THIRD EDITION

Infection Control During Construction MANUAL

Policies, Procedures, and Strategies for Compliance

WAYNE HANSEN, PE, REA, CEM, ASHE

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HCPro

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Contents

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Wayne Hansen, PE, REA, CEM, ASHE, in June 2005 formed the Hansen Cornel Consulting Group with Leon Cornel to address healthcare project construction-related issues with respect to fungal contamination and infection. In this area, Hansen has been involved with projects for clients in the United States and Seoul, Republic of South Korea.

Prior to this venture, Hansen was director of engineering for 15 years for the Mintie Corporation, a national indoor environmental solutions provider, specializing in environmental maintenance and engineering. He oversaw all aspects of risk management and indoor air quality assessments. Hansen has developed risk management plans that have been implemented by commercial real estate facilities and also healthcare facilities as a result of the JCAHO *IAQ Handbook* and the HCPro *Infection Control During Construction Manuals.*

Hansen's previous experience includes 20 years in principal positions with Jacobs Engineering and other major engineering firms.

Judene M. Bartley, MS, MPH, FSHEA

Judene M. Bartley, MS, MPH, FSHEA, vice president of Epidemiology Consulting Services (Beverly Hills, MI) provides infection/safety consultation services to healthcare agencies on a variety of issues, including safety, infection prevention and control, and occupational/environmental health. Prior work experience included directing epidemiology programs in major university-affiliated hospitals, principally Harper Hospital, Detroit Medical Center, where she also administered programs for quality management, safety, and regulatory compliance.

Bartley provides infection-related expertise to the Facility Guidelines Institute (FGI) Healthcare Guidelines Revision Committee (HGRC), publisher of the *Guidelines for Design and Construction of Hospitals and Healthcare Facilities*. She serves on the FGI HGRC Steering committee following her election in 1996. She helped develop and taught the American Society for Healthcare Engineering (ASHE)/AIA infection control and construction courses. She participates in national initiatives on sustainability in healthcare, such as Practice Greenhealth (PGH), ASHE and ASHRAE Sustainability Committees (STD 189.2), and ASHRAE's Ventilation Standard 170, newly incorporated into the 2010 *Guidelines.* She was also a member of Michigan's Minimum Design Standards revision committees.

Appointments to advisory boards include CDC's Healthcare Infection Control Practices Advisory Committee (HICPAC) 2011–14, The Joint Commission's Committee on Healthcare Safety, USP-797 special advisory committee, as well as editorial boards, such as the *American Journal of Infection Control* and the ECRI Institute's CHEM editorial board. Bartley is ASHE's official liaison with the Association of Professionals in Infection Control and Epidemiology (APIC) and the Society of Healthcare Epidemiologists of America (SHEA) and an active member of public policy committees of national APIC, ASHE, and SHEA.

Bartley participates in federal and state healthcare-associated infection (HAI) reduction efforts—including HHS-CDC meetings to develop the 2008 HHS-HAI Action plan and Michigan's Keystone Advisory Committee overseeing the statewide initiative focused on reducing and eliminating HAI, e.g., *Keystone: HAI* and MDCH HHS-HAI Prevention Collaborative (SHARP) representing APIC-Greater Detroit and the Michigan Society for Infection Prevention and Control (MSIPC).

Bartley earned a BS in chemistry, an MS in biochemistry (University of Detroit), and an MPH in epidemiology (University of Michigan). She has authored more than 100 publications, including journals, book chapters, and abstracts with an emphasis on patient and healthcare worker safety as well as environmental infection prevention related to design and construction. Construction-related contributions include authoring APIC's *State of the Art Report on Construction, Construction Tool Kits,* videos and current construction and related chapters in standard texts.

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Robert Case, MS, is president of Rob Case Consulting Service of San Pedro, CA, providing consulting and management services to clients in North America, Europe, and South America. His previous experience includes working at JA Jones Engineering, Ralph M. Parsons Engineering, Oderbrecht-Jurden Engineering, the City of Los Angeles, and the U.S. Navy.

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In his 40 plus years of healthcare facility planning and design experience, **Robert L. Dooley, AIA, ASHE,** has been responsible for a broad range of project types and has worked in all phases of projects. He is known for his expertise in the planning and design of the "high tech" areas of healthcare such as surgery, and for his ability to "speak the language" of medical staff. He is also known for his knowledge of the mechanical, plumbing, and electrical criteria unique to healthcare facilities.

Dooley has worked with the firms NBBJ, Anshen+Allen, and now Rice Fergus Miller and is considered an expert in infection control as it applies to the planning, design, and construction of healthcare facilities. For three years, Dooley was president of ICRA Design Consultants, LLC, a company he formed to offer consulting services to healthcare institutions, architects, and contractors on the facility planning and design aspects of infection control risk assessments. Dooley has served as an independent consultant to other firms on infection control and has provided expert witness services. In addition, he has lectured and led round-table discussions on infection control at the ASHE, Health Care Design, and APIC conferences.

Tim Keane

Tim Keane is consultant and proprietor of EIC Consultants, the healthcare division of Legionella Risk Management of Chalfont, PA. He is a member of the American Society of Heating, Refrigerating, and Air Conditioning Engineers, ASHE, APIC, and the American Society of Plumbing Engineers.

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John R. Layman, Esq., is a partner in Layman, Layman & Robinson in Spokane, WA. His practice involves serious personal injury complex litigation, with an emphasis on traumatic brain injuries and spinal/aquatic injuries.

Layman is active within the Washington State Brain Injury Association and has served as past executive director for the local chapter. He is currently the president of the Foundation Board for Inland Northwest Hospital Service and is past president of the St. Luke's Rehabilitation Advisory Board of Directors.

Layman has been honored by his peers as one of the state of Washington's "Super Lawyers" and was named one of Washington's top 100 trial lawyers by the American Trial Lawyers Association.

Bette Meins, RN, BSN, MSN, CHPN, CHA

Bette Meins, RN, BSN, MSN, CHPN, CHA, is an international healthcare consultant with Meins Consulting. She has previously served as director of clinical services at Beacon Hospice in Boston; vice president/chief nursing officer at Rutland (VT) Regional Medical Center; administrator, clinical services at Hospice of the Valleys in Sun City, CA; chief clinical officer/chief nursing officer at Corona (CA) Regional Medical Center; and assistant administrator, patient care services, and chief nursing executive at Scripps Memorial Hospital in Chula Vista, CA.

William Meins, BSc, MSc

William Meins, BSc, MSc, is an independent engineering consultant for many large healthcare delivery systems in the United States and England. He designed an on-site hospital decontamination installation for a major trauma center capable of processing 400 patients per hour.

Meins has previously served as chief engineer and technical director of the State Building Code Commission for the Commonwealth of Massachusetts; facilities administrator for Harvard Medical School in Boston, University of California San Diego, and Scripps Health in San Diego; and assistant hospital administrator, Riverside County Regional Medical Center in Moreno Valley, CA.

Philip R. Morey, PhD, CIH

Philip R. Morey, PhD, CIH, is principal consultant, microbiology for Environ. He received his PhD in biology from Yale University and is certified in the comprehensive practice of industrial hygiene.

Morey has held various teaching positions including lecturer of biology at Harvard University and professor of biological sciences at Texas Tech University in Lubbock, TX. He has also held a research position (research microbiologist; research industrial hygienist) while at the National Institute for Occupational Safety and Health and was subsequently director of indoor air quality (IAQ)/microbiology at several consulting companies. He was elected a member of the International Academy of Indoor Air Sciences in 1992 and a Fellow of the American Industrial Hygiene Association in 1997.

Morey was one of the panelists for the first consensus mold remediation guideline published by the New York Department of Health in 1993. He was assistant editor of the 1999 American Conference of Governmental Industrial Hygienists' book *Bioaerosols: Assessment and Control.* Landmark IAQ-microbial studies directed by Morey include the Polk County Courthouse (Florida), the Martin County Courthouse (Florida), and the Kalia Tower (Hawaii). Morey's interests include mold growth in HVAC systems, ultraviolet germicidal irradiation, and forensic microbial investigations in the built environment.

Andrew A. Schillinger, Esq.

Andrew A. Schillinger, Esq., graduated from the Gonzaga University School of Law Cum Laude and was an Associate Editor of Gonzaga Law Review. He practices plaintiff personal injury and medical malpractice law with the Spokane/Seattle firm Layman Law Firm, PLLP. He litigates cases ranging from traumatic brain injury to healthcare-associated infections.

Schillinger is currently on the Advisory Board for St. Luke's Rehabilitation Institute in Spokane, WA, and is currently the president of the Brain Injury Association of Washington, Spokane Chapter. In 2010, Schillinger was selected as a rising star in the publication *Super Lawyers.*

Joan M. Wideman, MS, MT(ASCP)SLS, CIC

Joan M. Wideman, MS, MT(ASCP)SLS, CIC, is the owner of JMW Consulting, LLC. As a consultant, she has assisted quality healthcare organizations and their business partners in pursuit of excellence since 2001. Her career experience includes clinical microbiology, infection prevention and control, and environmental safety. Wideman's formal education provides a complementary foundation to her work experience and includes two Master of Science degrees (Community Health and Occupational & Environmental Health, with a major in Industrial Hygiene) plus a Bachelor of Science in Medical Technology.

Wideman is very active in a number of professional organizations, including APIC, the APIC-Greater Detroit Chapter, and the Michigan Society for Infection Prevention and Control, among others. She is co-editor and chapter author of APIC's *Handbook of Infection Control and Epidemiology,* Third Edition, which was published in 2002. She is also a section editor, contributing author, and reviewer for the *APIC Text of Infection Control and Epidemiology,* Second Edition, published in 2005, and for the Third Edition from 2009, and she remains on the APIC Text Committee as a part of a team continuously reviewing the text to ensure that it is updated as needed. Additionally, Wideman has authored book chapters, articles, features, and abstracts that appear in a variety of publications.

Foreword

by Judene M. Bartley, MS, MPH, FSHEA

The title of this book—*Infection Control During Construction Manual*, Third Edition—reflects the continuing demand for more practical information and implementation tools in the ever-expanding world of healthcare construction and, particularly, renovation. The availability of the prior editions' policies, procedures, and strategies for compliance, and now the tools made available on the Web, also reflect the Internet world we live in, where we expect usable information at our fingertips. The changes reflect the exponential growth of knowledge and expertise that have occurred since the last edition, bridging very different worlds essential to healthcare safety—infection prevention and control (IPC) programs, planning, design, and construction/renovation expertise. The heavily revised and updated chapters also reflect a changing economy, changing healthcare requirements, and an increased awareness of the impact of the environment on infection. These integrated chapters provide the needed plan for systematic approaches in today's work, a needed plan by all professionals and stakeholders engaged in the design and construction process.

Events of the past few years have challenged both the IPC/epidemiology programs and designer/builder communities to respond to threats that were largely unanticipated and even unimaginable.

Impact of Healthcare-Associated Infections

At the same time, a deeper understanding of how infectious agents affect that environment along with newly revised guidelines and standards have converged to refresh our focus just as critically on basic issues such as safely maintaining building infrastructure. The hyperattention to healthcare-associated infections (HAI) is associated with media headlines generated when the Centers for Disease Control and Prevention (CDC) announced that annually, there were "1.7 million infections in hospitals and more than 98,000 of these patients die." Gradually, this was picked up by constant attention from *Consumer Reports*, and now there are state and federal requirements for public reporting of HAIs. In 2005, the Centers for Medicare & Medicaid

Services (CMS) began—at the request of Congress—to reduce payment for certain patients deemed to have had preventable HAIs among the other "healthcare-associated conditions," such as wrong-site surgery. This currently affects Medicare and Medicaid reimbursement for not only hospitals but also for hospital outpatient surgery departments and ambulatory surgery centers, as well as future payment programs in the value-based purchasing rule recently approved by CMS.

In the last few years, there have been numerous publications showing the equivalency of contaminated surfaces and contaminated hands in transferring microbes to patients. All of these changes and analyses have led to major attention to the risk of transmitting HAIs to patients and workers during construction and renovation.

Infection Control Risk Assessment

One good example of this convergence is the infection control risk assessment (ICRA) that originated in the 1996–1997 American Institute of Architects' (now known as Facility Guidelines Institute [FGI]) *Guidelines for Design and Construction of Hospitals and Healthcare Facilities*. The concept was further developed in the 2001 guidelines. After two more updates or review cycles of expansion and clarification in 2006 and 2010, the FGI guidelines continue to undergo refinement, even during the current review for the 2014 guidelines, because its basic principles are now clearly relevant to planning design and construction and renovation activities and outcomes. The 2003 CDC *Guidelines for Environmental Infection Control in Health-Care Facilities* (CDC-EIC) elaborated on the ICRA as well, anticipating the 2006 FGI guidelines and filling in the gaps.

Major Guidance

Although updates to the CDC-EIC guidelines have begun CDC/Healthcare Infection Control Practices Advisory Committee, much of it remains relevant and is discussed in this book. Finally, The Joint Commission (TJC) continues to focus on prevention of HAIs, not only in its IPC standards but directly in the Environment of Care standards. TJC places new emphasis on safe design and construction through planning and assessment and references the *Guidelines for Design and Construction of Health Care Facilities,* 2010 edition. Nevertheless, standards and guidelines require expertise to translate and apply important concepts into practical processes, and that is where this book is truly a "key" to guiding execution of the ICRA, which is addressed in multiple chapters for practical applications. Many more critical ideas and processes provide cutting-edge but well-tested recommendations.

Major Resources

This book also considers design and construction issues in the milieu of today's changing workplace, with an awareness of emerging hazards and concomitant planning for terrorism, as well as emergency response. By the same token, this book's contributors mine the literature, develop state-of-the-art solutions, and provide tools that should make readers better able to meet these unfolding challenges. Thanks to their creativity and willingness to share their strategies, tools, methodologies, and know-how, we all benefit from the dividends of their investment.

This new edition will assist infection preventionists, occupational health professionals, design and construction professionals, facility managers, risk and safety managers, industrial hygienists, and management to address today's critical issues by including expanded information about air contaminants and their impact on indoor air quality, HAI prevention, water issues, construction surveillance and environmental monitoring, education, contracting, and interaction with management.

Further, each chapter demonstrates the very features promoted by all contributors. That is, regardless of the topic, each author builds on the team concept necessary for risk assessments, partnering, and communicating among professional groups to plan, build, measure, and evaluate the process and the outcome in a cost-effective milieu.

There are two features of this edition worth noting:

- **A comprehensive program:** This book is a microcosm of what occurs in the realities of healthcare renovation and construction. The theme of risk assessment threads through each chapter, and together the chapters lay out a road map, beginning with the introduction and foundation of regulatory and accreditation standards basic to planning, the opportunistic pathogens or allergens of concern related to air and water, and the pertinent containment and prevention strategies. Essential prevention related to IPC programs includes construction surveillance and environmental monitoring, educational approaches, tools for the whole construction team, contracting and interaction with management, and the all-important program evaluation and assessment.

- **Practicality:** The book is not just a theoretical framework but is based on literature findings and experience, culling out what works and refining results into practical methodologies and procedures. Case studies and tools are built into each chapter as reality checks on applications and, with this edition, are now made available on the Web for easy access and usability.

The reader will need to keep in mind that in developing cutting-edge, state-of-the-art techniques, there will be different opinions and paths to reach the same goal, and different approaches will work better for some—and in different circumstances—than others. However, given the wealth of research, experience, and tested performance, this book should provide the direction organizations seek in a systematic guide for planning the safest possible facility, not only at the end of the project at the time of occupancy, but during construction and renovation.

Introduction

by Wayne Hansen, PE, REA, CEM, ASHE

The Art of Survival

We are pleased to include in this new expanded edition two new authors: Judene M. Bartley writing on current codes and standards, and legal experts John R. Layman and Andrew A. Schillinger presenting a case study of when things go terribly wrong. There is new terminology in this edition as well. The time-honored designation of infection control practitioner has been updated to more accurately reflect the duties of the position: infection preventionist.

Since the beginning of this series of books, the authors have been busy presenting educational seminars to various professional groups around the country. This gave us a great opportunity to learn firsthand of the issues most important to those of you in the trenches regarding construction in your facilities.

We have listened to you and expanded this edition to answer those questions and issues, including the following:

- What is meant by "construction"? We aren't building a new facility. (See Chapter 1.)
- What new codes and standards do I need to be aware of? (See Chapter 2.)
- Does my architectural design team know about these issues? (See Chapter 3.)
- Are there any airborne pathogens I need to be concerned with? (See Chapter 4.)
- Are there waterborne pathogens I need to know of? (See Chapter 5.)
- How do we assemble the proper team to address the project? (See Chapter 6.)

- What sort of protection and systems do we need to have in place prior to construction? (See Chapter 7.)
- At what point do we need to be concerned with environmental testing and project commissioning? (See Chapter 8.)
- How do we communicate the intricacies of the project and infection control issues to our hospital staff? (See Chapter 9.)
- Should we be involved in educating the construction personnel? (See Chapter 10.)
- This is going to be a large expensive project. How do we determine the best method to go about hiring the right contractors? (See Chapter 11.)
- Working with contractors and construction people is something we are not familiar with. What is the proper approach to achieve a successful project outcome? (See Chapter 12.)
- Are there any appropriate case studies I can refer to? (See Chapter 13.)
- How do we determine whether the programs and protocols we have in place will meet our needs? (See Chapter 14.)
- What is the impact on my facility if our program is not followed? (See Chapter 15.)
- If we don't follow all of the necessary steps, are there legal ramifications to be considered? (See Chapter 16.)
- How do I get my management to listen? (See Chapters 9, 10, and 14.)
- How will I get this new concept on infection control (IC) past the fire marshal? (See Chapter 7.)
- How do I convince my consulting architects and engineers to become involved with the Facility Guidelines Institute risk assessment? (See Chapter 3.)
- The contractors are balking at the cost of implementing new methods and telling me that we can't afford to do the projects. How do we answer this? (See Chapter 12.)

These are all valid and important questions. Regarding the last item, we are including a chapter written by an attorney that has been involved with lawsuits on behalf of patients (see Chapter 16).

Indoor Air Quality Scrutiny

The global issue of indoor air quality (IAQ) and fungal intrusion is not talked about as much as it was seven years ago, and the media has largely ignored it, but the issue still exists. In general, one does not see the issue discussed unless there is a lawsuit involved.

Clearly, IAQ issues are still of importance in all areas of human endeavor and occupation, especially in healthcare. A deeper, more-to-the-point element of global IAQ concerns includes the IC issues critical to the health and well-being of the patient and the financial health and reputation of the facility. Although the first and most important job of any healthcare facility is patient recovery, the financial consequences of inadequate infection containment and control cannot be ignored. Healthcare-associated infections can increase the cost of an average patient's hospital stay by $18,000. Similarly, if a facility makes corrections after the fact, it can cost hundreds of thousands of dollars and its loss of reputation. With a good containment program in place, the cost would be nominal (see Chapter 7).

Construction

We can't talk about IC and containment issues without discussing construction in occupied facilities (see Chapter 12). Construction is endemic in healthcare facilities; it is an inescapable fact of life. Of all hospital-related construction, approximately 75% involves remodeling, upgrading, or expanding an existing structure. Meanwhile, 25% covers new construction that consists of stand-alone structures not attached to an existing facility. Not included in these estimates are minor projects performed by facility staff and general maintenance functions.

The Bottom Line

Approaching this issue from different perspectives, the bottom line is to put in place a program of prevention that increases emphasis on engineering and design. Considering the invasiveness of construction in occupied facilities, it is logical that a sound, design-oriented, construction-related infection containment program be set up.

This book is intended to serve as a useful tool for healthcare facilities as they deal with construction, maintenance, and repair. To this end, each chapter that references figures, tables, and forms also will have these elements available in their entirety in the online toolkit. This toolkit will also include the references for each chapter and other information to help prepare for a smoother construction experience. All of these documents may be downloaded to your computer without additional charge.

DOWNLOAD YOUR MATERIALS NOW

The downloadable toolkit contains tools and documents from this edition and some online-only content. It is available at the website listed below. This is an additional service provided by HCPro, Inc., allowing readers to make use of the documents within and tailor them to specific organizational needs.

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CHAPTER 1

The Issues

by Wayne Hansen, PE, REA, CEM, ASHE

What Are the Issues?

With very few exceptions, most facilities ever built or remodeled come complete with built-in contaminants. All of the basic building blocks of a facility are exposed to the elements as it is built, and whatever is in the ceiling or wall spaces as the building is finished will remain there until those spaces are opened for service access or remodeling.

Choosing the type of construction or upgrade project for future work is an important consideration. Construction-related activities fall into the following categories: minor repair and system replacement, major system upgrades, area renovations and tenant improvements, major additions, and new adjacent construction. Often, a facility will undergo more than one of these projects simultaneously.

Minor repair and system replacement

Arguably, the most common type of activity is the updating of plumbing and piping systems, security systems, communications systems, data systems, and electrical systems. Activities such as these involve opening up ceiling cavities and, in some cases, wall chases. The duration of these penetrations may be brief, as in the case of inspection or component adjustment, or it could last for days, as in the case of piping and conduit runs. Some core drilling of the floor and hanging of pipe or conduit supports are often involved. All of these activities have the potential for spreading contamination into occupied spaces if not properly controlled. Methods of controlling the contracting process and spread of contamination will be discussed in detail in Chapters 6, 7, and 8.

Major system upgrades

System upgrades may be dictated by changes in the use of the facility requiring new or modified air conditioning systems, modifying exhaust systems to support expanded patient isolation rooms, and modernizing building information systems. Of these, the most invasive and difficult to control is a major computer and communication system upgrade. This type of project cannot be localized to a given area of the building because new cabling must be installed throughout the facility. This installation involves multiple ceiling access points, with the potential for major contamination, not only in patient care areas but also along patient transport corridors and pathways. Major cabling projects also present a safety issue when large reels and bundles of cable are present in corridors and circulation areas, along with the personnel and equipment.

Area renovation and tenant improvements

When construction is mentioned, renovation is the category that most often comes to mind, because several trades are involved and a good deal of construction debris accumulates. Major improvements to such areas as operating suites or patient floors often involve demolition of existing areas and some concrete core drilling or cutting, along with the new drywall work. This activity exposes patients to potentially infectious contaminants (see Chapter 4).

Major additions

Adding a new wing or major addition generally involves a higher level of awareness and is often easier to control. With more attention to planning and additional supervision from the contractors and hospital facilities staff, it is possible to control infection containment issues.

New adjacent construction

All too often, a new stand-alone project is perceived as more of an irritation to staff and a disruption to normal traffic flow. Although these projects are generally less of an infection control issue than other types of construction projects, they still must be treated with respect. New construction generates large amounts of airborne dust and debris and can find pathways into the existing buildings. A good example of this is adjacent freeway construction or the construction of a partially subterranean parking garage. In both cases, the projects churn and displace large amounts of soil, releasing fungal spores into the air.

Landscaping

A major landscaping or re-landscaping project can create problems inside a facility. Any disturbance of the soil aerosolizes fungi, which can enter the facility through doors, through air-conditioning systems, and on the clothing of people entering the facility. Another often-overlooked factor regarding major landscape work is the displacement of small animals that live in the landscaped areas. When these creatures are disturbed, they will seek a new habitat, which may be inside the facility, often in ceilings and wall chases.

Case Study

By way of illustration, a major medical facility in southern California went through many of the previously mentioned project types simultaneously. At one point, 17 different contracting firms were working on projects in the facility; work ranged from repair and renovation of library plumbing systems to complete demolition and remodeling. To add to the confusion, this facility was participating in a systemwide computer system and communication system upgrade. Although the major remodeling was largely contained to two floors, the cabling upgrade involved the entire facility; at one point, the cabling contractor had more than 80 men working two shifts on multiple floors. Associated with the cable project was the supporting general construction to create the necessary distributed equipment rooms, along with the supporting electrical distribution work. With this type of mobilization, control of the facility was all but impossible.

As the cabling project progressed, the ceiling cavity became a chaotic nightmare of workers, tools, equipment, and materials, with the attendant disturbance of material present since first construction. Figure 1.1 shows typical examples of the type of debris encountered in these ceiling cavities, where the general rule seemed to be "out of sight, out of mind." Some of the debris shown includes rodent droppings, which as much as we don't like to admit it, are common in nearly all facilities.

As cable bundles were pulled through the space from ceiling opening to ceiling opening, this debris was dragged across the upper ceiling surface and dropped into the occupied area through the next opening. This situation was further exacerbated when the cable bundles were in place, ready to be hung. This required either core drilling for supports or ram setting, and the ensuing vibration and noise added to the disruption.

Figure 1.2 shows just how involved these ceiling cavities were. We see a plethora of cable television cables, communications cables, computer cabling, plumbing and fire protection lines, electrical conduits, and air-conditioning flexible ducts. This complexity is rather typical of most facilities. With this kind of above-ceiling involvement, it is easy to see that any maintenance will be difficult and quite likely to dislodge debris. What is not shown are the various utility chases that traverse from floor to floor. Although some are fire rated and sealed from the ceiling cavity, many others are not, and the chase becomes an extension of the ceiling cavity. The chases become a problem if there are access panels in them for service valves or other items of equipment. When they are opened, whatever is in the chase and the ceiling cavity has a clear path to the occupied area.

Small facilities

Although Figures 1.1 and 1.2 represent complications in a very large facility, small facilities are not without problems. Often, smaller regional hospitals are one- and two-story facilities of frame construction. In many of these hospitals, the ceiling cavity has very poor access and limited room. Hence, there is more of a potential for problems of a very different nature. Figure 1.3 is a photograph of a cavity in a small facility that had limited human access but was not so limited to birds and rodents. The birds had found a protected refuge and had taken up residence. The rodents followed, finding both a refuge and a food source, preying on the eggs and baby birds. Occupants below complained of hearing noises in the ceilings, and the investigation showed what is seen in Figure 1.3.

Firewalls

Ceiling work involving installation of cables, pipes, or conduits poses the problem/need to penetrate firewalls. Even when these penetrations are done in a neat and orderly manner, debris is generated. More often than not, the penetrations are made haphazardly, such as by the old tried-and-true method of "hole size by fist estimation."

Figure 1.4 shows a firewall penetration that appears more to be a general lack of firewall. The rationale for this type of penetration is that, because the worker knows that repairs will have to be made, usually by another contractor, the thing to do is just make a hole and not worry about the consequences. Firewalls that are not repaired after needed penetrations are made become a fire-/life-safety issue for the facility. In some cases, such as the one shown in Figure 1.4, the repairs require substantial amounts of drywall to complete the task. Once the repair is complete, then there is the cleanup issue, because it is impossible to affect this kind of repair without creating a mess in the ceiling space.

Figure 1.5 shows a properly repaired firewall penetration. To make this repair, the horizontal conduits attached to the metal studs had to be detached to allow the drywall to be installed. It is common in firewall penetration repair work to encounter existing utilities or items of equipment that have to be temporarily relocated or detached to affect the repairs. This increases the time required for repair work and the amount personnel have to spend in the ceiling cavity. The longer the time, the greater the potential for contaminants to spread into the occupied area below.

Contaminants

Contaminants cover a broad range of materials:

- *Inorganic nuisance dust and respirable dust* can cause eye and throat irritation and general discomfort.
- *Fibers* are another source of mechanical irritation to sensitive mucous membranes, with fiberglass being the most notorious.
- *Chemical odors* can be a nightmare for facilities personnel because they are often difficult to trace. In some cases, an odor triggers a "chemical smell" complaint that is actually caused by microbiological contamination.
- Microbiological contaminants are the primary contaminant of concern in a healthcare setting. In this category, there can be bacteriological issues, such as the case shown in Figure 1.3, but the primary focus in this category is fungal contamination. *Aspergillus* is undoubtedly the most common fungus worry in a hospital because of the virulent nature of the organism and its effect on immunosuppressed patients.

The Bottom Line

With so much attention being directed toward healthcare today, it is incumbent on all of us to improve the environment of care by addressing all cost-related issues that have a negative impact on the financial status of healthcare organizations. From a health and comfort standpoint, controlling the indoor environment is critical to this effort.

Figure 1.1

First Floor Ceiling Cavity

Source: Infection Control During Construction: A Guide to Prevention and JCAHO Compliance. *Copyright 2002 HCPro, Inc.*

Figure 1.2

Fourth Floor Ceiling Cavity

Source: Infection Control During Construction: A Guide to Prevention and JCAHO Compliance. *Copyright 2002 HCPro, Inc.*

Figure 1.3

The Wildlife Penthouse

Source: Infection Control During Construction: A Guide to Prevention and JCAHO Compliance. *Copyright 2002 HCPro, Inc.*

Figure 1.4

Typical Firewall Penetration

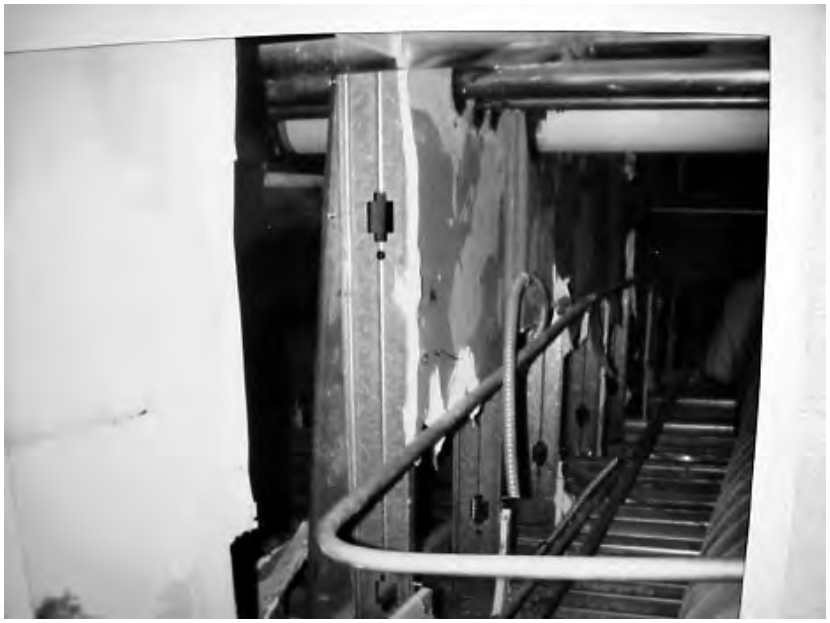

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Figure 1.5

Firewall Penetration Repaired

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THIRD EDITION

Infection Control During Construction

MANUAL

Policies, Procedures, and Strategies for Compliance

WAYNE HANSEN, PE, REA, CEM, ASHE

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