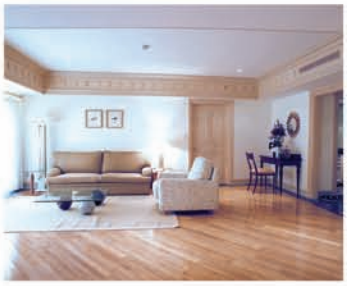
AirAdvice State of Our Indoor Air



A report on indoor air quality issues across North America

REPORT 2007

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About the Report

The AirAdvice mission is to help people live healthier, more comfortable, and safer lives inside their homes, schools, businesses, and other indoor spaces via IAQ education and analysis. The *AirAdvice State of Our Indoor Air Report 2007* provides data and information on the consistent severity of IAQ problems in homes across North America. The purpose of the report is to increase public understanding and awareness of IAQ problems, as well as to offer information and resources regarding effective IAQ solutions.

The data in the *AirAdvice State of Our Indoor Air Report 2007* was gathered in cooperation with a network of over 1500 HVAC-IAQ professionals who placed the AirAdvice IAQ monitoring systems in homes across North America. The findings are based on 49,130 individual IAQ tests conducted during a 34-month period (3/1/2004 – 12/31/2006).

Each of these 49,130 tests represents, on average, 4,320 unique air samples (based on the typical test scenario of one air sample collected per minute during a three-day period). With each unique air sample per minute analyzed for six individual environmental issues, collectively these findings comprise nearly 1.3 billion IAQ data points.

Acknowledgements

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Table of Contents

Introduction

Since 1990, the U.S. Environmental Protection Agency (EPA) has consistently ranked indoor air pollution as one of the top five environmental risks to public health.

Indoor air quality (IAQ) affects our health, comfort, productivity, and quality of life.

During each minute of the more than 21 hours we spend inside our homes and other indoor spaces each day,[1,2] we breathe an average of 12 to 20 times per minute, taking in one to two gallons of air.[3 – 5] Each of those 12 to 20 breaths per minute — or in the case of our children, an average of 16 to 30 breaths per minute — contains not only the oxygen we need to stay alive, but also any airborne pollutants that may be present. Given that indoor air pollution levels are typically two to five times greater than outdoor levels, and occasionally even 25 to 100 times greater,[1,2] the immediate importance of understanding indoor air quality and how we can control and improve our indoor air environment is clear.

Since 1990, the U.S. Environmental Protection Agency (EPA) has consistently ranked indoor air pollution as one of the top five environmental risks to public health. Around the world, a death occurs every 20 seconds due to poor indoor air quality; each day in America alone, 11 people die from asthma. Some of those people are our children: since 1980, the asthma death rate for children under 19 years old has increased by nearly 80%.[6,7]

Despite the many adverse affects known to be associated with indoor air pollution, over half of all Americans are unaware that poor IAQ is one of the top five most urgent environmental risks to public health.[8] Therefore, the *AirAdvice State of Our Indoor Air Report 2007* is presented as:

- A resource for timely information regarding the nature, frequency, and severity of IAQ problems in homes;
- A foundation for discussion of IAQ issues and solutions, including source control and better in-home indoor air practices; and
- A guideline to actions regarding IAQ awareness, education, and improvement.

Why Clean Indoor Air Matters

Indoor air quality directly affects the health, comfort, productivity, and quality of life of anyone who breathes indoor air.

Indoor air quality matters because it directly affects our health, comfort, productivity, and quality of life. Everyone, even healthy adults, is at risk regarding the potential adverse affects of indoor air pollution. Sensitive populations like asthma and allergy sufferers, children, the elderly, diabetics, pregnant women, and those with chronic cardiovascular and respiratory diseases are especially at risk.

Nearly every aspect of home life can potentially generate indoor air pollutants. When trapped and recirculated within the home, these pollutants accumulate over time and can have a serious, long-term adverse effect on occupant health. Some indoor air pollutants can have immediate short-term impact, as well.

Our Health

Indoor air pollution can impact our health both immediately, with symptoms such as headaches, dizziness, and eye, nose, or throat irritation resulting from as little as a single exposure, or over an extended time frame. Respiratory disease, heart disease, and cancer are examples of conditions that may occur or be exacerbated with extended or repeated exposure to polluted indoor air.

Each year, 342,000 lives are claimed by lung disease overall.[9] Asthma and allergies are serious and growing concerns, with asthma alone affecting an estimated 20 million people (one of every 15 Americans). Spending on medications to relieve allergy and asthma symptoms stands at over $5 billion a year.[10] Every day in America: [7, 11 – 15]

- 30,000 people have an asthma attack
- 5,000 people visit the emergency room due to asthma—in fact, asthma accounts for one quarter of all emergency room visits in the U.S. each year
- 1,000 people are admitted to the hospital due to asthma—nearly half (44%) are children
- 11 people die from asthma—a rate that has increased by more than 50% across all age, ethnic, and gender groups since 1980

Specific Pollutant Effects

Chemical pollutants and airborne particle allergens such as dust, pollen, and smoke, can trigger or worsen asthma, allergies, and other respiratory conditions. Other symptoms such as red or burning eyes, nose and throat irritation, shortness of breath, coughing and sneezing, headaches, nausea, dizziness, fatigue, lethargy, poor concentration, rashes, and digestive problems can be attributed to elevated levels of chemical pollutants and airborne particle allergens. Chemical pollutants and airborne particle allergens may be involved in sensitivity syndromes such as chemical sensitivity and sick building syndrome where even healthy individuals may experience adverse health effects in multiple organ systems due in part or whole to chemical pollutants.[16 – 19]

Some indoor air pollutants, particularly radon† (a naturally occurring radioactive gas), and certain chemical pollutants like formaldehyde and benzene are known to cause cancer.

A particularly dangerous indoor air pollutant, carbon monoxide, poses a safety risk because it can quickly cause death in high concentrations. This colorless, odorless gas can also cause many of the above symptoms at lower concentrations.

Temperature and humidity also play a role in our health and well-being because levels that are too high or too low can contribute to illness as well as discomfort. People feel and function at their best within a temperature range of 68 – 77 degrees Fahrenheit (depending on the season) and an ideal relative humidity range of 30% – 55%.[20, 21] Temperatures that are too high, too low, or inconsistent can stress the body, especially in the elderly and young children, while air that is too dry can aggravate asthma and bronchitis.

Incidence of Diseases and Disabilities Attributable to Environmental Contaminants

For the past 20 years, environmental health scientists have been researching the question of how environmental pollutants influence the occurrence of diseases and disabilities in children as well as the cost of these diseases and disabilities to our society as a whole.

These researchers' estimates of proportions of incidence of diseases and disabilities attributable to environmental contaminants support the importance of taking measures to control the environment around us to protect our health.

As an example, according to the study on Environmental Pollutants and Disease in American Children by Philip Landrigan et al,[22] the environmentally attributable fraction range (EAFR)†† for asthma is 10% – 35% (with a best estimate of 30%), 5% for cancer, and 10% for neurobehavioral disorders **(Figure 1).**

Figure 1

Environmentally Attributable Fractions and Best Estimates of Selected Diseases and Disabilities[23]

Disease/Disability	EAFR	Best Estimate
Asthma	10 – 35%	30%
Cardiovascular Disease	5 – 10%	7.5%
Cancer	2 – 10%	5%
Lead Exposure	100%	100%
Birth Defects	2.5 – 5%	2.5%
Neurobehavioral Disorders	5 – 20%	10%

The incidence of these environmentally attributable diseases and disabilities can be reduced or even prevented if exposures to environmental contaminants were reduced or eliminated. One way a homeowner can do this is to ensure that the air inside their home is safe. Given that people spend most of their time indoors, it is possible for homeowners to alleviate the risks of exposure to environmental contaminants by taking control of indoor air quality.

Indoor Chemistry and Health

In the developed world, human exposure to airborne chemicals is dominated by indoor exposures. Inhalation of airborne pollutants is known to adversely affect human health, producing both acute and chronic effects. These include mucous membrane irritation, allergies and asthma, cardiopulmonary effects, and cancer.

According to the National Institute for Occupational Safety and Health (NIOSH) Workgroup Report on Indoor Chemistry and Health,[24] chemicals present in indoor air can react with

† *AirAdvice State of Our Indoor Air Report 2007* data does not include radon testing. However, radon testing is currently available. According to the U.S. Environmental Protection Agency, every home should be tested for radon.

†† EAF (environmentally attributable fraction) model was used to determine the proportion of each attributable disorder to environmental toxins.

one another either in the gas phase or on surfaces, altering concentrations of both reactants and products. Such chemistry is often the major source of free radicals and other short-lived reactive pollutants indoors.

Some of the pollutants inhaled indoors come from outdoors; some come directly from materials and products used indoors; and some are a consequence of chemical reactions occurring in the indoor environment. Certain chemical processes are continually occurring indoors. Other chemical processes are occurring intermittently, varying with time of day, day of week, season, and location. Indoor air testing services can help homeowners and consumers identify those problems and alleviate the effects of negative indoor exposure.

Our Productivity

According to the American Lung Association (ALA), in America, asthma alone accounted for 14.5 million lost workdays for adults in 2004, resulting in productivity losses of nearly $3 billion.[14, 25] It is the fourth leading cause of work absenteeism. The annual cost to society due to asthma illness or death is estimated at nearly $18 billion.[15] Allergies and other respiratory diseases, related to poor IAQ show similar and additional personal and economic impact.

In children aged 5 to 17 years, asthma is the leading cause of school absence, with over 14 million school days lost to this disease. Studies estimate that children with asthma spend nearly 8 million days restricted to bed.[13, 15]

Our Comfort and Quality of Life

In addition to discomfort associated with temperature, humidity, and "stuffy air" (carbon dioxide) problems, surveys show that consumers link poor indoor air quality with quality of life in general. For example, 48% of asthma sufferers feel that the disease limits their ability to take part in sports and recreation; 25% say it interferes with their social activities.[26]

AirAdvice consumer surveys have revealed that health related IAQ complaints — such as coughing, sneezing, burning eyes, increased asthma symptoms, etc.— often coincide with complaints about smells, dust build-up, and heating or cooling system problems.

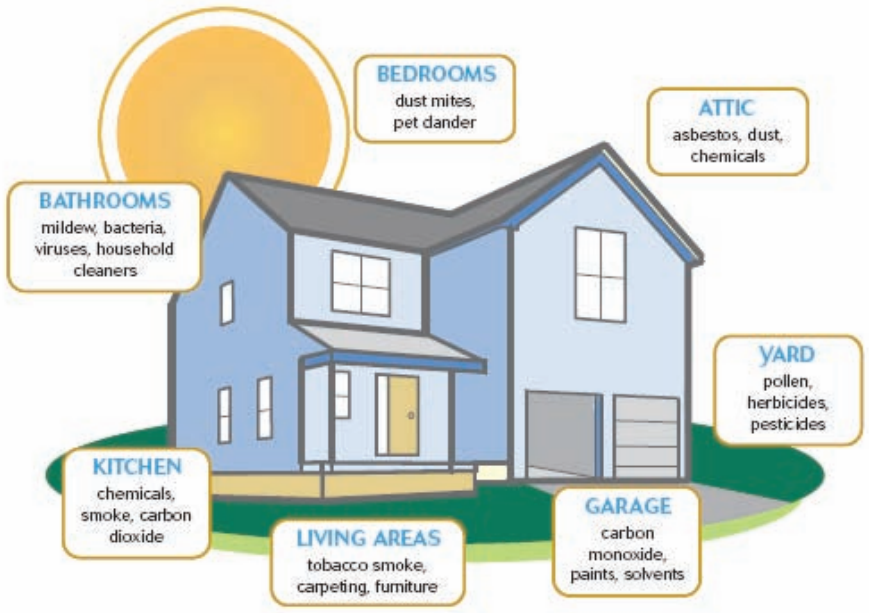
Today's Homes

New home sizes have steadily increased from approximately 1,100 average square feet in the 1940s and 1950s to over 2,400 square feet in 2005.[27, 28] At the same time, even as home sizes have increased, home building techniques have resulted in "tighter," more energy-efficient homes that unfortunately also allow a greater build-up of indoor air pollution **(Figure 2).**

- **Garages:** a common source of chemical pollutants and carbon monoxide. In 1967, only 48% of new homes had a two-car garage vs. 82% in 2002; from 1991 to 2005 the number of new homes with three or more garages has doubled from 10% to 20%.

Figure 2

Potential IAQ Problem Sources



- **Bathrooms:** a source of chemical pollutants, particle allergens, and humidity issues. Over half (55%) of new homes in 2002 had 2.5 or more baths, contrasted to only one in five (20%) in 1975. Over the past 30 years, homes built with 1.5 baths or less has declined from 41% to just over 4%.
- **Bedrooms:** a common source of particle allergens, chemical pollutants and carbon dioxide. The average number of bedrooms in owner-occupied homes is three. While most new homes continue to be built with three bedrooms, the percentage with four or more has risen from 21% in 1975 to 39% in 2005.
- **Air Conditioning:** impacts temperature, humidity, particle allergens, and other IAQ issues. Between 1975 and 2005, the percentage of homes built with air conditioning rose from 46% to 89%.
- **Fireplaces:** a source of carbon dioxide, carbon monoxide, particle allergens and chemical pollutants. They also play a role in temperature and humidity issues. Over half of all new homes built over the last three decades have included a fireplace.
- **Heat Sources:** impact temperature, humidity, particle allergens, ventilation, and other IAQ issues. According to the U.S. Census Bureau, as of the year 2000, just over half of all homes were heated with gas; the next most frequently-used heating fuel was fuel oil (kerosene, etc.) at just under a third of all homes. Less than 20% of households used other fuels such as coal (9%), electricity (6.5%), or wood (1.7%) as their main heat source. Each of these fuels and the associated equipment is a potential source of IAQ problems.
- **Common Items:** such as paint, carpets, furniture, bedding, household cleaners, candles, air fresheners, and more can be significant sources of indoor air pollution. The popularity of scented household air freshener products more than doubled since 2003. This year alone, consumers are expected to spend $1.72 billion on scented air freshener products.[31] The incidence of indoor air pollution has more than doubled partially due to chemicals emitted by these products. For more information on air fresheners and other common household IAQ problem sources, see Appendix A, Do I Have an IAQ Problem? and Appendix B, IAQ Source Control.

Energy Efficiency

Energy efficiency is extremely important to the modern homeowner. Today's energy-efficient and airtight homes save energy and help the environment. Energy efficiency is closely related to home comfort and can minimize your carbon footprint†.

† Carbon footprint—the amount of carbon dioxide emitted into the atmosphere from a given source.

Unfortunately, because these efficient homes are "tighter," indoor air pollution levels can quickly build up. This can occur if the home is not properly ventilated or if the heating and cooling system is inadequate for the home's total square footage.

The good news is that homeowners will often enjoy increased energy efficiency in their homes by addressing IAQ and comfort problems.

"Green" (Environmental) Issues

According to the U.S. Green Building Council (USGBC),[32] a "green" home uses less energy, water, and natural resources, creates less waste, and provides a healthier indoor environment.

A green home is considered to be safer, healthier, and more comfortable for its occupants, as well as more durable. Green home occupants also enjoy lower energy bills, reduced overall ownership costs, and reduced greenhouse gas emissions **(Figure 3).**

Figure 3

Estimated Annual Carbon Dioxide (CO_2) Reduction Using High Efficiency HVAC Equipment*

HVAC Equipment	Savings in Pounds of CO_2
High Efficiency Furnace	3,011
High Efficiency A/C	3,788
Programmable Thermostat	1,488
	Savings = 8,287 lbs of CO_2

* Source: U.S. Environmental Protection Agency (EPA)

Improving a home's indoor air quality, improves its efficiency and lessens its total impact on the environment, because it uses less energy and creates less waste. Four common ways to green a home and improve IAQ, based on the USGBC's 16 recommendations[33] are to:

- properly maintain heating and cooling systems
- use programmable thermostats and high efficiency HVAC equipment
- fix ventilation issues
- reduce chemical pollutant sources

IAQ Test Findings, 2004 – 2006

Over the course of three test years, almost 97% of all homes tested exhibited an alert in at least one of the six IAQ issue categories.

The 2004 – 2006 AirAdvice IAQ test findings provide insight into the type and frequency of indoor air quality problems found in homes across North America.

Overview

Over the past three years (3/1/2004 – 12/31/2006), AirAdvice collected data from 49,130 individual IAQ tests conducted in homes across North America in cooperation with a network of 1,500 trained HVAC-IAQ professionals. At an average of 4,320 unique air samples per test period per AirAdvice monitor, this represents the analysis of about 1.3 billion air samples from almost 50,000 locations.

Air samples were analyzed for six indoor air quality issues:

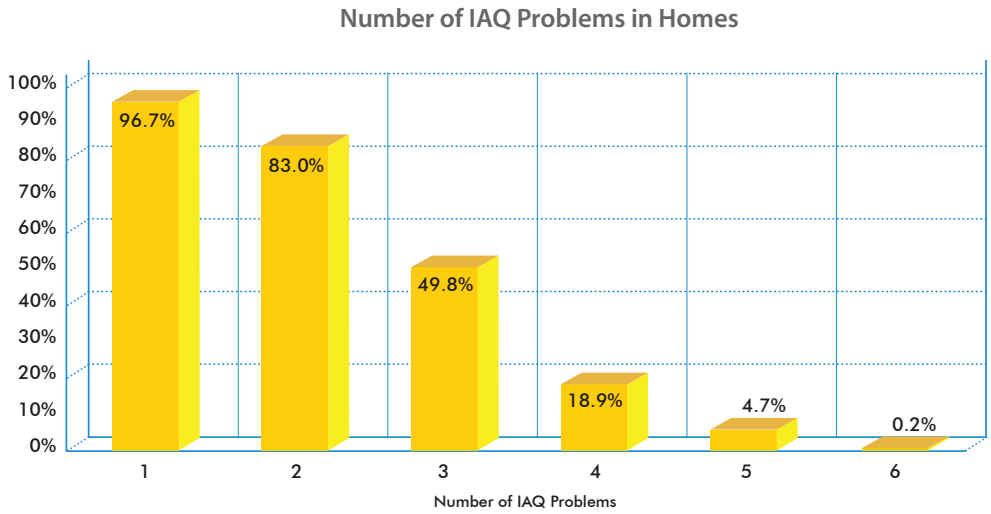
- Particle allergens (airborne particulate matter like dust, dander, pollen, spores, etc.)
- Chemical pollutants (volatile organic compounds)
- Carbon dioxide
- Temperature
- Humidity
- Carbon monoxide

IAQ Problem Prevalence

Findings show that poor IAQ is alarmingly prevalent. Over the course of three test years, almost 97% (96.7) on average of all homes tested exhibited an alert (levels outside recommended ranges) in at least one of the six IAQ issue categories.

Many locations had an alert in more than one category. Eighty-three percent (83%) exhibited two or more alerts; nearly half (49.8%) exhibited three or more alerts. One in five of all homes tested (18.9%) had alerts in four or more categories **(Figure 4).**

Figure 4



Particle allergen alerts occurred most frequently with 91% of locations exhibiting levels outside recommended ranges during the average test period of three days. Because particle allergens are known to trigger and worsen allergy and asthma symptoms, as well as impact general health, these findings raise strong concern, especially with regard to sensitive populations like the elderly, children, and people with chronic respiratory diseases.

Chemical pollutants — some of which are known carcinogens (cancer-causing) — were the second-most frequent type of alert. Alerts occurred in 70% of all tests conducted.

IAQ Problem Type and Occurrence

Homes were tested for six IAQ problem categories: particle allergens, chemical pollutants, carbon dioxide, temperature, humidity, and carbon monoxide **(Figure 5).** For information on the sources and solutions for each type of IAQ problem, see Appendix A, Do I Have an IAQ Problem? and Appendix B, IAQ Source Control.

Particle Allergens

In nine out of 10 homes (91%), particle allergen levels (dust, dander, pollen, bacteria, spores and smoke) are outside the recommended range. Homeowners and their families are breathing air that holds a potential health risk due to airborne particles, especially if anyone in the home suffers from allergies and asthma. Approximately, 20 million Americans suffer from asthma[34] — 9 million of these are under age 18, making it the most prevalent chronic disease among children.[35, 36]

Chemical Pollutants

Also known as volatile organic compounds (VOCs), chemical pollutants were found at levels above recommended ranges in over two-thirds (70%) of homes tested. Chemical pollutants can be harmful to human health. Some are known carcinogens (cancer-causing chemicals) like formaldehyde and benzene. Sources of chemical pollutants include: household cleaners, carpets, furniture, fuel fumes, scented products and air fresheners, personal care products, "bad smell" sources such as garbage and bathrooms, and many common household products like paint, glue, and plastics.

Carbon Dioxide

Carbon dioxide, often experienced as "stuffy air," was found to be outside recommended levels in almost half (45%) of all homes tested. A common by-product of breathing and combustion, carbon dioxide can affect alertness and cause fatigue. Common sources of combustion include: fireplaces, gas stoves, water heaters, HVAC equipment, and candles. High levels of carbon dioxide often indicate improper or ineffective ventilation, which also leads to unhealthy levels of other indoor air pollutants.

Temperature

Temperature problems occurred in nearly a third of all homes (30%). Low temperatures may induce shivering, cause joint and muscle stiffness, reduce blood flow to the skin and extremities (skin feels cold), and reduce concentration. Conversely, temperatures that are even just a few degrees too warm may lead to increased body temperature, increased heart rate, reduced blood flow to major organs, sweating,

dehydration, faintness, and drowsiness.

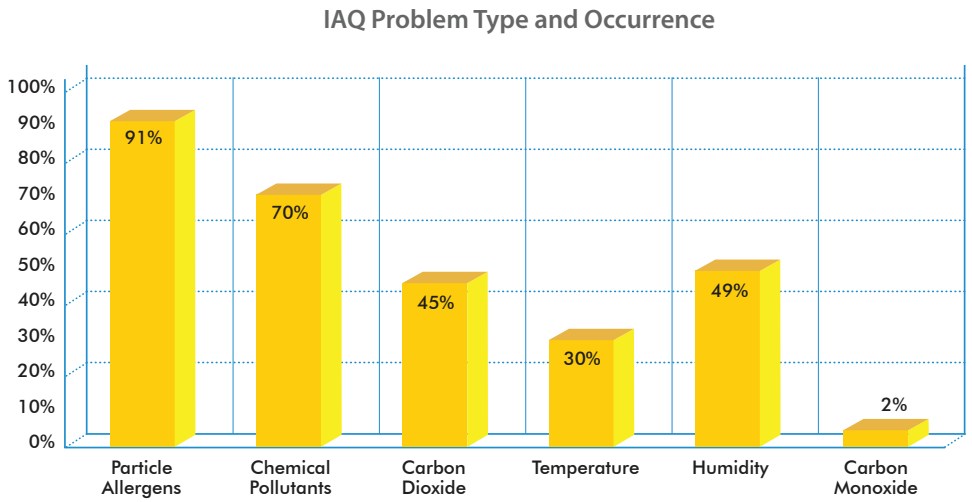
Basic comfort also ties into home energy costs and efficiency. Managing a home's temperatures with appropriately sized heating and cooling systems lowers overall energy costs while improving IAQ at the same time.

Humidity

Low relative humidity, air that is too dry, can aggravate asthma and bronchitis and lead to sinusitis, nosebleeds, dry skin, and dry eyes. Air that is too moist encourages mold growth. Both low and high humidity levels, either below or above the 30% – 55% ideal relative humidity range,[20, 21] can accelerate home deterioration rates.

Humidity issues were found in nearly half (49%) of tested locations. As with temperature, addressing humidity problems in the home can result in lower energy bills and improved efficiency as well as better comfort for occupants.

Figure 5



Carbon Monoxide

Carbon monoxide exceeded the recommended levels in only 2% of cases. This colorless, odorless gas is the by-product of combustion (fires, cooking, smoking, vehicle emissions) and can cause death at high levels. At lower levels, it can create nausea, disorientation, and other adverse effects. Carbon monoxide alarms are recommended for all residences as a safety precaution (similar to smoke detectors).

Regional Variations

North American homeowners can expect certain variations in the frequency of IAQ problems depending upon their geographic location — the Middle Atlantic, Midwest, New England, South, Southwest, West, or Canadian province.

Problem Prevalence by Region

Of the six U.S. regions, New England homes had the greatest incidence of multiple alerts per report: one third (33.3%) of all homes tested in that region exhibited four or more alerts per test. The second highest incidence of multiple alerts per report, the West, had only one fifth (21.6%) of homes tested exhibiting four or more alerts **(Figure 6).**

Regionally, the Southwest had the best occurrence of homes with only one or less IAQ alerts — 3.4% of Southwest homes had zero IAQ problems and 16.6% had only one problem. However, the best occurrence of zero IAQ alerts overall was in the West where 3.9% of homes tested had no IAQ problems measured **(Table C-5a).**

The region that experienced the greatest number of alerts per home overall was New England. The region with the fewest number of alerts per home overall was the Southwest.

Problem Type and Occurrence by Region

IAQ problems varied among the six U.S. regions **(Figures 7, 8, 9).** For example, humidity problems were most prevalent in the South, while temperature variation problems were most prevalent in the New England region. In general, the prevalence of IAQ problems was high throughout all regions.

New England homeowners had high incidence of problems overall. The occurrence in four out of six alert categories was: particle allergens (93.7%), chemical pollutants (78.5%), temperature (44.5%), and carbon dioxide (47.7%).

The Southwest had low incidence of problems overall. The occurrence in four out of six alert categories was: chemical pollutants (64.1%), carbon dioxide (39.6%), temperature (19.6%), and carbon monoxide (1.5%).

Of the six regions, the Middle Atlantic homes tested closest to the national average in each IAQ alert category.

The biggest variation in problem occurrence across the six regions was in the temperature category. New England had a 44.5% occurrence of temperature alerts versus the next highest occurrence of 37.8% in the West and 32.5% in the Midwest. Only 19.6% of Southwest homes tested had temperature alerts.

Figure 6

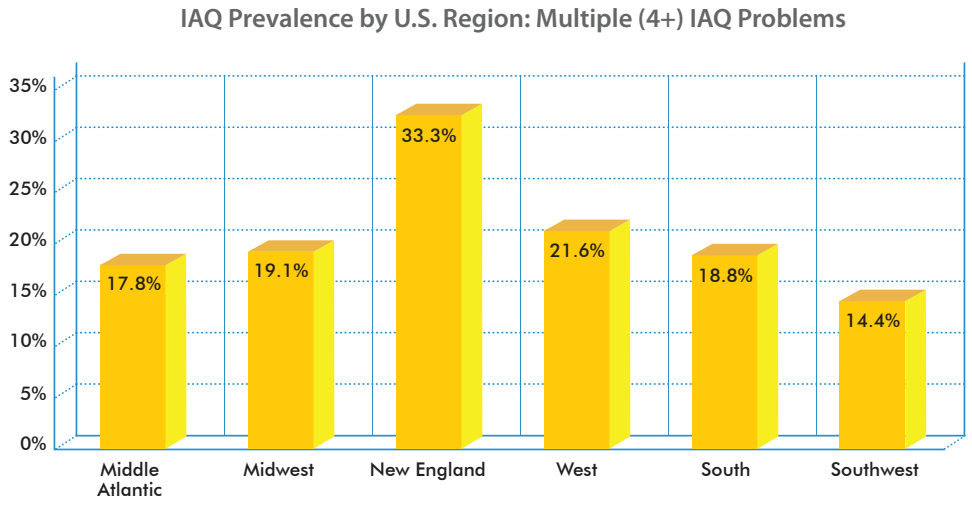


Figure 7

Regional Comparison, IAQ Problem Type and Occurrence

	Particle Allergens	Chemical Pollutants	Carbon Dioxide	Temperature	Humidity	Carbon Monoxide
More Likely	New England 93.7%	New England 78.5%	New England 47.7%	New England 44.5%	South 59.6%	Midwest 3.0%
U.S. Average	91.2%	69.6%	45.3%	30.0%	49.8%	2.4%
Less Likely	West 89.9%	Southwest 64.1%	Southwest 39.6%	Southwest 19.6%	West 40.3%	Southwest 1.5%

The biggest variation in problem occurrence across the six regions was in the temperature category. New England had a 44.5% occurrence of temperature alerts versus the next highest occurrence of 37.8% in the West and 32.5% in the Midwest. Only 19.6% of Southwest homes tested had temperature alerts **(Figure 9).**

Homeowners in the South experienced the highest occurrence of humidity alerts—59.6%. New England was a close runner-up at 58.4%. Overall, the tests over three years showed that humidity problems plague a significant portion of total homes tested; the lowest incidence of humidity was in the West at 40% **(Figure 9).**

All six U.S. regions were relatively similar in the occurrence of particle allergen, carbon dioxide, and carbon monoxide alert levels, with variances of only 9% or less.

Canadian provinces and United States regions were within a ± 5.3% difference in prevalence of IAQ problems tested, with the exception of humidity. Humidity alerts occurred in half (49.8%) of all U.S. regions, but in only two-fifths (38%) of Canadian provinces overall **(Figure 10, Table C-4b).**

Figure 8

IAQ Prevalence by U.S. Region: Multiple (4+) IAQ Problems

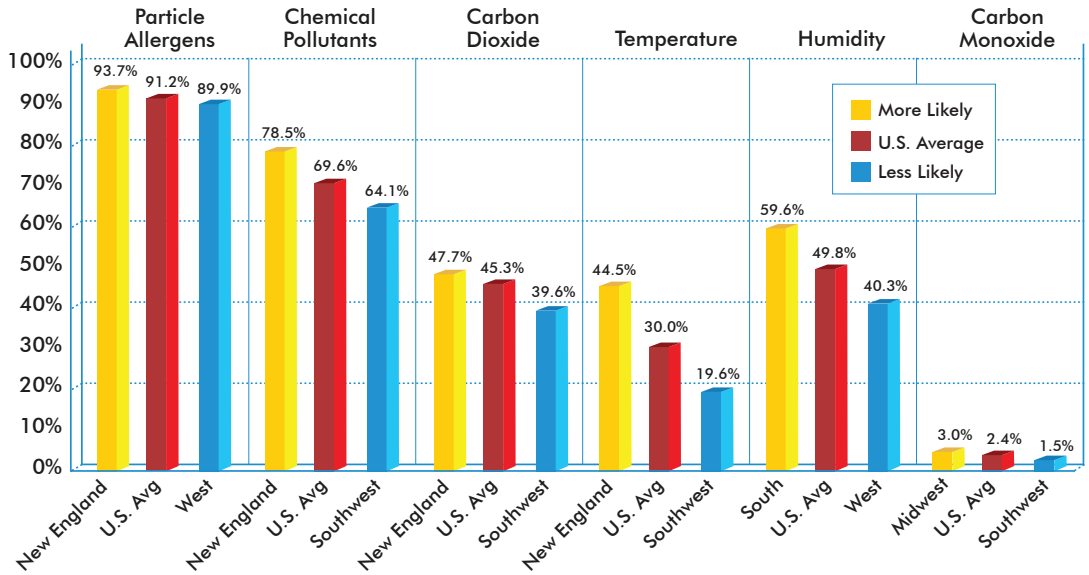


Figure 9

IAQ Problem Type and Occurrence by Region (U.S.)

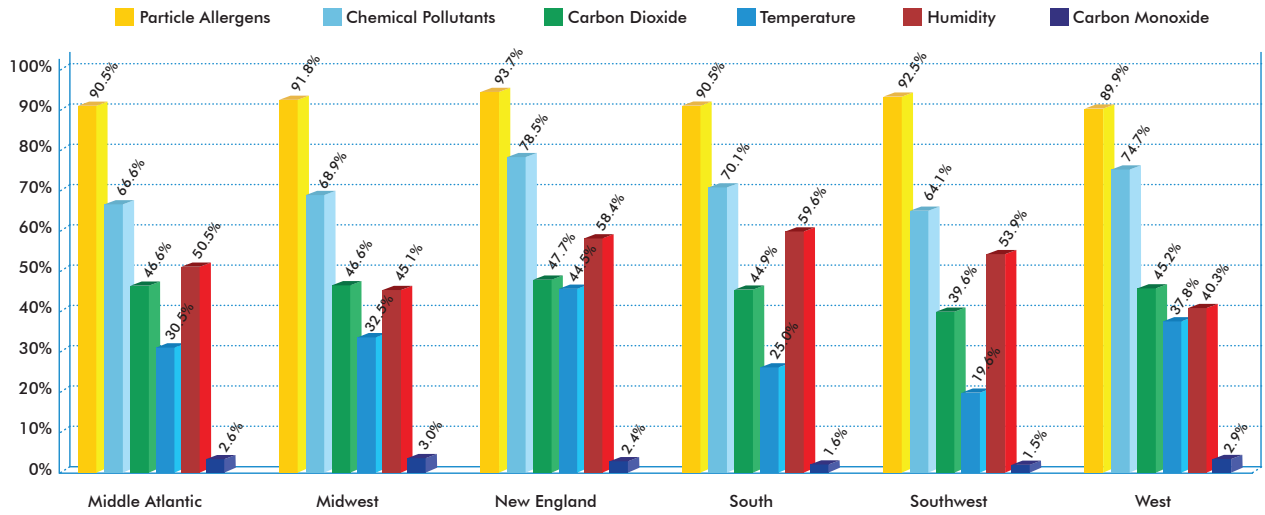
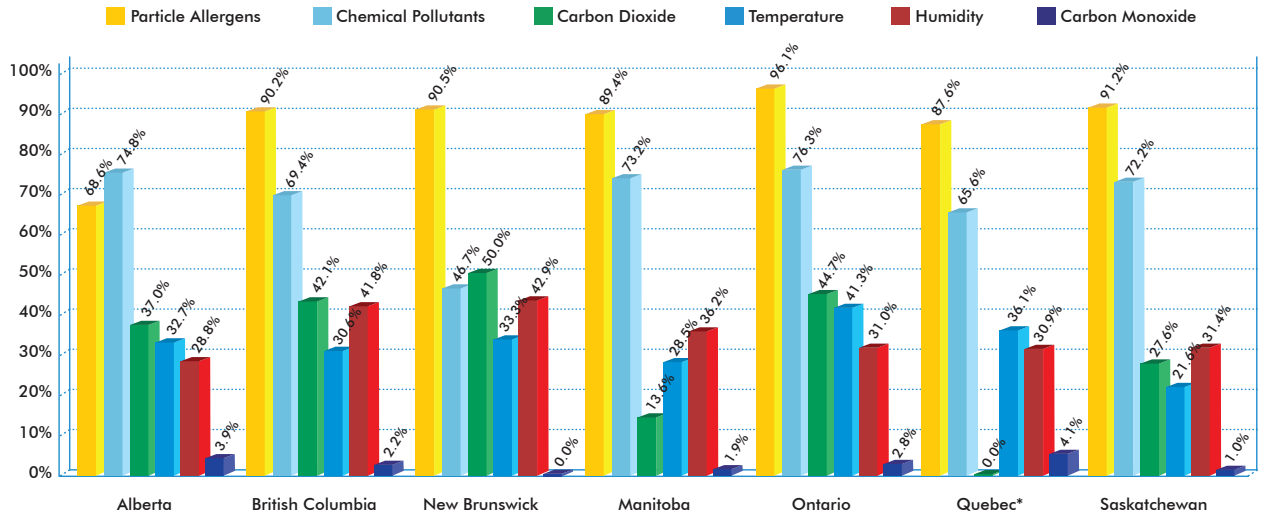


Figure 10

IAQ Problem Type and Occurrence by Region (Canada)



* Carbon Dioxide data was not collected in Quebec.

Seasonal Variations

The most notable seasonal variations across the six IAQ issues tested occurred in the temperature and humidity categories. Total humidity alerts **(Figure 11)** increased across all North American regions from a spring low of 28.3% in April† to a summer high of 73.3% in August. Temperature alerts across all regions dipped to a low of 21.2% in June to a high of 48.6% in December **(Figure 12).**

† Seasonal humidity and temperature variations are averaged across 2004 – 2006

Figure 11

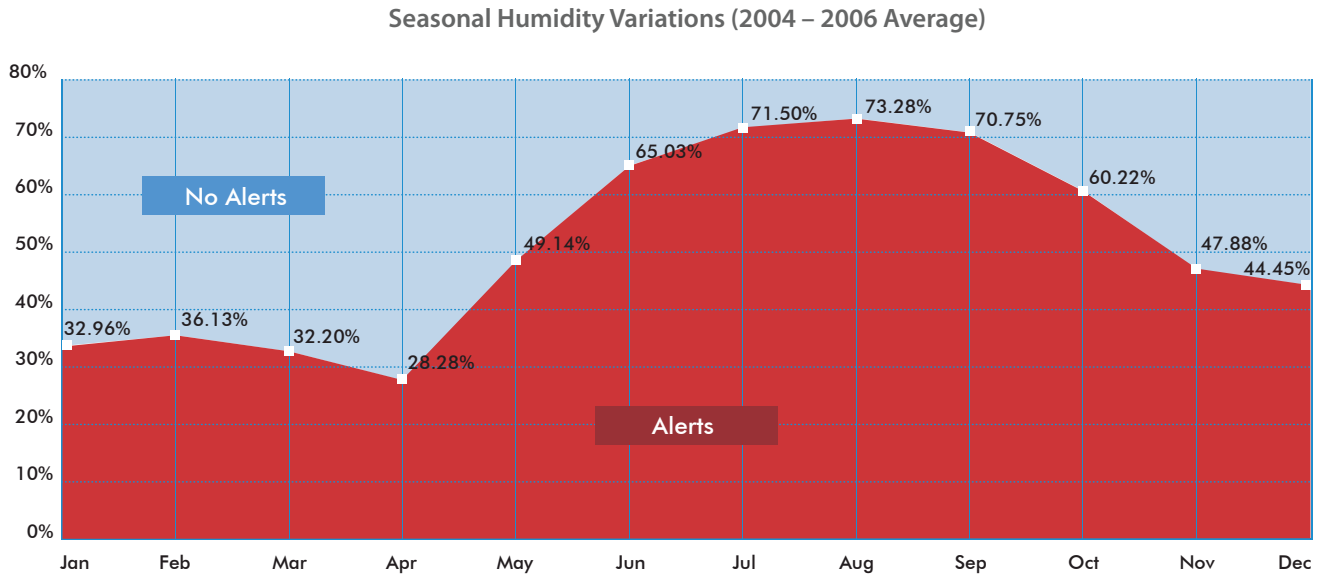
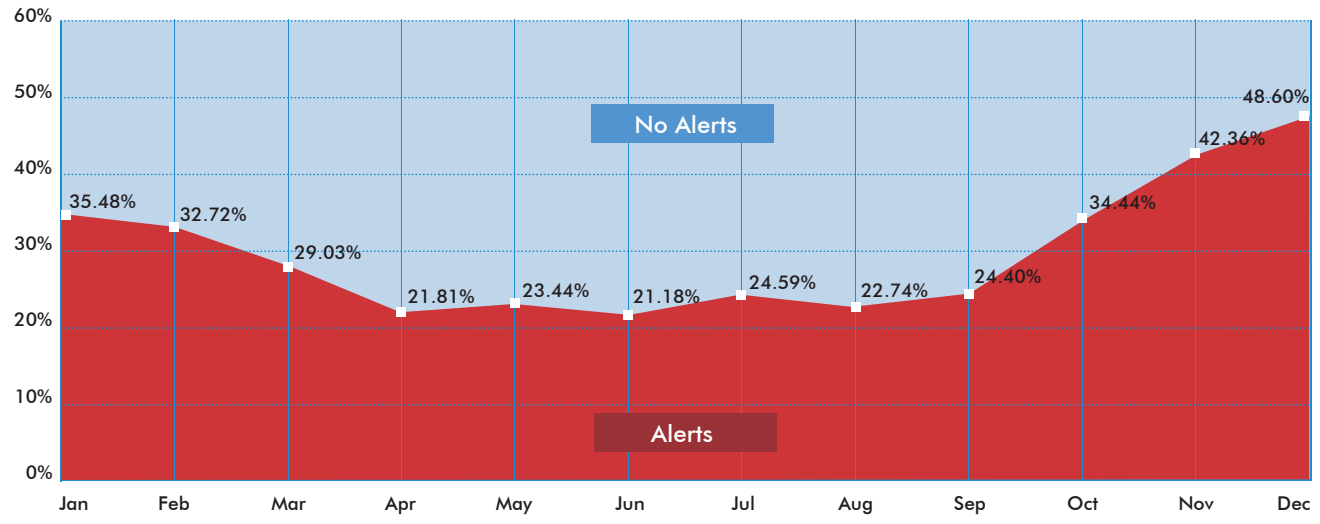


Figure 12



Conclusions

The consistent prevalence of IAQ problems in homes across three test years demonstrates an obvious need for concern among homeowners.

The data on the state of our indoor air is clear and compelling, given the number of reports run to date. Indoor air problems exist in most homes: nine out of 10 (96.7%) have one or more IAQ problems.

The fact is most North Americans are breathing polluted indoor air, resulting in health risks, lost productivity, diminished comfort and poor quality of life for millions. With over 150 million Americans — over half the U.S. population — living in areas that have unhealthy levels of outdoor pollution,[37] the need to create and sustain a pure, healthy indoor air environment for our families and ourselves becomes imperative.

AirAdvice's mission is to enable everyone to breathe cleaner air through IAQ awareness, testing, and education. With indoor air problems at intolerably high rates, immediate action is necessary. Our health, comfort, and safety are at risk, especially for our sensitive populations such as the elderly, asthma and allergy sufferers, and our children.

Homeowner Resources and Actions

The consistent prevalence of IAQ problems in homes across three test years demonstrates an obvious need for concern among homeowners. The good news is that effective indoor air quality evaluation and improvement options already exist. Once a homeowner is made aware of a problem and its nature or source, specific solutions can be applied.

Homeowners can take action to ensure cleaner indoor air for themselves and their family members via:

- **IAQ Education —** A wealth of IAQ information is offered by the U.S. Environmental Protection Agency (EPA), American Lung Association (ALA), and other accredited organizations.

- **Source Control —** There are many simple ways to reduce indoor air pollution levels inside the home, such as eliminating common sources. For more information, visit www.airadvice.com or see Appendix A, Do I Have an IAQ Problem? and Appendix B, IAQ Source Control.
- **Evaluation and Improvement Options —** In addition to source control, homeowners can take steps to improve their home's indoor air quality, utilizing professional IAQ evaluation and solutions. AirAdvice recommends that homeowners work with trained and licensed HVAC service providers who perform IAQ testing. In addition to the health, comfort, and safety benefits, improved IAQ in the home is also associated with improved energy efficiency and cost savings.

Consumers who don't own their own home can still have a role in controlling their indoor air quality. In addition to seeking information and taking steps within their rental to reduce sources of pollution, tenants can also get independent indoor air testing and alert their landlords to any problems that may be found.

The Future of Indoor Air Quality

AirAdvice is committed to helping people live healthier, more comfortable, and safer lives through indoor air quality awareness and improvement. The data presented in the *AirAdvice State of Our Indoor Air Report 2007* is the largest known collection of annual indoor air quality statistics of its kind.

The data reveals that indoor air quality problems occur at intolerably high rates across North America. AirAdvice hopes that reporting these finding will increase public awareness of the alarming scope of IAQ problems inside our homes. It is further hoped that this awareness will encourage increased IAQ remediation and control, as well as provide a basis for individuals, groups, and communities to take action and work together to ensure healthier indoor air for us all.

The incidence of IAQ problems increased from at least one problem per household in almost 96% of homes in 2004, to almost 97% in 2006. AirAdvice looks to 2007 and beyond as opportunity to decrease the occurrence of IAQ problems in the home.

Appendix A

Do I Have an IAQ Problem?

The following are possible common indications of an indoor air quality problem in a home. For more detailed information on common IAQ problem indicators and possible solutions, visit www.airadvice.com.

Some indications of IAQ problems in your home include:

- Excessive dust
- “Stuffy” rooms
- Some rooms feel hot or cold when the rest of the house feels comfortable
- Moisture on window panes
- A mildew (musty) smell in your home
- Family members often sneeze, feel lethargic, or have dry skin
- Home is located in a high-risk radon area
- In-room air cleaners are in use in the home
- Air fresheners or scented candles are used to improve the smell in the home

If you experience any of these problems in your home, you may have an indoor air quality problem. A qualified HVAC indoor air quality service professional can test your home to help you objectively diagnose possible problems as well as recommend solutions.

Appendix B

IAQ Source Control

There are many ways to improve the indoor air quality (IAQ) in your home. Solutions can range from mechanical adjustments on your heating and cooling system to something as simple and inexpensive as altering some of your habits and product choices.

Source control means limiting the amount of pollutants in your home and it is an important step in improving the quality of air you breathe. The following sections describe some easy ways to control sources of common indoor air quality problems.

Particle Allergens

The EPA cautions that the air inside your home is typically two to five times more polluted than outdoor air. How can this happen? One way to understand how the air inside your house can be two to five times worse than outdoor air — despite cleaning your home — is to realize where the air you breathe inside comes from and how it behaves inside your home.

Air enters your home each time you open a door or window. With that air comes dust, dirt, pollen, spores, and other parts of the "outside" that you would prefer to keep there.

Air does not always arrive through obvious sources like doors and windows. Cracks, fissures, windows that aren't sealed tightly, and attached garages can all deliver polluted air.

Once inside your home, air is recirculated, becoming slightly more polluted each time dinner is cooked, the carpets are vacuumed, or cleaning products are used. Many common household activities produce indoor air pollution.

There are a number of easy steps you can take to control sources of airborne particles in your home:

- **Use a doormat —** A wipe-off mat will cut down on one of the biggest carriers of particulates in your home: the bottom of your shoes. For those with allergies, asthma, or other particle sensitivities, removing shoes in an entry area or foyer will reduce the amount of particulates that are tracked into a home.
- **Use high efficiency particulate air filter (HEPA) or central vacuum system —** Cleaning the dust and dirt from your carpets is an important part in keeping your home's air clean. Trapping the dirt in a closed container is even more important. Old-fashioned vacuums with a paper bag may potentially do little more than noisily redistribute dust from the carpet into the air. Purchase a cleaner that will trap the dust and dirt in a container, such as a HEPA vacuum, or even better, a whole-home central vacuum system which vents to the outside.

- **Limit smoking indoors —** The U.S. Office of the Surgeon General places a label on every pack of cigarettes warning of the dangers of smoking. Smoking can also be bad for the quality of air inside your home by elevating particulates and chemcial pollutants.
- **Use exhaust fan while cooking —** Get rid of particulates generated by cooking with a true exhaust fan that moves air at a rate of 100 cubic feet per minute (CFM). This will help improve the air you breathe.
- **Use bathroom exhaust fan —** Personal care products are rich sources of particulates: hairsprays, gels, perfumes, colognes, and deodorants are all examples of products we use that often emit particulates. Make sure the fan vents to outside.
- **Wash bedding frequently —** Wash bedding frequently in hot water of at least 140°F to get rid of dust mites that are found in sheets, blankets, pillows, and pillowcases.
- **Limit indoor flame sources —** Burning wood in stoves and fireplaces is a frequent source of indoor air pollution if not properly vented.

Chemical Pollutants

Chemical pollutants — also known as volatile organic compounds (VOCs) — arrive in the home's air from many different sources. Some of these are easy to eliminate. For instance, most people store a lot of house cleaning products in their bathrooms and the kitchens. Reducing the number of cleaning products and choosing "greener" alternatives will help reduce indoor air pollution.

Other ways to reduce chemical pollutant sources include:

- **Limit the use of scented candles and/or room fresheners —** Everybody occasionally enjoys burning candles. Choose soy- or beeswax-based candles whenever possible. They are more expensive, but generally emit lower levels of VOCs. Scented room fresheners should be used as little as possible due to the high VOC levels they emit.
- **Seal door between house and garage —** Most people store an assortment of chemicals, petroleum products, old paint cans and other items in the garage. The fumes from these storables can be drafted back into the house and recirculated throughout. If these items cannot be moved to a shed or well-ventilated space, store them in a sealed container.
- **Use bathroom exhaust fan —** Personal care products are rich sources of VOCs: hairsprays, gels, perfumes, colognes, and deodorants are all examples of products we use that emit VOCs. Make sure the fan vents to outside.

Carbon Dioxide

We breathe oxygen and expel carbon dioxide. A high level of carbon dioxide is often described as "stuffiness." Unlike carbon monoxide, there is no immediate danger with high levels of carbon dioxide. Instead, home occupants might experience fatigue, yawning, and lack of concentration. Fresh air is a solution to high levels of carbon dioxide.

- **Use adequate ventilation to lower carbon dioxide levels.**

Temperature

With the proper equipment, you can achieve the desired temperature levels in a home.

- **Use a programmable thermostat —** Make sure that you have a modern programmable thermostat and set it to a temperature that is comfortable for the whole family. A programmable thermostat automates temperature setbacks while you're not at home, which can lead to significant energy savings.
- **Use energy efficient appliances —** Energy efficiency can be improved through proper insulation, sealed double-paned windows, and ENERGY STAR appliances. High efficiency furnaces and air conditioning units also play a major role is delivering consistent comfort at a lower cost while reducing your carbon footprint and greenhouse gas emissions. Energy-efficient homes maintain a consistent seasonal temperature and lower monthly utility bills.

Humidity

Relative humidity (RH) is important for comfort and safety inside your home. Low humidity can lead to nose bleeds, electrical shocks, and feeling colder than the temperature indicates. High humidity makes you feel uncomfortable and can also have health effects if RH levels rise above 55% indoors. Above 55%, dust mites and cockroach populations thrive. Mold growth can be an additional complication in a high humidity environment when RH is sustained above 60% for long periods of time.

- **Don't use wood fires or overheat your home to mitigate low humidity.**
- **Program your thermostat to maintain longer A/C run times —** Your A/C system can reduce humidity levels with longer run times. Air conditioning not only provides cooling, it removes air humidity.
- **Install humidifiers or dehumidifiers if there are chronic issues.**

Carbon Monoxide

Carbon monoxide is a clear, odorless, potentially deadly gas that is a by-product of combustion. To eliminate the possibility of carbon monoxide build-up in your home air:

- **Inspect all gas appliances —** Make sure all gas appliances are properly vented and operating according to manufacturers' specifications. Verify that the pilot lights are lit.
- **Do not operate propane stoves or barbeques indoors.**
- **Make sure car exhaust does not enter the home —** Homes with attached garages can experience unsafe carbon monoxide levels from car exhaust. When you start your car or turn it off, the car exhaust remains in the garage, which can then enter your living area and circulate for hours. To avoid contamination, leave the garage door open for half an hour to ensure that the exhaust is not vented into the home.

Appendix C

AirAdvice IAQ Reports Summary Tables

Table C-1

Number of Alerts per IAQ Category

Parameter	Alert		Total Reports	% Incidence
	Yes	No		
Particle Allergens	44,748	4,382	49,130	91%
Chemical Pollutants (Volatile Organic Compounds—VOCs)	31,719	13,809	45,528	70%
Carbon Dioxide	7,839	9,563	17,402	45%
Temperature	14,799	34,331	49,130	30%
Humidity (Relative Humidity—RH)	24,161	24,969	49,130	49%
Carbon Monoxide	1,177	47,953	49,130	2%

Table C-2

Total Number of Alerts per Report

Total Alerts per Report	0	1	2	3	4	5	6
Number of Occurrences	1,603	6,764	16,305	15,179	6,967	2,208	104
% Incidence	3.3%	13.8%	33.2%	30.9%	14.2%	4.5%	0.2%

Table C-3

Frequency of Alerts

Total Alerts per Report	1 or more	2 or more	3 or more	4 or more	5 or more	6 or more
Number of Occurrences	45,527	40,763	24,458	9,279	2,312	104
% Incidence	96.7%	83.0%	49.8%	18.9%	4.7%	0.2%

Table C-4a

Number of Alerts per IAQ Category (Particle Allergens, Chemical Pollutants, Carbon Dioxide)

		Particle Allergens		Chemical Pollutants		Carbon Dioxide	
Region	**# Reports**	Alerts	Incidence	Alerts	Incidence	Alerts	Incidence
United States							
Middle Atlantic	3,995	3,617	90.5%	2,416	66.6%	528	46.6%
Midwest	15,744	14,451	91.8%	10,181	68.9%	2,648	46.6%
New England	1,033	968	93.7%	776	78.5%	283	47.7%
South	11,868	10,744	90.5%	7,648	70.1%	1,962	44.9%
Southwest	5,747	5,316	92.5%	3,452	64.1%	614	39.6%
West	8,062	7,245	89.9%	5,531	74.7%	1,447	45.2%
Subtotal	46,449	42,341	91.2%	30,004	69.6%	7,482	45.3%
Canada							
Alberta	436	105	68.6%	77	74.8%	27	37.0%
British Columbia	153	1,501	90.2%	1,019	69.4%	250	42.1%
New Brunswick	21	19	90.5%	7	46.7%	2	50.0%
Manitoba	207	185	89.4%	150	73.2%	3	13.6%
Ontario	1,664	419	96.1%	331	76.3%	67	44.7%
Quebec	102	85	87.6%	61	65.6%	0	0.0%
Saskatchewan	97	93	91.2%	70	72.2%	8	27.6%
Subtotal	2,680	2,407	89.8%	1,715	71.0%	357	40.4%
Grand Total	**49,129**	**44,748**	**91.1%**	**31,719**	**69.7%**	**7,839**	**45.0%**

Table C-4b

Number of Alerts per IAQ Category (Temperature, Humidity, Carbon Monoxide)

		Temperature		Humidity		Carbon Monoxide	
Region	**# Reports**	Alerts	Incidence	Alerts	Incidence	Alerts	Incidence
United States							
Middle Atlantic	3,995	1,217	30.5%	2,016	50.5%	103	2.6%
Midwest	15,744	5,123	32.5%	7,105	45.1%	473	3.0%
New England	1,033	460	44.5%	603	58.4%	25	2.4%
South	11,868	2,964	25.0%	7,075	59.6%	193	1.6%
Southwest	5,747	1,127	19.6%	3,095	53.9%	88	1.5%
West	8,062	3,045	37.8%	3,246	40.3%	232	2.9%
Subtotal	46,449	13,936	30.0%	23,140	49.8%	1,114	2.4%
Canada							
Alberta	436	50	32.7%	44	28.8%	6	3.9%
British Columbia	153	510	30.6%	696	41.8%	36	2.2%
New Brunswick	21	7	33.3%	9	42.9%	0	0.0%
Manitoba	207	59	28.5%	75	36.2%	4	1.9%
Ontario	1,664	180	41.3%	135	31.0%	12	2.8%
Quebec	102	35	36.1%	30	30.9%	4	4.1%
Saskatchewan	97	22	21.6%	32	31.4%	1	1.0%
Subtotal	2,680	863	32.2%	1,021	38.1%	63	2.4%
Grand Total	**49,129**	**14,799**	**30.1%**	**24,161**	**49.2%**	**1,177**	**2.4%**

Table C-5a

Frequency of Alerts (0 – 3)

		0		1		2		3	
Region	**Total Reports**	Reports	Incidence	Reports	Incidence	Reports	Incidence	Reports	Incidence
Middle Atlantic	3,995	153	3.8%	535	14.9%	1,327	33.2%	1,209	30.3%
Midwest	15,744	434	2.8%	2,284	14.5%	5,132	32.6%	4,884	31.0%
New England	1,033	15	1.5%	62	6.0%	251	24.3%	361	34.9%
South	11,868	378	3.2%	1,422	12.0%	3,854	32.5%	3,986	33.6%
Southwest	5,747	198	3.4%	956	16.6%	2,055	35.8%	1,712	29.8%
West	8,062	314	3.9%	1,024	12.7%	2,746	34.1%	2,242	27.8%
Alberta	436	4	0.9%	46	10.6%	165	37.8%	133	30.5%
British Columbia	153	20	13.1%	24	15.7%	60	39.2%	32	20.9%
New Brunswick	21	0	0.0%	8	38.1%	6	28.6%	4	19.0%
Manitoba	207	9	4.3%	26	12.6%	87	42.0%	64	30.9%
Ontario	1,664	70	4.2%	281	16.9%	540	32.5%	496	29.8%
Quebec	102	4	3.9%	17	16.7%	43	42.2%	29	28.4%
Saskatchewan	97	3	3.1%	19	19.6%	39	40.2%	27	27.8%
Grand Total	**49,129**	**1,602**	**3.3%**	**6,764**	**13.8%**	**16,305**	**33.2%**	**15,179**	**30.9%**

Table C-5b

Frequency of Alerts (4 – 6)

		4		5		6	
Region	**Total Reports**	Reports	Incidence	Reports	Incidence	Reports	Incidence
Middle Atlantic	3,995	545	13.6%	155	3.9%	11	0.3%
Midwest	15,744	2,301	14.6%	677	4.3%	32	0.2%
New England	1,033	257	24.9%	82	7.9%	5	0.5%
South	11,868	1,663	14.0%	544	4.6%	21	0.2%
Southwest	5,747	647	11.3%	172	3.0%	7	0.1%
West	8,062	1200	14.9%	512	6.4%	24	0.3%
Alberta	436	73	16.7%	13	3.0%	2	0.5%
British Columbia	153	16	10.5%	1	0.7%	0	0.0%
New Brunswick	21	3	14.3%	0	0.0%	0	0.0%
Manitoba	207	21	10.1%	0	0.0%	0	0.0%
Ontario	1,664	224	13.5%	51	3.1%	2	0.1%
Quebec	102	9	8.8%	0	0.0%	0	0.0%
Saskatchewan	97	8	8.2%	1	1.0%	0	0.0%
Grand Total	**49,129**	**6,967**	**14.2%**	**2,208**	**4.5%**	**104**	**0.2%**

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