension errors. Thus, in order to produce effective warnings, pictorial symbols must be designed and tested repeatedly for an acceptable level of comprehension among the target group.

*Testing Marshmallow Warnings.* People do not usually consider it hazardous to eat marshmallows, despite the fact that some children have died through suffocation or are permanently injured after choking on them or related foods (Kalsher et al., 1999). Why are marshmallows hazardous? Because marshmallows possess characteristics that make them especially dangerous to children: (1) they are sweet and therefore attract children; (2) young children do not chew food completely before swallowing; (3) marshmallows appear soft and therefore, innocuous to parents; (4) marshmallows become stickier and swell when they contact the moisture present in the mouth; (5) an aspirated piece of marshmallow can be very difficult to dislodge because it continues to expand after entering the airway, thereby efficiently obstructing airways, including the trachea; and (6) marshmallows are light and can therefore be easily inhaled into the respiratory system (e.g., Kalsher et al., 1999; Rothman and Boeckman, 1980).

One study compared the effectiveness of warnings that depict choking hazards from eating marshmallows (Kalsher et al., 2000). Researchers asked participants to rate how well



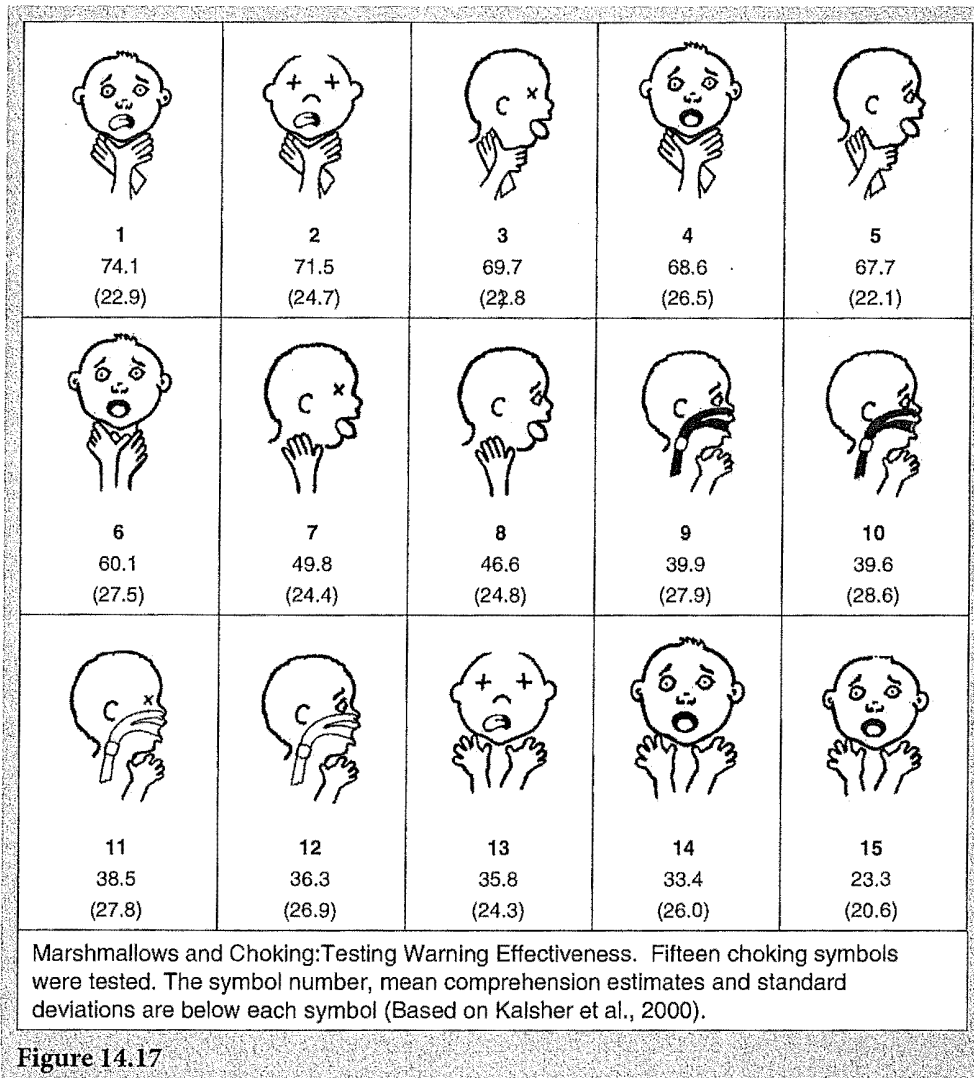


Figure 14.17

pictorial symbols communicated the idea of a choking hazard. As shown in Figure 14.17, the comprehensibility estimates covered a fairly large range (from 74.1% to 23.3%), suggesting that the symbols differed dramatically in their ability to communicate.

Participants then assembled a combination of any three of the candidate symbols to depict a choking "sequence." The symbols they selected for this purpose were not always the ones that had previously received the highest comprehensibility estimates (Figure 14.18). Interestingly, participants reported that they constructed the multiple-panel pictorials according to how they perceived a choking event would progress over time. Thus, the last symbol in the sequence frequently conveyed loss of consciousness, such as limp or uncrossed hands and the crossed representation of eyes.

As illustrated by these examples, conducting careful evaluation of warnings and warning components is critical to ensure that warnings achieve their intended goals and among those in the intended target audience.

*Behavioral* testing enables researchers to observe how a participant responds to a particular warning. It is sometimes considered the "gold standard" method of determining warning effectiveness.

There is inherent risk when observing whether an adult or a child adheres to a warning's directives in the presence of a (real) hazard. Yet this kind of testing can provide greater assurance that a warning will (or will not) be effective in promoting safe behavior. Behavioral testing methods can be applied to safety and education materials, and when actual safety of a child can be assured.

Unfortunately, behavioral testing cannot always be done because of cost, time, and the risks associated with this type of testing.

If testing indicates that a warning component does not reach satisfactory levels of effectiveness, the symbol or text needs to be modified and reevaluated. Initially, a smaller number of participants can be employed to test prototypes. Once the design is finalized, a more formal test with a larger number of participants is necessary. The process is iterative and should continue until the warning reaches a satisfactory level of effectiveness.

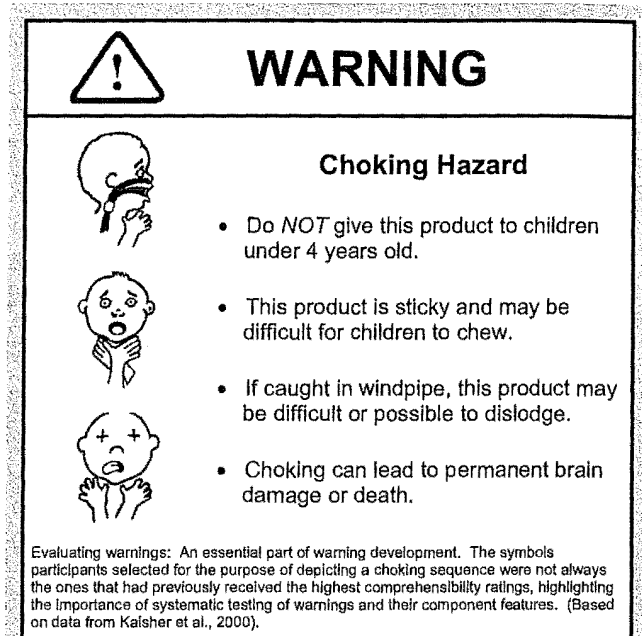


Figure 14.18

## CONCLUSIONS

Manufacturers should eliminate hazards and dangers from children's products whenever possible. Since eliminating all risk is not possible, however, caregivers should also learn about effective injury prevention methods.

This chapter has presented a broad overview of ways to inform children and their caregivers of hazards. It has considered the roles of both manufacturers and caregivers in protecting children through designing out the hazard, guarding against the hazard, and warning about the hazard.

Most warnings for child-related hazards are directed to caregivers, who are then responsible for using that information to keep children safe. They must often "translate" warnings so that their children can comprehend their intended meanings. Manufacturers can assist by designing warnings that have clear and unambiguous meanings to both parents and (whenever feasible) their children. Unfortunately, relatively little is known with regard to developing warnings specifically for children, particularly younger children.

Most children above the age of 8 can read and therefore, may be able to take part in assisting in their own safety. As children get older, they tend to take on increasingly greater responsibility for their safety (e.g., Laughery et al., 1996; Lovvoll et al., 1996). Well-designed symbols may also help if they have attributes that make them understandable to children.

\* Note that in Figures 14.17 and 14.18, symbol creators Jennifer Snow Wolff and Michael S. Wogalter grant free "copyleft" access to these figures. That is, anyone is free to copy, modify, and redistribute the figure so long as the new versions grant the same freedoms to others.

When possible, it is best to test the effectiveness of warnings with caretakers and if possible, children. Testing can help to determine whether a warning accurately communicates its intended message. Testing may also be useful for assessing whether a warning or other aspects of the product's labeling gives rise to misunderstandings or has attractive value to very young children. One benefit of designing warnings directed to older children is that it can bolster a caregiver's admonitions. A caregiver is assisted in telling their child to sit in the back seat of the vehicle because is safer will have some support because they can point to the strong relevant manufacturer's warning on the vehicle's sun visor.

In summary, although warnings and injury prevention programs will not eliminate childhood injuries, they can provide caregivers and their children with the opportunity to make informed decisions about the products they will use and the knowledge of how to use them safely.

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