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Healthy Housing Reference Manual

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"*The connection between health and dwelling is one of the most important that exists.*"

Florence Nightingale

Introduction

It seems obvious that health is related to where people live. People spend 50% or more of every day inside their homes. Consequently, it makes sense that the housing environment constitutes one of the major influences on health and well-being. Many of the basic principles of the link between housing and health were elucidated more than 60 years ago by the American Public Health Association (APHA) Committee on the Hygiene of Housing. After World War II, political scientists, sociologists, and others became interested in the relation between housing and health, mostly as an outgrowth of a concern over poor housing conditions resulting from the massive influx into American cities of veterans looking for jobs. Now, at the beginning of the 21st century, there is a growing awareness that health is linked not only to the physical structure of a housing unit, but also to the neighborhood and community in which the house is located.

According to Ehlers and Steel [1], in 1938, a Committee on the Hygiene of Housing, appointed by APHA, created the Basic Principles of Healthful Housing, which provided guidance regarding the fundamental needs of humans as they relate to housing. These fundamental needs include physiologic and psychologic needs, protection against disease, protection against injury, protection against fire and electrical shock, and protection against toxic and explosive gases.

Fundamental Physiologic Needs

Housing should provide for the following physiologic needs:

1. protection from the elements,
2. a thermal environment that will avoid undue heat loss,
3. a thermal environment that will permit adequate heat loss from the body,
4. an atmosphere of reasonable chemical purity,
5. adequate daylight illumination and avoidance of undue daylight glare,
6. direct sunlight,
7. adequate artificial illumination and avoidance of glare,
8. protection from excessive noise, and
9. adequate space for exercise and for children to play.

The first three physiologic needs reflect the requirement for adequate protection from the elements. The lack of adequate heating and cooling systems in homes can contribute to respiratory illnesses or even lead to death from extreme temperatures. According to the National Weather Service, 98 people died from extreme temperatures in 1996; 62 of these were due to extreme cold. Hypothermia occurs when the body temperature drops below 96°F (46°C). It can occur in any person exposed to severe cold without enough protection. Older people are particularly susceptible because they may not notice the cold as easily and can develop hypothermia even after exposure to mild cold. Susceptibility to the cold can be exacerbated by certain medications, medical conditions, or the consumption of alcohol. Hyperthermia is the name given to a variety of heat-related illnesses. The two most common forms of hyperthermia are heat exhaustion and heat stroke. Of the two, heat stroke is especially dangerous and requires immediate medical attention.

According to the National Institute on Aging (NIA) [2], lifestyle factors can increase the risk for hyperthermia:

Unbearably hot living quarters. This would include people who live in homes without fans or air conditioners. To help avert the problem, residents should open windows at night; create cross-ventilation by opening windows on two sides of the building; cover windows when they are exposed to direct sunlight and keep curtains, shades, or blinds drawn during the hottest part of the day.

Lack of transportation. People without fans or air conditioners often are unable to go to shopping malls, movie theaters, and libraries to cool off because of illness or the lack of transportation.

Inadequate or inoperable windows. Society has become so reliant on climate control systems that when they fail, windows cannot be opened. As was the case in the 2003 heat wave in France, many homes worldwide do not even have fans for cooling.

Overdressing. Older people, because they may not feel the heat, may not dress appropriately in hot weather.

Visiting overcrowded places. Trips should be scheduled during nonrush-hour times and participation in special events should be carefully planned to avoid disease transmission.

Not checking weather conditions. Older people, particularly those at special risk, should stay indoors on especially hot and humid days, particularly when an air pollution alert is in effect.

USCB [3] reported that about 75% of homes in the United States used either utility gas or electricity for heating purposes, with utility gas accounting for about 50%. This, of course, varies with the region of the country, depending on the availability of hydroelectric power. This compares with the 1940 census, which found that three-quarters of all households heated with coal or wood. Electric heat was so rare that it was not even an option on the census form of 1940. Today, coal has virtually disappeared as a household fuel. Wood all but disappeared as a heating fuel in 1970, but made a modest comeback at 4% nationally by 1990. This move over time to more flexible fuels allows a majority of today's homes to maintain healthy temperatures, although many houses still lack adequate insulation.

The fifth through the seventh physiologic concerns address adequate illumination, both natural and artificial. Research has revealed a strong relationship between light and human physiology. The effects of light on both the human eye and human skin are notable. According to Zilber [4], one of the physiologic responses of the skin to sunlight is the production of vitamin D. Light allows us to see. It also affects body rhythms and psychologic health. Average individuals are affected daily by both natural and artificial lighting levels in their homes. Adequate lighting is important in allowing people to see unsanitary conditions and to prevent injury, thus contributing to a healthier and safer environment. Improper indoor lighting can also contribute to eyestrain from inadequate illumination, glare, and flicker.

Avoiding excessive noise (eighth physiologic concern) is important in the 21st century. However, the concept of noise pollution is not new. Two thousand years ago, Julius Caesar banned chariots from traveling the streets of Rome late at night. In the 19th century, numerous towns and cities prohibited ringing church bells. In the early 20th century, London prohibited church bells from ringing between 9:00 PM and 9:00 AM. In 1929, New York City formed a Noise Abatement Commission that was charged with evaluating noise issues and suggesting solutions. At that time, it was concluded that loud noise affected health and productivity. In 1930, this same commission determined that constant exposure to loud noises could affect worker efficiency and long-term hearing levels. In 1974, the U.S. Environmental Protection Agency (EPA) produced a document titled *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare With an Adequate Margin of Safety* [5]. This document identified maximum levels of 55 decibels outdoors and 45 decibels indoors to prevent interference with activities and 70 decibels for all areas to prevent hearing loss. In 1990, the United Kingdom implemented The Household Appliances (Noise Emission) Regulations [6] to help control indoor noise from modern appliances. Noise has physiologic impacts aside from the potential to reduce hearing ability. According to the American Speech-Language-Hearing Association [7], these effects include elevated blood pressure; negative cardiovascular effects; increased breathing rates, digestion, and stomach disturbances; ulcers; negative effects on developing fetuses; difficulty sleeping after the noise stops; plus the intensification of the effects of drugs, alcohol, aging, and carbon monoxide. In addition, noise can reduce attention to tasks and impede speech communication. Finally, noise can hamper performance of daily tasks, increase fatigue, and cause irritability.

Household noise can be controlled in various ways. Approaching the problem during initial construction is the simplest, but has not become popular. For example, in early 2003, only about 30% of homebuilders offered sound-attenuating blankets for interior walls. A sound-attenuating blanket is a lining of noise abatement products (the thickness depends on the material being used). Spray-in-place soft foam insulation can also be used as a sound dampener, as can special walking mats for floors. Actions that can help reduce household noise include installing new, quieter appliances and isolating washing machines to reduce noise and water passing through pipes.

The ninth and final physiologic need is for adequate space for exercise and play. Before industrialization in the United States and England, a preponderance of the population lived and worked in more rural areas with very adequate areas for exercise and play. As industrialization impacted demographics, more people were in cities without ample space for play and exercise. In the 19th century, society responded with the development of playgrounds and public parks. Healthful housing should include the provision of safe play and exercise areas. Many American neighborhoods are severely deficient, with no area for children to safely play. New residential areas often do not have sidewalks or street lighting, nor are essential services available by foot because of highway and road configurations.

Fundamental Psychologic Needs

Seven fundamental psychologic needs for healthy housing include the following:

1. adequate privacy for the individual,
2. opportunities for normal family life,
3. opportunities for normal community life,
4. facilities that make possible the performance of household tasks without undue physical and mental fatigue,
5. facilities for maintenance of cleanliness of the dwelling and of the person,
6. possibilities for aesthetic satisfaction in the home and its surroundings, and
7. concordance with prevailing social standards of the local community.

Privacy is a necessity to most people, to some degree and during some periods. The increase in house size and the diminishing family size have, in many instances, increased the availability of privacy. Ideally, everyone would have their own rooms, or, if that were not possible, would share a bedroom with only one person of the same sex, excepting married couples and small children. Psychiatrists consider it important for children older than 2 years to have bedrooms separate from their parents. In addition, bedrooms and bathrooms should be accessible directly from halls or living rooms and not through other bedrooms. In addition to the psychologic value of privacy, repeated studies have shown that lack of space and quiet due to crowding can lead to poor school performance in children.

Coupled with a natural desire for privacy is the social desire for normal family and community life. A wholesome atmosphere requires adequate living room space and adequate space for withdrawal elsewhere during periods of entertainment. This accessibility expands beyond the walls of the home and includes easy communication with centers of culture and business, such as schools, churches, entertainment, shopping, libraries, and medical services.

Protection Against Disease

Eight ways to protect against contaminants include the following:

1. provide a safe and sanitary water supply;
2. protect the water supply system against pollution;
3. provide toilet facilities that minimize the danger of transmitting disease;
4. protect against sewage contamination of the interior surfaces of the dwelling;
5. avoid unsanitary conditions near the dwelling;
6. exclude vermin from the dwelling, which may play a part in transmitting disease;
7. provide facilities for keeping milk and food fresh; and
8. allow sufficient space in sleeping rooms to minimize the danger of contact infection.

According to the U.S. EPA [8], there are approximately 160,000 public or community drinking water systems in the United States. The current estimate is that 42 million Americans (mostly in rural America) get their water from private wells or other small, unregulated water systems. The presence of adequate water, sewer, and plumbing facilities is central to the prevention, reduction, and possible elimination of water-related diseases. According to the Population Information Program [9], water-related diseases can be organized into four categories:

- waterborne diseases, including those caused by both fecal-oral organisms and those caused by toxic substances;
- water-based diseases;
- water-related vector diseases; and
- water-scarce diseases.

Numerous studies link improvements in sanitation and the provision of potable water with significant reductions in morbidity and mortality from water-related diseases. Clean water and sanitation facilities have proven to reduce infant and child mortality by as much as 55% in Third World countries according to studies from the

1980s. Waterborne diseases are often referred to as "dirty-water" diseases and are the result of contamination from chemical, human, and animal wastes. Specific diseases in this group include cholera, typhoid, shigella, polio, meningitis, and hepatitis A and E. Water-based diseases are caused by aquatic organisms that spend part of their life cycle in the water and another part as parasites of animals. Although rare in the United States, these diseases include dracunculiasis, paragonimiasis, clonorchiasis, and schistosomiasis. The reduction in these diseases in many countries has not only led to decreased rates of illness and death, but has also increased productivity through a reduction in days lost from work.

Water-related diseases are linked to vectors that breed and live in or near polluted and unpolluted water. These vectors are primarily mosquitoes that infect people with the disease agents for malaria, yellow fever, dengue fever, and filariasis. While the control of vectorborne diseases is a complex matter, in the United States, most of the control focus has been on controlling habitat and breeding areas for the vectors and reducing and controlling human cases of the disease that can serve as hosts for the vector. Vectorborne diseases have recently become a more of a concern to the United States with the importation of the West Nile virus. The transmission of West Nile virus occurs when a mosquito vector takes a blood meal from a bird or incidental hosts, such as a dog, cat, horse, or other vertebrate. The human cases of West Nile virus in 2003 numbered 9,862, with 264 deaths. Finally, water-scarce diseases are diseases that flourish where sanitation is poor due to a scarcity of fresh water. Diseases included in this category are diphtheria, leprosy, whooping cough, tetanus, tuberculosis, and trachoma. These diseases are often transmitted when the supply of fresh water is inadequate for hand washing and basic hygiene. These conditions are still rampant in much of the world, but are essentially absent from the United States due to the extensive availability of potable drinking water.

In 2000, USCB [10] reported that 1.4% of U.S. homes lacked plumbing facilities. This differs greatly from the 1940 census, when nearly one-half of U.S. homes lacked complete plumbing. The proportion has continually dropped, falling to about one-third in 1950 and then to one-sixth in 1960. Complete plumbing facilities are defined as hot and cold piped water, a bathtub or shower, and a flush toilet. The containment of household sewage is instrumental in protecting the public from waterborne and vectorborne diseases. The 1940 census revealed that more than a third of U.S. homes had no flush toilet, with 70% of the homes in some states without a flush toilet. Of the 13 million housing units at the time without flush toilets, 11.8 million (90.7%) had an outside toilet or privy, another 1 million (7.6%) had no toilet or privy, and the remainder had a nonflush toilet in the structure.

In contrast to these figures, the 2000 census data demonstrate the great progress that has been made in providing sanitary sewer facilities. Nationally, 74.8% of homes are served by a public sewer, with 24.1% served by a septic tank or cesspool, and the remaining 1.1% using other means.

Vermin, such as rodents, have long been linked to property destruction and disease. Integrated pest management, along with proper housing construction, has played a significant role in reducing vermin around the modern home. Proper food storage, rat-proofing construction, and ensuring good sanitation outside the home have served to eliminate or reduce rodent problems in the 21st century home.

Facilities to properly store milk and food have not only been instrumental in reducing the incidence of some foodborne diseases, but have also significantly changed the diet in developed countries. Refrigeration can be traced to the ancient Chinese, Hebrews, Greeks, and Romans. In the last 150 years, great strides have been made in using refrigeration to preserve and cool food. Vapor compression using air and, subsequently, ammonia as a coolant was first developed in the 1850s. In the early 1800s, natural ice was extracted for use as a coolant and preserver of food. By the late 1870s, there were 35 commercial ice plants in the United States and, by 1909, there were 2,000. However, as early as the 1890s, sources of natural ice began to be a problem as a result of pollution and sewage dumped into bodies of water. Thus, the use of natural ice as a refrigerant began to present a health problem. Mechanical manufacture of ice provided a temporary solution, which eventually resulted in providing mechanical refrigeration.

Refrigeration was first used by the brewing and meat-packing industries; but most households had iceboxes (Figure 2.1), which made the ice wagon a popular icon of the late 1800s and early 1900s. In 1915, the first refrigerator, the Guardian, was introduced. This unit was the predecessor of the Frigidaire. The refrigerator became as necessary to the household as a stove or sewing machine. By 1937, nearly 6 million refrigerators were manufactured in the United States. By 1950, in excess of 80% of American farms and more than 90% of urban homes had a refrigerator.

Adequate living and sleeping space are also important in protecting against contagion. It is an issue not only of

Figure 2.1. Circa 1890 Icebox
Source: Robert R. McCormick Museum, Wheaton, Illinois

privacy but of adequate room to reduce the potential for the transmission of contagion. Much improvement has been made in the adequacy of living space for the U.S. family over the last 30 years. According to USCB [11], the average size of new single homes has increased from a 1970 average of 1,500 square feet to a 2000 average of 2,266 square feet. USCB [11] says that slightly less than 5% of U.S. homes were considered crowded in 1990; that is, they had more than one person per room. However, this is an increase since the 1980 census, when the figure was 4.5%. This is the only time there has been an increase since the first housing census was initiated in 1940, when one in five homes was crowded. During the 1940 census, most crowded homes were found in southern states, primarily in the rural south. Crowding has become common in a few large urban areas, with more than one-fourth of all crowded units located in four metropolitan areas: Houston, Los Angeles, Miami, and New York. The rate for California has not changed significantly between 1940 (13%) and 1990 (12%). Excessive crowding in homes has the potential to increase not only communicable disease transmission, but also the stress level of occupants because modern urban individuals spend considerably more time indoors than did their 1940s counterparts.

Protection Against Injury

A major provision for safe housing construction is developing and implementing building codes. According to the International Code Council one- and two-family dwelling code, the purpose of building codes is to provide minimum standards for the protection of life, limb, property, environment, and for the safety and welfare of the consumer, general public, and the owners and occupants of residential buildings regulated by this code [12].

However, as with all types of codes, the development of innovative processes and products must be allowed to take a place in improving construction technology. Thus, according to the International Code Council one- and two-family dwelling code, building codes are not intended to limit the appropriate use of materials, appliances, equipment, or methods by design or construction that are not specifically prescribed by the code if the building official determines that the proposed alternate materials, appliances, equipment or methods of design or construction are at least equivalent of that prescribed in this code. While the details of what a code should include are beyond the scope of this section, additional information can be found at http://www.iccsafe.org/, the Web site of the International Code Council (ICC). ICC is an organization formed by the consolidation of the Building Officials and Code Administrators International, Southern Building Code Congress International, Inc., and the International Conference of Building Officials [12].

According to the Home Safety Council (HSC) [13], the leading causes of home injury deaths in 1998 were falls and poisonings, which accounted for 6,756 and 5,758 deaths, respectively. As expected, the rates and national estimates of the number of fall deaths were highest among those older than 64 years, and stairs or steps were associated with 17% of fall deaths. Overall, falls were the leading cause of nonfatal, unintentional injuries occurring at home and accounted for 5.6 million injuries. Similar to the mortality statistics, consumer products most often associated with emergency department visits included stairs and steps, accounting for 854,631 visits, and floors, accounting for 556,800 visits. A national survey by HSC found that one-third of all households with stairs did not have banisters or handrails on at least one set of stairs. Related to this, homes with older persons were more likely to have banisters or handrails than were those where young children live or visit. The survey also revealed that 48% of households have windows on the second floor or above, but only 25% have window locks or bars to prevent children from falling out. Bathtub mats or nonskid strips to reduce bathtub falls were used in 63% of American households. However, in senior households (age 70 years and older), 79% used mats or nonskid strips. Nineteen percent of the total number of homes surveyed had grab bars to supplement the mats and strips. Significantly, only 39% of the group most susceptible to falls (people aged 70 years and older) used both nonskid surfaces and grab bars.

Protection Against Fire

An important component of safe housing is to control conditions that promote the initiation and spread of fire. Between 1992 and 2001, an average of 4,266 Americans died annually in fires and nearly 25,000 were injured. This fact and the following information from the United States Fire Administration (USFA) [14] demonstrate the impact that fire safety and the lack of it have in the United States. The United States has one of the highest fire death rates in the industrialized world, with 13.4 deaths per million people. At least 80% of all fire deaths occur in residences. Residential fires account for 23% of all fires and 76% of structure fires. In one- and two-family dwellings, fires start in the kitchen 25.5% of the time and originate in the bedroom 13.7% of the time. Apartment fires most often start in the kitchen, but at almost twice the rate (48.5%), with bedrooms again being the second most common place at 13.4%.

These USFA statistics also disclose that cooking is the leading cause of home fires, usually a result of unattended cooking and human error rather than mechanical failure of the cooking units. The leading cause of fire deaths in homes is careless smoking, which can be significantly deterred by smoke alarms and smolder-resistant bedding and upholstered furniture. Heating system fires tend to be a larger problem in single-family homes than in apartments because the heating systems in family homes frequently are not professionally maintained.

A number of conditions in the household can contribute to the creation or spread of fire. The USFA data indicate that more than one-third of rural Americans use fireplaces, wood stoves, and other fuel-fired appliances as primary sources of heat. These same systems account for 36% of rural residential fires. Many of these fires are the result of creosote buildup in chimneys and stovepipes. These fires could be avoided by

- inspecting and cleaning by a certified chimney specialist;
- clearing the area around the hearth of debris, decorations, and flammable materials;
- using a metal mesh screen with fireplaces and leaving glass doors open while burning a fire;
- installing stovepipe thermometers to monitor flue temperatures;
- leaving air inlets on wood stoves open and never restricting air supply to the fireplaces, thus helping to reduce creosote buildup;
- using fire-resistant materials on walls around wood stoves;
- never using flammable liquids to start a fire;
- using only seasoned hardwood rather than soft, moist wood, which accelerates creosote buildup;
- building small fires that burn completely and produce less smoke;
- never burning trash, debris, or pasteboard in a fireplace;
- placing logs in the rear of the fireplace on an adequate supporting grate;
- never leaving a fire in the fireplace unattended;
- keeping the roof clear of leaves, pine needles, and other debris;
- covering the chimney with a mesh screen spark arrester; and
- removing branches hanging above the chimney, flues, or vents.

USFA [14] also notes that manufactured homes can be susceptible to fires. More than one-fifth of residential fires in these facilities are related to the use of supplemental room heaters, such as wood- and coal-burning stoves, kerosene heaters, gas space-heaters, and electrical heaters. Most fires related to supplemental heating equipment result from improper installation, maintenance, or use of the appliance. USFA recommendations to reduce the chance of fire with these types of appliances include the following:

- placing wood stoves on noncombustible surfaces or a code-specified or listed floor surface;

- placing noncombustible materials around the opening and hearth of fireplaces;

- placing space heaters on firm, out-of-the-way surfaces to reduce tipping over and subsequent spillage of fuel and providing at least 3 feet of air space between the heating device and walls, chairs, firewood, and curtains;

- placing vents and chimneys to allow 18 inches of air space between single-wall connector pipes and combustibles and 2 inches between insulated chimneys and combustibles; and

- using only the fuel designated by the manufacturer for the appliance.

The ability to escape from a building when fire has been discovered or detected is of extreme importance. In the modern home, three key elements can contribute to a safe exit from a home during the threat of fire. The first of these is a working smoke alarm system. The average homeowner in the 1960s had never heard of a smoke alarm, but by the mid-1980s, laws in 38 states and in thousands of municipalities required smoke alarms in all new and existing residences. By 1995, 93% of all single-family and multifamily homes, apartments, nursing homes, and dormitories were equipped with alarms. The cost decreased from $1,000 for a professionally installed unit for a three-bedroom home in the 1970s to an owner-installed $10 unit. According to the EPA [15], ionization chamber and photoelectric are the two most common smoke detectors available commercially. Helmenstein [16] states that a smoke alarm uses one or both methods, and occasionally uses a heat detector, to warn of a fire. These units can be powered by a 9-volt battery, a lithium battery, or 120-volt house wiring. Ionization detectors function using an ionization chamber and a minute source of ionizing radiation. The radiation source is americium-241 (perhaps 1/5,000th of a gram), while the ionization chamber consists of two plates separated by about a centimeter. The power source (battery or house current) applies voltage to the plates, resulting in one plate being charged positively while the other plate is charged negatively. The americium constantly releases alpha particles that knock electrons off the atoms in the air, ionizing the oxygen and nitrogen atoms in the chamber. The negative plate attracts the positively charged oxygen and nitrogen atoms, while the electrons are attracted to the positive plate, generating a small, continuous electric current. If smoke enters the ionization chamber, the smoke particles attach to the ions and neutralize them, so they do not reach the plate. The alarm is then triggered by the drop in current between the plates [16].

Photoelectric devices function in one of two ways. First, smoke blocks a light beam, reducing the light reaching the photocell, which sets off the alarm. In the second and more common type of photoelectric unit, smoke particles scatter the light onto a photocell, initiating an alarm. Both detector types are effective smoke sensors and both must pass the same test to be certified as Underwriters Laboratories (UL) smoke detectors. Ionization detectors respond more quickly to flaming fires with smaller combustion particles, while photoelectric detectors respond more quickly to smoldering fires. Detectors can be damaged by steam or high temperatures. Photoelectric detectors are more expensive than ionization detectors and are more sensitive to minute smoke particles. However, ionization detectors have a degree of built-in security not inherent to photoelectric detectors. When the battery starts to fail in an ionization detector, the ion current falls and the alarm sounds, warning that it is time to change the battery before the detector becomes ineffective. Backup batteries may be used for photoelectric detectors that are operated using the home's electrical system.

According to USFA [14], a properly functioning smoke alarm diminishes the risk for dying in a fire by approximately 50% and is considered the single most important means of preventing house and apartment fire fatalities. Proper installation and maintenance, however, are key to their usefulness. Figure 2.2 shows a typical smoke alarm being tested.

Following are key issues regarding installation and maintenance of smoke alarms. (Smoke alarms should be installed on every level of the home including the basement, both inside and outside the sleeping area.)

- Smoke alarms should be installed on the ceiling or 6–8 inches below the ceiling on side walls.

- Battery replacement is imperative to ensuring proper operation. Typically, batteries should be replaced at least once a year, although some units are manufactured with a 10-year battery. A "chirping" noise from the unit indicates the need for battery replacement. A battery-operated smoke alarm has a life expectancy of 8 to 10 years.

- Battery replacement is not necessary in units that are connected to the household electrical system.

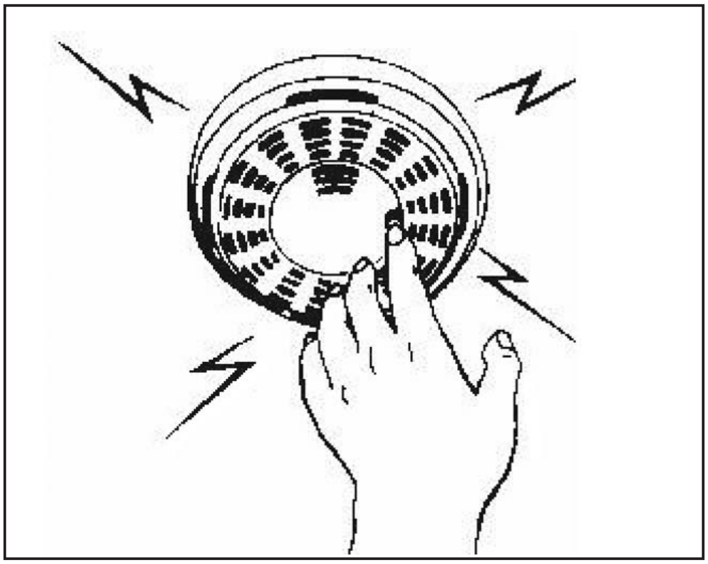

Figure 2.2. Smoke Alarm Testing
Source: Federal Emergency Management Agency

- Regardless of the type, it is crucial to test every smoke alarm monthly. Data from HSC [13] revealed that only 83% of individuals with fire alarms test them at least once a year; while only 19% of households with at least one smoke alarm test them quarterly.

A second element impacting escape from a building is a properly installed fire-suppression system. According to USFA [14], sprinkler systems began to be used over 100 years ago in New England textile mills. Currently, few homes are protected by residential sprinkler systems. However, UL-listed home systems are available and are designed to protect homes much faster than standard commercial or industrial sprinklers. Based on approximately 1% of the total building price in new construction, sprinkler systems can be installed for a reasonable price. These systems can be retrofitted to existing construction and are smaller than commercial systems. In addition, homeowner insurance discounts for such systems range between 5% and 15% and are increasing in availability.

The final element in escaping from a residential fire is having a fire plan. A 1999 survey conducted by USFA [14] found that 60% of Americans have an escape plan, with 42% of these individuals having practiced the plan. Surprisingly, 26% of Americans stated they had never thought about practicing an escape plan, and 3% believed escape planning to be unnecessary. In addition, of the people who had a smoke alarm sound an alert over the past year before the study, only 8% believed it to be a fire and thought they should evacuate the building.

Protection from electrical shocks and burns is also a vital element in the overall safety of the home. According to the National Fire Protection Association (NFPA) [17], electrical distribution equipment was the third-leading cause of home fires and the second-leading cause of fire deaths in the United States between 1994 and 1998. Specifically, NFPA reported that 38,300 home electrical fires occurred in 1998, which resulted in 284 deaths, 1,184 injuries, and approximately $670 million in direct property damage. The same report indicated that the leading cause of electrical distribution fires was ground fault or short-circuit problems. A third of the home electrical distribution fires were a result of problems with fixed wiring, while cords and plugs were responsible for 17% of these fires and 28% of the deaths.

Additional investigation of these statistics reveals that electrical fires are one of the leading types of home fires in manufactured homes. USFA [14] data demonstrate that many electrical fires in homes are associated with improper installation of electrical devices by do-it-yourselfers. Errors attributed to this amateur electrical work include use of improperly rated devices such as switches or receptacles and loose connections leading to overheating and arcing, resulting in fires. Recommendations to reduce the risk of electrical fires and electrocution include the following:

1. Use only the correct fuse size and do not use pennies behind a fuse.

2. Install ground fault circuit interrupters (GFCI) on all outlets in kitchens, bathrooms, and anywhere else near water. This can also be accomplished by installing a GFCI in the breaker box, thus protecting an entire circuit.

3. Never place combustible materials near light fixtures, especially halogen bulbs that get very hot.

4. Use only the correct bulb size in a light fixture.

5. Use only properly rated extension cords for the job needed.

6. Never use extension cords as a long-term solution to the need for an additional outlet. Size the extension cord to the wattage to be used.

7. Never run extension cords inside walls or under rugs because they generate heat that must be able to dissipate.

Fire Extinguishers

A fire extinguisher should be listed and labeled by an independent testing laboratory such as FM (Factory Mutual) or UL. Fire extinguishers are labeled according to the type of fire on which they may be used. Fires involving wood or cloth, flammable liquids, electrical, or metal sources react differently to extinguishers. Using the wrong type of extinguisher on a fire could be dangerous and could worsen the fire. Traditionally, the labels A, B, C, and D have been used to indicate the type of fire on which an extinguisher is to be used.

Type A—Used for ordinary combustibles such as cloth, wood, rubber, and many plastics. These types of fire usually leave ashes after they burn: Type A extinguishers for ashes. The Type A label is in a triangle on the extinguisher.

Type B—Used for flammable liquid fires such as oil, gasoline, paints, lacquers, grease, and solvents. These substances often come in barrels: Type B extinguishers for barrels. The Type B label is in a square on the extinguisher.

Type C—Used for electrical fires such as in wiring, fuse boxes, energized electrical equipment, and other electrical sources. Electricity travels in currents; Type C extinguishers for currents. The Type C label is in a circle on the extinguisher.

Type D—Used for metal fires such as magnesium, titanium, and sodium. These types of fires are very dangerous and seldom handled by the general public; Type D means don't get involved. The Type D label is in a star on the extinguisher.

The higher the rating number on an A or B fire extinguisher, the more fire it can put out, but high-rated units are often the heavier models. Extinguishers need care and must be recharged after every use—a partially used unit might as well be empty. An extinguisher should be placed in the kitchen and in the garage or workshop. Each extinguisher should be installed in plain view near an escape route and away from potential fire hazards such as heating appliances.

Recently, pictograms have come into use on fire extinguishers. These picture the type of fire on which an extinguisher is to be used. For instance, a Type A extinguisher has a pictogram showing burning wood. A Type C extinguisher has a pictogram showing an electrical cord and outlet. These pictograms are also used to show what not to use. For example, a Type A extinguisher also show a pictogram of an electrical cord and outlet with a slash through it (do not use it on an electrical fire).

Fire extinguishers also have a number rating. For Type A fires, 1 means 1¼ gallons of water; 2 means 2½ gallons of water, 3 means 3¾ gallons of water, etc. For Type B and Type C fires, the number represents square feet. For example, 2 equals 2 square feet, 5 equals 5 square feet, etc.

Fire extinguishers can also be made to extinguish more than one type of fire. For example, you might have an extinguisher with a label that reads 2A5B. This would mean this extinguisher is good for Type A fires with a 2½-gallon equivalence and it is also good for Type B fires with a 5-square-foot equivalency. A good extinguisher to have in each residential kitchen is a 2A10BC fire extinguisher. You might also get a Type A for the living room and bedrooms and an ABC for the basement and garage.

PASS is a simple acronym to remind you how to operate most fire extinguishers—pull, aim, squeeze, and sweep. Pull the pin at the top of the cylinder. Some units require the releasing of a lock latch or pressing a puncture lever. Aim the nozzle at the base of the fire. Squeeze or press the handle. Sweep the contents from side to side at the base of the fire until it goes out. Shut off the extinguisher and then watch carefully for any rekindling of the fire.

Protection Against Toxic Gases

Protection against gas poisoning has been a problem since the use of fossil fuels was combined with relatively tight housing construction. NFPA [17] notes that National Safety Council statistics reflect unintentional poisonings by gas or vapors, chiefly carbon monoxide (CO), numbering about 600 in 1998. One-fourth of these involved heating or cooking equipment in the home. The U.S. Consumer Product Safety Commission [18] states that in 2001 an estimated 130 deaths occurred as a result of CO poisoning from residential sources; this decrease in deaths is related to the increased use of CO detectors. In addition, approximately 10,000 cases of CO-related injuries occur each year. NFPA [17] also notes that, similar to fire deaths, unintentional CO deaths are highest for ages 4 years and under and ages 75 years and older. Additional information about home CO monitoring can be found in Chapter 5.

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