Ergonomics for Healthcare Environments

Tim Springer, Ph.D.
President
HERO, Inc.

Knoll

Table of Contents

Executive Summary

The healthcare industry faces a number of significant challenges:

- **Rising Costs**
  Healthcare costs continue to rise faster than inflation. Consequently, increasing attention is focused on how healthcare organizations operate. Management is looking for ways to economize through cost savings and cost cutting.

- **Increased Demand**
  Demand for healthcare will grow, at least through 2030-2050 due to population growth, immigration, population shifts, and increasing expectations and demands of aging Baby Boomers

- **Building Boom**
  In response to increased demand, the US is experiencing a huge hospital building boom.
  Over the next ten years $200 billion dollars will be spent on hospital construction.

- **War for Talent**
  In the face of increased demand and an unprecedented building boom, hospitals and healthcare organizations face significant staffing shortages. Issues of recruiting, retention and turn-over are critical to the survival and success of any healthcare organization.

In addition to these forces for change in healthcare, there are changes and trends within the industry:

- **Changing Nature of Work**
  Regulations (HIIPA, Medicare Plus Choice), technology and changing work styles (multidisciplinary teams) are exerting profound effects on healthcare.

- **Industry Trends**

  1. Evidence-based practice. Applying this concept to the development and provision of healthcare environments has lead to evidence-based design. Research cited in this white paper speaks to the value of applying ergonomics to the design of healthcare work environments.

  2. Focus on the patient experience. Representing a shift from provider focus to patient focus, this trend has raised the issue of environmental quality for both patients and staff.

Healthcare is focusing on the physical environment as a health and healing tool and as an asset to be managed. Two organizations - Center for Healthcare Design (CHD) and Planetree are dedicated to fostering evidence-based design of healthcare environments.

Taken together, the above conditions represent a golden opportunity to introduce ergonomic concepts and principles to the design and configuration of healthcare environments.

When Applying Ergonomics to Healthcare Environments several unique characteristics distinguish them from other types of workplaces:

• Unique Setting

Healthcare presents a unique combination of challenges and opportunities for applying ergonomics.

- Nonstop operation - 24/7/365 means shift work and shared workplaces.
- Healthcare must serve entire population
- Regulations and information security requirements impose unique and potentially conflicting demands on workplaces.
- Nearly the complete range of physical actions performed from less than ideal positions and postures increase risk of injury.
- Many healthcare jobs involve multi-tasking with physical activity and highly skilled knowledge work and technology use.
- Predominantly female workforce

• History & Tradition

A long history of looking for ways to improve the working environment; however the primary focus has been on the patient and staff-patient interactions. (e.g. adjustable beds)

• Untapped Potential

Staff workplaces not involving direct patient contact have not benefited from applying ergonomics. Potential is found in three primary areas:

1. Market differentiation

a. In a war for talent, workplace makes a difference.

b. Culture image and identity are reflected in the physical environment

c. The workplace is a strategic asset

2. Performance

Performance improved 17.7% while the benefit-to-cost ratio was 24:1

a. Increase Staff Effectiveness, Reduce Errors, and Increase Staff Satisfaction

b. Improve patient safety

c. Reduce stress and improve outcomes

d. Improve overall healthcare quality

3. Health & Safety

a. MSD injuries are very expensive

b. Carpal Tunnel can be reduced or alleviated

Why is Ergonomics Important?

The goal of ergonomics is to support people in what they do for work so that they are safe, comfortable and productive. The primary focus is on people and the tools and technology they use.

- Ergonomics focuses on people
- Good ergonomics yields improved performance and productivity
- Good ergonomic programs include training and change management
- Good ergonomics programs always yield more benefits and save more money than they cost

Ergonomic Fundamentals

Ergonomics approaches design tries to address functional requirements of people at work by asking six basic questions:

- Who are the users?
- What do workers do?
- How do workers perform their job?
- When do workers engage in specific work behaviors?
- Where do workers engage in tasks?
- Why do workers do what they do in the way that they do it?

Design Approaches

Ergonomics employs three fundamental approaches to design to accommodate individual differences while simultaneously meeting the needs of the population of users.

- Design for the extreme
- Design for the average
- Design for the adjustable range

Ergonomic Strategies

- Adapt the workplace to the worker
- Support work in the way it is done
- Optimize support for the primary task
- Provide appropriate user control
- Emphasize ease of use
- Provide for Personalization of Space
- Train people in the proper use of equipment

The Practice of Ergonomics

When applying ergonomics, one considers the nature of the workers, the work they perform and the workplaces. Functional requirements tend to cluster into one of three workplace types: Dedicated or solo workplaces, shared workplaces and collaboration workplaces:

Dedicated Workplaces

- Used primarily by only one person
- Designed or adapted to the needs of a specific user.
- Primary tasks are typically:
    - Seated
    - Solo, “heads down”
- Minimize distractions

Dedicated Workplaces - Examples

- Executives & Administrators
- "Patient facing"
- Registration & Admitting
- Specialty
- Diagnostic imaging
- Physician's offices
- "Back office" support personnel
    - Health records
    - Quality Control
    - Accounting

Dedicated Workplace Considerations

- Appropriately adaptable workplaces
- Work surface heights set at appropriate level for specific user st time of set-up. (may trade ease of adjustment for cost)
- Task seating
- Support the position in which primary task is performed
- User adjustable
- Task lighting
- Sufficient storage
    - "Hot files" and project work within reach
    - Archive everything else off site
- Space for two or more for collaboration

Shared Places

- Used by multiple people during a shift and throughout a 24 hour period
- Often multiple tasks including:
- Heads down concentration
- Communication & collaboration
- Multi-tasking
- Maximize adaptability and flexibility

Shared Workplaces - Examples

- Nurses station
- Patient rooms
- Registration
- Labs
- Pharmacy

Shared Workplace Considerations

- Support both sitting and standing work as appropriate
- Maximize adjustability to accommodate multiple users
- Ease of use of any adjustments is essential
- Support multi-tasking
    - Solo, “heads down”
    - Collaboration
- Support variety of work styles

Collaboration Places

- Used concurrently by two or more people
- Support team work and communication
- Minimize distraction to users and others
- Support both formal and informal communication

Collaboration Workplaces - Examples

- Meeting rooms
- Training rooms
- Offices
- Hallways
- Nurses stations
- Cafeteria/lunch rooms
- Break rooms

Collaboration Workplace Considerations

- Comfort
    - Variety of users
    - Length of use (minutes to hours)
- Duration
- Information sharing
- Display
- Distraction
    - To others
    - To users

Conclusion

Healthcare environments possess significant untapped potential for benefits to organizations willing to apply ergonomics to staff workplaces. Evidence supports investing in workplace ergonomics to realize improved performance, improved worker satisfaction, positive affect on recruiting and retention and improved quality of patient care.

Ergonomics for Healthcare Environments

Introduction

Healthcare as an industry and as a work environment presents a unique set of circumstances, opportunities and challenges for applying ergonomics. This report is intended to work as a companion piece to the PowerPoint presentation of the same name. In it you will find background, research, references and discussion of the issues surrounding the application of ergonomics to healthcare environments.

I. Background - Context

Healthcare is the largest industry in the American economy:

- Healthcare provided 13.5 million jobs in 2004
- Eight (8) out of 20 occupations projected to grow the fastest are in healthcare.
- More new wage and salary jobs created between 2004 and 2014 will be in healthcare than in any other industry —about 19 percent, or 3.6 million.

Rising Costs

Healthcare spending in the U.S. continues to rise at the fastest rate in history. Total national health expenditures for 2005 (the last year for which data are available) rose 6.9 percent — two times the rate of inflation. Total spending was $2 Trillion in 2005, or $6,700 per person. Total healthcare spending represented 16 percent of the gross domestic product (GDP).

U.S. healthcare spending is expected to increase at similar levels for the next decade reaching $4 Trillion in 2015, or 20 percent of GDP.

For perspective, healthcare spending in the U.S. is 4.3 times the amount spent on national defense.

Consequently, Healthcare as an industry is under intense pressure to control costs, economize, stream-line and seek best practices to increase efficiency and effectiveness. Appropriate application of ergonomics to healthcare workplaces offers one tool to meet those goals.

Increased Demand

The demand for healthcare is high and will continue to increase. Several factors are fueling the demand - population shifts in the United States, the graying of the baby boom generation, and the introduction of new technologies. Consider the following:

- The population of the U.S. is projected to grow 18% from 2000 to 2020.
- Population growth is driven by fertility, mortality, and net immigration. Population growth should continue through 2030 and then slowly begin to decline.
- Immigration and higher birth rates among ethnic groups means greater cultural and ethnic diversity.
- Aging population. The elderly (age 65 and over) currently represent 13 percent of the U.S. population. That proportion is expected to rise to 17 percent by 2020. By 2020 almost 40 percent of a physician's time will be spent treating the elderly.
- Retirement among Baby Boomers will increase the population shift to warmer climes (i.e., Sun Belt states).
- Increasingly affluent and demanding consumers (Baby Boomers) will remain more active as they age and expect special treatment.
- Improved medical technology and procedures will yield longer life spans, greater demands for state of the art and increased demands on HealthCare.

Building Boom

The United States is facing one of the largest hospital building booms in history. Nationwide, more than $16 billion was spent for hospital construction in 2004. Spending will rise to more than $20 billion per year by the end of the decade. Over the next ten years at estimated $200 billion will be spent on new construction. These hospitals will remain in place for decades.

War for Talent

In the face of this increased demand and new building boom, healthcare organizations are locked in an increasingly fierce competition for qualified employees. This "War for talent" is driven by:

- Staffing shortfalls
- Recruiting costs and practices
- Turnover

Staffing Shortfalls

Healthcare organizations in the US and worldwide face significant staffing shortfalls. Data from the US Department of Health and Human Services project the following shortfalls:

Position	2005	2010	2020
Nurses	126000	275000	800000
Pharmacists	10000		
Lab Tech	13000		
Imaging Tech	13000	75000	75000

Source: USDHHS

A study sponsored by the American Hospital Association shows a consistent trend in staffing vacancies across all types of healthcare work.

Position	Mean Vacancy Rate
Registered Nurses	13.0%
Pharmacists	12.7%
Housekeeping/Maintenance	5.3%
IT Technologists	5.7%
Billers/Coders	8.5%
Laboratory Technicians	9.5%
Nursing Assistants	12.0%
Licensed Practical Nurses	12.9%
Imaging Technicians	15.3%

Recruiting Costs and Practices

The circumstances reflected by these data has helped fuel competition for qualified healthcare professionals. As a result, costs associated with finding and hiring staff, especially nurses, has risen 50-75% . According to the Harvard Business School, the cost of hiring an unsuitable person can be two times the employee's annual compensation, including expenses, training, benefits, wages, commissions, and bonuses. That means, for example, that having to terminate a newly hired $60,000-per-year employee can cost an organization more than $120,000 in both direct and indirect costs. Consequently it is not surprising to find organizations offering incentives to recruits and bonuses for those who can find and recommend qualified candidates. One example is a program at Duke University Medical System that pays $5000 for referrals that are hired.

Historically, US healthcare organizations have looked to imported talent to help meet staffing shortfalls and help contain personnel costs. The Philippines has been the primary source of foreign nurses and staff. However, global competition has forced the US organizations to broaden where they look for talent to include South Africa, The Mediterranean, The Middle East and Eastern Europe adding cultural and ethnic diversity to the healthcare work environment.

Turnover

Staff turnover is a significant issue for healthcare leaders due to the shrinking workforce in Western countries and an increased demand for healthcare services as the population ages. Nurse turnover is typically highest on medical/surgical units, compromising quality and increasing cost. Staff shortages and high turnover are often associated with registered nurses, but also affect other professions such as imaging technicians, pharmacists, and lab technicians. Both shortages and high turnover place additional stress and strain on remaining staff, eroding continuity of care and creating unwanted expense

The economic impact of turnover is significant:

1. Recruitment of replacements, including administrative expenses, advertising, screening and inter-viewing, and services associated with selection, such as security checks, processing of references, and, possibly, psychological testing.
2. Administrative hiring costs.
3. Lost productivity associated with the interim period before a replacement can be placed on the job.
4. Lost productivity due to the time required for a new worker to get up to speed on the job.
5. Lost productivity associated with the time that coworkers must spend away from their work to help a new worker.
6. Costs of training, including supervisory and coworker time spent in formal training, as well as the time that the worker in training must spend off the job.
7. Costs associated with the period prior to voluntary termination when workers tend to be less productive.
8. In some cases costs associated with the communication of proprietary trade secrets, procedures, and skills to competitive organizations.
9. Public relations costs associated with having a large number of voluntary or involuntary terminations in the community spreading gossip about the organization.
10. Increased unemployment insurance costs.

Example

The cost of replacing 288 employees per year (in a hospital with 200 beds employing 1200 persons with a turnover rate of 2% per month) was $2,888,295.52 when all sources of costs were analyzed.

The American Hospital Association estimates the cost of replacing one staff nurse equals the annual salary for that nurse.

Why do some people leave their jobs while others stay? Research suggests a causal chain in which perceived autonomy, job satisfaction, intent to leave the hospital and turnover are the sequence of outcomes.

Reasons People Leave

1. Bad management, supervisor or team leader
2. “Many healthcare workers are disenchanted with their profession and feel undervalued”

Reasons People Stay

- Exciting work
- Career growth
- Working with great people
- Fair pay
- Space (both personal and physical)

Changing Nature of Work

The organization and delivery of healthcare in the United States is undergoing significant social, organizational, economic, political, and cultural changes with important implications for the future of medicine as a profession. In part due to increased demand and rising costs, healthcare is under more regulatory pressure than almost any other industry.

Examples

- HIPPA (Health Insurance Portability and Accountability Act) & information security
- Medicare Plus Choice

HIPPA exerts far-reaching effect since sharing information regarding a patient’s condition and treatment are fundamental to effective, team-based healthcare. The workplace can play a major role either helping or hindering healthcare professionals collaborate while complying with information security requirements of HIPPA.

Healthcare has a long history of applying technology to advance the practice of medicine. However, rapid advances in information technology are changing all aspects of work from decision support to in-formation management to patient care

Examples

- Electronic medical records (EMR) software
- Electronic medication management
- Computer aided imaging
- Remote collaboration
- Robotics - from surgery to consultation
- PCs to laptops to handhelds & PDAs

Here too, the workplace can play a pivotal role in helping healthcare staff maximize the benefits of technology while minimizing the potential risks of its use.

Finally, healthcare work is exploring and evolving new approaches to care. The nature of how healthcare is applied and administered is constantly changing

Examples

- Interdisciplinary team work
- Prevention and holistic approaches

Industry Trends

Two key industry initiatives are beginning to change the way hospitals operate and especially how they view the physical environment:

- **Evidence-based practice.** This initiative of the US Government, Department of Health and Human Services, Agency for Healthcare Research and Quality. (AHRQ) began in 1997. AHRQ launched a program to promote evidence-based practice in everyday care by establishing 12 Evidence-based Practice Centers (EPCs). The EPCs develop evidence reports and technology assessments on topics relevant to clinical, social science/behavioral, economic, and other healthcare organization and delivery issues—specifically those that are common, expensive, and/or significant for the Medicare and Medicaid populations.
- **Focus on the patient experience.** Representing a the shift from provider focus to patient focus, organizations are tracking outcomes including: improved food service; reducing the length of hospital stays; reducing or eliminating infections; a more holistic approach to healing; a focus on the physical environment; and including a patient's family and support network in healthcare decisions.

Hospitals are beginning to focus on the physical environment as a tool in health and healing - not only for patients' benefit but also for healthcare workers. The Center for Healthcare Design (CHD) and Planetree are two organizations dedicated to fostering evidence-based design and a more comprehensive approach to healthcare environments.

CHD launched its Pebble Project, to measure the effects of the built environment. The project also aimed to create a ripple effect of sharing documented examples of healthcare facilities in which design has improved quality of care and financial performance of the institution. Pebble Project partners are demonstrating that facility design can:

- **Improve the quality of care for patients**
- **Attract more patients**
- **Recruit and retain staff**
- **Increase philanthropic, community, and corporate support**
- **Enhance operational efficiency and productivity**

Planetree is a nonprofit membership organization founded in 1978. Planetree works with hospitals and health centers to develop and implement patient-centered care in healing environments. One of the core competencies of Planetree is Architectural and Interior Design Conducive to Health & Healing:

> "Planetree firmly believes that the physical environment is vital to the healing process of the patient. Facility design should include efficient layouts which support patient dignity and personhood. Domestic aesthetics, art and warm home-like, non-institutional designs which value humans, not just technology, are emphasized. Architectural barriers which inhibit patient control and privacy as well as interfere with family participation are re-moved. Awareness of the symbolic messages communicated by design is essential.
>
> "Designing and maintaining an uncluttered environment encourages patient mobility and a sense of 'safe shelter.' The design of a Planetree facility provides patients and families with spaces for both solitude and social activities, and includes libraries, kitchens, lounges, activity rooms, chapels, and gardens. Comfortable space and accommodations are provided for families to stay overnight. Healing gardens, fountains, fish tanks and waterfalls are provided to connect patients, families and staff with the relaxing, invigorating, healing, and meditative aspects of nature.
>
> "It is just as essential (emphasis added) to create healing environments for the staff as it is for patients. Physicians, nurses and ancillary staff are very much affected by their working environment. It is very hard to help patients heal and recover in inhospitable, cold and impersonal spaces. Lounges and sacred space for staff are an important component in the creation of a healing environment."

Golden Opportunity

In the context of these industry trends, the boom in hospital construction provides an opportunity to re-think healthcare environmental design. Of particular interest are ways in which improved hospital design can help reduce staff stress and fatigue and increase effectiveness in delivering care, improving patient safety, reducing patient and family stress and improving outcomes and overall healthcare quality.

Just as medicine has increasingly moved toward "evidence-based medicine," where clinical choices are informed by research, healthcare design should be guided by rigorous research linking the physical environment of hospitals to patients and staff outcomes. In other words, "evidence-based design."

Ulrich and Zimring (2004) reviewed the research evidence regarding the design of healthcare environments and its affect on patients and staff. "The research team found rigorous studies that link the physical environment to patient and staff outcomes in four areas:

1. Increase Staff Effectiveness, Reduce Errors, and Increase Staff Satisfaction by Designing Better Workplaces
2. Improve patient safety
3. Reduce stress and improve outcomes
4. Improve overall healthcare quality

II. Applying Ergonomics in Healthcare Environments

When considering healthcare environments, several unique characteristics distinguish them from other types of workplaces.

Unique Setting

Healthcare presents greater ergonomic challenges and opportunities than any other industry:

- Constant operation (24/7/365). This means shift work and shared workplaces are common. Also, most work environments, involve both solo work and collaboration.
- The client/patient population includes all ages, all sizes and all characteristics of people from the youngest to oldest, smallest to largest.
- Regulations, security and privacy are becoming an increasingly important considerations in healthcare environments. HIPPA has imposed unique privacy requirements for patient information that must be accommodated in a work setting that is, in both design and practice, inherently open and shared.
- Many jobs in healthcare involve a very wide range of physical action from positions and postures that may not be ideal and could place workers at risk for accidents and injuries. It is common to find jobs involving pushing, pulling, reaching, bending, stretching, lifting, lowering, sitting, standing, walking and carrying.
- Many healthcare jobs are characterized by multi-tasking physical activity with highly skilled knowledge work and technology use.
- The workforce is predominantly, but not exclusively, female.

History & Tradition

The concepts of ergonomics are not new to healthcare. Making the things people use and how and where they use them as safe, easy to use, comfortable and effective as possible parallel the goals and objectives of effective healthcare.

Medicine and Healthcare have a long tradition of attention to the importance of the physical environment and developing and using devices and techniques that reflect ergonomic ideas and principles. One of the earliest proponents of this notion was Florence Nightingale. Her efforts on behalf of the British soldiers during the Crimean War focused on design engineering to improve lighting (especially with sunlight), ventilation, heating and cooling, sewerage facilities, and sufficient space for soldiers' personal belongings. Since then, environmental factors such as noise, air quality, light, toxic exposures, temperature humidity, and aesthetics have been scrutinized for their effects on both patients and workers.

In today's modern hospital, ergonomics is an accepted part of much of the patient care setting. Devices such as adjustable hospital beds are accepted and expected as standard equipment.

Recently, hospitals have begun to address risks associated with moving patients. A rise in obesity (bariatric patients), staffing shortages and an aging healthcare workforce has increased concern regarding accidents and injuries associated with patient transport. Many organizations employ "lifting teams" and "Zero-lift" policies while moving patients. These approaches rely on technology and devices to relieve or eliminate the stress and strain of physical lifting that can lead to injuries. Recognizing the potential risks associates with patient transport, a national movement is underway to pass "safe patient handling – no manual lift" laws at both state and national levels. These laws would require mechanical lifting equipment and friction-reducing devices for all healthcare workers, patients, and residents across all healthcare settings.

These examples illustrate the historic and traditional approach of healthcare when applying ergonomics — a focus on patients and patient-staff interactions.

Untapped Potential

The workplace represents an area of substantial untapped potential to yield benefits to healthcare organizations by applying ergonomics in three principle areas:

1. Market Differentiation

As discussed above, healthcare organizations are engaged in a war for talent caused by staffing shortfalls, rising recruiting costs, and increased turnover. The way to win the war for talent is by attracting and retaining the best employees. An effective and underutilized tool in this war for talent is the workplace.

The physical workplace is the single most visible manifestation of an organization's culture, image and identity. The nature of the workplace states in loud, clear, nonverbal terms, how an organization values its employees and how it communicates its values.

The importance of high-performing healthcare environments is recognized by the Baldrige National Quality Program: "Organizations with high levels of workforce engagement are often characterized by high-performing work environments. Research has indicated that engagement is characterized by performing meaningful work; having organizational direction, performance accountability, and an efficient work environment."

Few hospitals and healthcare organizations actively employ the power of the physical workplace as a market differentiator in the competition to attract and retain the best employees. Research results support investing in the physical workplace pays dividends through higher performance levels, greater job satisfaction and improved patient satisfaction. Researchers also identified the built environment's role as a moderating variable that can lead to improved processes and outcomes.

2. Performance

Healthcare professionals are under increasing pressure to work more efficiently with fewer resources. This stressful situation can be made worse by physical discomforts in the workplace.

In a review of relevant literature, Ulrich & Zimring (2004, 2006) found scientific evidence linking the physical environment to performance in the following areas:

1. Increase Staff Effectiveness, Reduce Errors, and Increase Staff Satisfaction by Designing Better Workplaces (emphasis added)
    - Improve Staff Health and Safety through Environmental Measures (e.g. In-door air quality, thermal environment)
2. Improve patient safety
    - Reduced staff fatigue
3. Reduce stress and improve outcomes
    - Reduce Noise. Studies have shown that noisy environments contribute to the perception of increased work demands, stress, and burnout. Not surprisingly, high noise levels can also in-crease the risk of errors when staff are performing critical tasks such as dispensing medical prescriptions, and can even interfere with patient healing and recovery. They can also put patient confidentiality at risk, as staffs are forced to speak more loudly to communicate vital health information. A quieter atmosphere can also create a more nurturing, healing environment for patients and staff alike.
    - Reduce Spatial Disorientation (wayfinding)
4. Improve overall healthcare quality

Adapting workplaces to fit workers and the work they perform is a fundamental principle of ergonomics. Highly supportive workplaces - those that are designed to optimize performance of the tasks and support the work behaviors of staff - are also high performance workplaces.

While cost control is critical in today's healthcare industry, organizations rarely recognize the workplace as an asset from which one can expect a return on investment. Evidence suggests spending on workplaces to improve worker performance, satisfaction and retention is a small, but highly leveraged investment. In other words, the relatively small expense of workplace can yield substantial returns by improving the performance of the comparatively large investment in personnel.

Example

Amick and colleagues (2002) showed that attention to ergonomics in healthcare workplaces provides a cost-effective way to improve performance and productivity. Performance increased 17.7% while the benefit-to-cost ratio was 24:1.

3. Health and Safety of Workers

Healthcare has recognized the potential risk for injuries caused by lifting - especially lifting associated with patient transport.(see "zero lift" above). The National Institute of Occupational Safety & Health (NIOSH) tracks the economic affect of back injuries and the associated medical, worker compensation and lost time associated with them:

- Back-related injuries cost $52 Billion in direct medical and lost time expenses.
- Musculoskeletal Disorders (MSD) result in 16 Million lost workdays ($50 Billion) per year.
- 30% of all workers' compensation claims are MSD costing $18 Billion per year.
- The average MSD claim is over $18,000.
- Carpal Tunnel surgery is now among the most frequently performed procedures in the US — average cost $50,000 per wrist.

Sources: US Bureau of Labor Statistics & NIOSH

The untapped potential for ergonomics in healthcare is addressing musculoskeletal disorders (MSD) that affect activities beyond patient transport. Improperly or inappropriately adjusted and configured workplaces contribute to MSDs such as those associated with computer use (e.g. carpal tunnel syndrome) and constrained postures (neck, shoulder, leg and back problems). Ergonomics can reduce the incidence and costs associated with these health and safety issues.

Why is Ergonomics Important?

It seems obvious that people prefer workplaces that are more comfortable, safe, simple and easy to use, healthy and productive — but it requires both science and art to achieve that — the science and art of ergonomic design.

- Ergonomics focuses on people - the single largest and most valuable asset of any organization. Regardless of appearances, people are different from one another. Ergonomics recognizes and strives to accommodate individual differences in everything from size to skills, from work styles to idiosyncrasies.
- Good ergonomics yields improved performance and productivity. Research evidence over the past 25 years consistently shows an average of 12% improvement in performance when a comprehensive approach to ergonomics is applied to workplaces. Comprehensive ergonomics means looking at the total workplace from task design and work behaviors, to tools and technology to visual, auditory, thermal, air quality and spatial environmental variables.
- Good ergonomic programs include training and change management. Ergonomics may seem intuitive - but people still need to be shown how to use features and understand how some behaviors increase risk of injury. Also, changing a person's environment can profoundly affect their behavior. So, to minimize negative affect and maximize acceptance and positive affect, communication and change management are essential.
- Good ergonomics programs always yield more benefits and save more money than they cost.

Ergonomic Fundamentals

Ergonomics addresses the functional requirements of people at work by asking six basic questions: who, what, how, when, where and why?

- *Who are the users?*
  Ergonomics begins by understanding the characteristics of the population of users. The challenge is to develop solutions that accommodate individual differences while accommodating everyone who will use the designed product or environment. Physical measures of people, such as standing height, hip circumference or knee height when seated, are called anthropometrics. These measures are important when designing things for people to use. The assumption is that measures of the entire population assume a "normal" distribution that is shown graphically by a bell shaped curve. The nature of anthropometric data and the normal distribution allows ergonomists to determine who among the population will be accommodated by a particular design decisions. How this is used is discussed below.

- *What do workers do?*
  It is important to understand the activities that comprise the tasks and jobs workers perform. Task analysis allows ergonomists to understand the work behaviors and functional requirements of a set of tasks or a job family.

- *How do workers perform their job?*
  Are there particular work styles or sequences of activities that characterized a specific job or group of workers? This understanding informs functional design specifications that support work in the way it is done.

- *When do workers engage in specific work behaviors?*
  Sequence and duration of work activities helps determine levels of importance. There is a notable trade-off between time on task and accommodation for comfort. Generally, it is more important to support activities and work behaviors that constitute the majority of a person's day - what might be called their primary tasks. If a person spends 15-30 minutes at a particular workplace, they can tolerate a solution that is more generic and potentially less comfortable, than if they are engaged in intensive concentrated work for two to four hours. However, priorities and solutions must be weighted by other information relating to importance. For example, in healthcare a "code" signifies a special event of critical importance (like heart failure) that may be infrequent. Under such special circumstance the critical importance of the out-come requires the best support for workers performing that job function at that time.

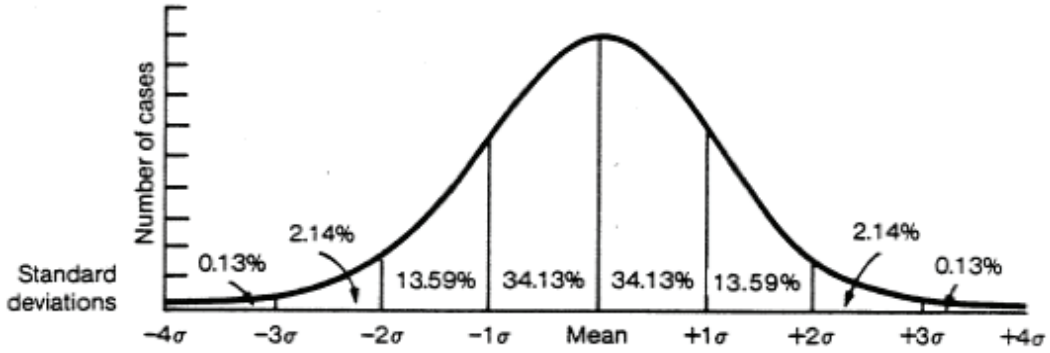
- *Where do workers engage in tasks?*
  The characteristics of location and configuration of workplace helps determine how best to support the necessary work behaviors and functions. Workplaces tend to fall into one of three categories: solo or dedicated workplaces, shared workplaces, and collaborative workplaces. Each have different purposes and functional requirements. Thus, each workplace type has corresponding ergonomic considerations.

- *Why do workers do what they do in the way that they do it?*
  Are their policies, procedures or practice guidelines or requirements that influence why workers perform their assigned tasks in a certain order or fashion? Routine, peer suggestions, and superstitious behavior may also play a role in why work is performed in a certain way.

Understanding the nature of the workers, work and workplace enables ergonomic experts to apply the appropriate design approach.

Design Approaches

Ergonomics employs three fundamental approaches to design to accommodate individual differences while simultaneously meeting the needs of the larger population of users. To understand the differences in these approaches and why each is appropriate for particular settings, consider the bell shaped curve shown below:



Notice a few important characteristics of the distribution represented by this graph. The highest point of the curve is in the center and represents the average or mean. In this case, the mean is the exact middle of the distribution - the median. Thus half the population falls on either side of both the average (mean) and the median. The ends of the curve are called the extremes. Looking at either end of the curve, one sees small percentage figures (2.14%; 0.13%). These are the percentage of the population that falls between that point and the nearest end. The numbers along the baseline (-4σto +4σ are standard deviations (sd). So, the area under the curve from -2σto +2σincludes approximately 95% of the population.

Using these characteristics of the normal distribution, ergonomics has developed three approaches to design:

Design for the Extreme

This approach is used where accommodating the largest or smallest individuals will also serve the needs of the rest of the population. For example, doorways are designed so the tallest person can walk through them - as well as the rest of the population.

Design for the Average

Where a large portion of the population will use the same device or environment, design for the average may be most appropriate. It is used in circumstances where duration of use or cost precludes designing in adjustments. Examples include grocery store checkout aisles and office reception counters.

Design for the Adjustable Range

This approach is used to maximize “goodness of fit” where the device or environment adapts to the user. A common example is automobile driver seats with 6 or 8 way adjustments to meet the full range of the user population. Similarly most modern office chairs employ this design approach and provide several axes of adjustment to accommodate a wide range of users.

Ergonomic Strategies

- Adapt the workplace to the worker - not vice versa. People are very adaptive. They can accommodate poor design and hostile environments. But adaptation takes its toll on users, requiring energy to adapt. Adapting to poor design or environmental elements leads to de-creased performance and fatigue. Fatigue leads to errors, accidents and injury. Appropriately adaptive equipment and environments relieve strain on the worker to adapt to short-comings in the workspace. Provide adjustable furniture and equipment to support the wide range of sizes and shapes of people in the workforce.
- Support work in the way it is done. Appropriate support of work styles and practices should be provided. For example, if people prefer storing paper information in “piles”, expecting information to be stored in drawers or bins works against the way work is done. Providing of horizontal surfaces and shelves for storage supports the inherent work behaviors. Similarly, multiple users assuming multiple positions and postures require easily moveable and adjustable support surfaces.
- Optimize support for the primary task. Work surfaces that are solid and large enough to sup-port the primary task are required.
- Provide appropriate user control. Control over their workplace is important to workers’ sense of satisfaction and performance. Adjustments must be simple and easy to perform. Some workplace adjustments may be made at the time of setup; however important adjustments like seat position should be user controlled.
- Emphasize ease of use. Adjustments, control motions, connects and disconnects should be easy to use. For example, controls (e.g., seat adjustments) should be easy to reach, easy to operate and should be either clearly labeled or communicate function by shape or motion. Access to power, net-work, and telecommunication ports should be at desk height or belt-line level, not where access re-quires stooping, bending or crawling under work surfaces.
- Provide for Personalization of Space. Accessories that complement, as opposed to supplant, the function of the workplace allow the user to “fine tune” their workspace to meet their individual preferences.
- Train people in the proper use of equipment. Good design is not enough. Ergonomics may seem intuitive - but people still need to be shown how to use features and understand how some behaviors increases risk of injury. Training that demonstrates the technique and benefits of appropriate adjustments are required. The best workplace is only effective if people know how and why to use it.

The Practice of Ergonomics

Different Places - Different Needs

When examining work behaviors, functional requirements tend to cluster into one of three workplace types: Dedicated or solo workplaces; shared workplaces; and collaborative work-places.

Dedicated Workplaces

As the name implies, these places are used primarily by one specific person. They are, in effect, a “home base”. Consequently, they should be designed or adapted to meet the needs of the primary user. Typically, dedicated spaces are used for tasks that involve a high level of concentration - what is referred to as “heads down” work, or a high level of privacy or information security. To provide the best support for concentration, it is advisable to use environmental elements, such as partitions, sound absorption or sound masking, to minimize distractions of workers performing their jobs in dedicated places.

The ***primary*** tasks are usually performed “solo” and in a seated position. However, dedicated places can also be used for consultation and other functions, as noted below - but the primary function is for solo, heads down work.

Dedicated Workplaces - Examples

Examples of dedicated workplaces are found in most organizations. The most common are private offices for Executives and Administrators. In healthcare, particularly with information security concerns associated with HIPPA, one might also find a need for dedicated workplaces among “patient facing” tasks such as Admitting and Registration as well as “back office” sup-port jobs such as Patient Health Records and Accounting. Similarly, Physician’s offices also re-quire a level of privacy and information security associated with dedicated workplaces.

Finally, one can find functional requirements for dedicated workplaces throughout and organization. One example is diagnostic imaging where advances in digital imaging technology have changed the nature of the tasks and the functional requirements. In today’s diagnostic imaging workplace, it is common to find the need for dedicated, low distraction workplaces.

Dedicated Workplace Considerations

In keeping with the global ergonomic strategies, dedicated workplace should be appropriately adaptive. Since the workplace should be designed and adapted to a specific, primary end user, it may be possible to set such things as worksurface height at the appropriate level during construction or set up of the workplace. Doing so may trade ease of adjustment for cost; however if done correctly, the worksurface should fit the worker.

Because most solo, heads down work is done from a seated position, it is essential that dedicated workplaces are equipped with user adjustable task seating. Good task seating should do four things:

1. Support the body anatomically. Our bodies are round and curved, Task seating should be curved to fit the shape of our bodies - not angled and sharp edged.
2. Provide a stable platform from which to work. Adjustments often translate into surfaces and elements that move. Good ergonomic task seating should allow the worker to feel secure and not concerned that the chair might move unexpectedly or unnecessarily.
3. Support work in the way it is performed. People come in a wide range of shapes and sizes. They also adopt a wide range of postures and positions to do their jobs. Often they will change positions throughout the day. There is no one right way to sit, so good task seating should be adaptable to worker’s posture and position.
4. Be easy to use - by the user. Adjustments should not require tools or manuals to perform. If adjustments are easy to use - they won’t get used. The result may constrained postures and higher risk of discomfort and injury.

Dedicated workplaces should have good uniform lighting supplemented by user con-trolled task lighting. Again, people exhibit a wide range of visual acuity and ability to see under different lighting conditions. As we age we need more light to see as well as when we were younger. All of which point to the need for user control over light falling on the primary task space.

Because dedicated workplaces are “home base” for their occupants, storage becomes a major concern. Mike Brill, the late head of BOSTI, once remarked, “Everybody needs a place to keep their stuff.” With regard to dedicated workplaces, this means providing sufficient work surface space for “hot files” - those documents and work product on which people are currently working. These materials should be within easy reach. To minimize space requirements and discourage “pack rat” behavior, the amount of file drawer storage should be kept to a minimum. A good archive system, where records can be retrieved within twenty-four hours will allow everything but the most current information to be kept off-site.

Finally, dedicated workplaces are also often used as meting places (see collaborative spaces below). Consequently, it is advisable to include sufficient space and seating for at least one person other than the primary user.

Shared Places

Because healthcare operates around the clock, many places must be shared. Whether shared by workers on different shifts or by several people during the shift, sharing is something that is much more common in healthcare environments than other industries.

Often the shared places must support a variety of behaviors and multiple tasks including the solo, heads down work typically found in dedicated places, as well as collaboration and communication.

Consequently, shared places offer an opportunity to exercise appropriate adaptability and flexibility through the application of one or more of the design approaches discussed above.

Shared Workplaces - Examples

The most common and obvious shared workplace in healthcare environments is a nurses station on a hospital floor. These workplaces must accommodate a wide range of different people over both a short period of time and within any given twenty-four hour period.

Similarly, patient rooms qualify as shared workplaces since many people from nurses and technicians to physicians to volunteers work with patients in these spaces, occasionally at the same time.

Other common shared spaces include laboratory and pharmacy workplaces as well as registration and admitting.

Shared Workplaces - Considerations

Because shared workplaces must accommodate the widest range of uses and users, they must exhibit a wide range of adjustments and flexibility or ability to be reconfigured. As discussed in regard to task seating, adjustments must be users controlled and easy to use.

Shared workplaces should support both sitting and standing work postures as appropriate. The frequency and duration of use of shared workplaces necessitates the ability to quickly and easily change. Similarly, shared workplaces must support multi-tasking, since both solo, heads down work and collaboration and communication occur there.

Finally, in addition to supporting the variety of users and tasks, shared workplaces should accommodate differences in work styles. People perform the same jobs in a variety of ways. That may mean differences in how they handle “hot files” or differences such as sitting or standing to do the same task. Whatever the difference in work, worker or work style, good ergonomics will accommodate those differences with adjustments that are quick, secure and easy to use.

Collaboration Places

Collaboration is essential to the practice of medicine and the delivery of effective healthcare. Collaboration happens everywhere in healthcare environments. But recent concerns and regulations regarding information security and patient health records (e.g. HIPPA) will affect the ways and places collaboration occurs. The design and configuration of healthcare workplaces should support and facilitate collaboration while meeting both the letter and spirit of the information security regulations.

Collaboration places are used concurrently by two or more people. Because collaboration is at the heart of teamwork, such places should support not only verbal communication, but also information sharing and display. Collaboration places should also sup-port episodes of activity where team members work independently in close proximity to one another. The nature of communication associated with collaboration can be formal (e.g., scheduled interaction with agendas) or informal (e.g., chance encounters or interrupt driven interactions).

By its nature, collaboration can be distracting to those not directly involved. Consequently, attention should be paid to how collaboration places affect and are affected by proximity to others.

Collaboration Workplaces - Examples

The most common form of collaboration workplaces are meeting rooms. These collaboration workplaces best support formal interactions - usually involving a schedule, an agenda and a known list of participants. Similarly, other workplaces help support formal collaboration, such as offices with small conference tables and training rooms. However, a great deal of collaboration inherent to healthcare is event driven, informal, and unscheduled. Informal collaboration relies on serendipity and opportunity (e.g., seeing a person who can help). Thus many other places in healthcare environments qualify as collaboration workplaces. Examples include hallways, nurses stations, break rooms, cafeterias, lunch rooms, patient rooms, as well as more traditional meeting rooms and offices.

Collaboration Workplaces - Considerations

Formal collaboration tends to have more structured requirements. Formal meeting spaces, whether meeting rooms, break rooms, or training rooms, should support many different users in a seated position. Comfortable, easily adjusted chairs and meeting tables will help support the variety of users and the range of duration and frequency of user for these workplaces.

Sharing information in a variety of forms and formats is fundamental to collaboration. Thus formal collaboration workplaces should include display walls (e.g., writable and “tack-able” surfaces) and electronic displays (e.g. computer projectors). Increasingly, collaboration can occur remotely using technology. Thus some formal collaboration workplaces should support teleconferencing, either by telephone, computer or video link.

For short duration, informal interactions, the primary requirement is effective communication. Thus, it may be appropriate to support standing postures and focus on the auditory and visual elements of the workplace. For example, hallways can be configured with small “niches”, equipped with a whiteboard and a small shelf for leaning, coffee cups are other materials.

Distraction is a major consideration for collaboration workplaces. Distraction can take two forms - activity that distracts those not participating and distraction from outside the group involved in collaboration. Minimizing distraction serves to improve collaboration and also ad-dresses concerns with information security. Thus, attention to the acoustic characteristic of collaboration workplaces, both formal and informal is essential. Similarly, sight lines and visual distractions should be considered, especially for information displays.

Conclusion

Healthcare environments possess significant untapped potential for benefits to organizations willing to apply ergonomics to staff workplaces. Evidence supports investing in workplace ergonomics to realize improved performance, improved worker satisfaction, positive affect on recruiting and retention and improved quality of patient care.

Annotated Bibliography & Information Resources

The Hospital Built Environment: What Role Might Funders of Health Services Research Play?
Cameron Nelson, MPP, Terry West, MBA, Clifford Goodman, PhD

Agency for Healthcare Research and Quality
U.S. Department of Health and Human Services
AHRQ Publication No. 05-0106-EF August 2005

"A body of evidence is developing about how attributes of the various environments in which healthcare is provided mediate healthcare quality. But no one has yet identified what questions remain to be answered that might help health services researchers, architects, or others decide where more research is needed or how research dollars could be best spent to address the many outstanding issues. This environmental scan is intended to assess what is and is not known about the relationships between hospital design and construction—the built environment—and:

1. Patient outcomes
2. Patient safety and satisfaction
3. Hospital staff safety and satisfaction

Hospital design and construction is vital, yet costly, to our healthcare system. An estimated $200 billion will be spent on new hospital construction across the United States in the next 10 years (6). Among the factors driving the market for hospital design and construction are: 1) competition for patient market share; 2) technology innovation and diffusion; 3) efficiency and cost effectiveness; and 4) regulatory compliance.

Despite the enormous expenditures projected for new hospital construction, there remains considerable potential for quality improvement in our nation's hospitals. The Institute of Medicine's widely cited report, To Err is Human, concluded that tens of thousands of patients die each year from preventable medical errors while in the hospital (6). Furthermore, up to two million U.S. hospital patients contract dangerous infections during their hospital stays that complicate treatment and frequently result in adverse patient outcomes (6).

Hospital physical environments also can create stress for patients, their families and staff. This stress derives from factors such as excessive noise due to hospital alarms, paging systems and equipment; feelings of helplessness and anxiety triggered by poor signage, confusing building and corridor lay-outs and other flawed aspects of hospital design; and lack of privacy as a result of double-occupancy rooms. These may disturb a patient's rest, more readily enable transmission of infection and prompt the need for more frequent, time-consuming and potentially error-inducing patient transfers (6).

Due to growing knowledge and awareness of these issues, the hospital built environment increasingly is being influenced by research linking the physical environment to patient outcomes and patient and staff safety and satisfaction. Consistent with the growing movement to apply clinical evidence-based approaches to improve patient outcomes, hospital administrators and researchers also are placing greater emphasis on "evidence-based design" to support and facilitate clinical advances in the field (7).This is a process for creating hospital environments that is informed by the best available evidence concerning how the physical environment can affect patient-centered care and staff safety and satisfaction (8). However, the field is relatively new, evidence supporting this approach is not yet robust in many areas and existing research on evidence-based hospital design is not widely known among policymakers, regulators and other decision-makers and opinion leaders.

These issues are discussed in the remainder of this environmental scan, which includes the following sections:

- What is currently driving the market for hospital design and construction?
- To what extent are hospitals requesting evidence-based designs?
- What is the research base for the hospital built environment?
- What are major challenges in building the field of evidence-based hospital design?
- What are the major gaps in current research and relevant areas of future focus?
- What are appropriate roles for funders of health services research interested in furthering improvements within the built environment?

The Role of the Physical Environment in the Hospital of the 21st Century: A Once-in-a-Lifetime Opportunity

Roger Ulrich*, Xiaobo Quan, Center for Health Systems and Design, College of Architecture, Texas A&M University
Craig Zimring*, Anjali Joseph, Ruchi Choudhary, College of Architecture, Georgia Institute of Technology

Report to The Center for Health Design for the Designing the 21 Century Hospital Project.
This project is funded by the Robert Wood Johnson Foundation.
September 2004

"According to the Institute of Medicine in its landmark Quality Chasm report: "The frustration levels of both patients and clinicians have probably never been higher. Yet the problems remain. Healthcare today harms too frequently and routinely fails to its benefits" (IOM, 2001). Problems with U.S. healthcare not only influence patients; they impact staff. Registered nurses have a turnover rate averaging 20 percent (Joint Commission on Accreditation of Healthcare Organizations, 2002)."

"At the same time, the United States is facing one of the largest hospital building booms in US history.
As a result of a confluence of the need to replace aging 1970s hospitals, population shifts in the United States, the graying of the baby boom generation, and the introduction of new technologies, the United States will spend more than $16 billion for hospital construction in 2004, and this will rise to more than $20 billion per year by the end of the decade (Babwin, 2002). These hospitals will remain in place for decades.

This once-in-lifetime construction program provides an opportunity to rethink hospital design, and especially to consider how improved hospital design can help reduce staff stress and fatigue and increase effectiveness in delivering care, improve patient safety, reduce patient and family stress and improve outcomes and improve overall healthcare quality.

Just as medicine has increasingly moved toward "evidence-based medicine," where clinical choices are informed by research, healthcare design is increasingly guided by rigorous research linking the physical environment of hospitals to patients and staff outcomes and is moving to-ward "evidence-based design" (Hamilton, 2003).

- What can research tell us about "good" and "bad" hospital design?
- Is there compelling scientifically credible evidence that design genuinely impacts staff and clinical outcomes?
- Can improved design make hospitals less risky and stressful for patients, their families, and for staff?"

"The research team found rigorous studies that link the physical environment to patient and staff outcomes in four areas:

1. Reduce staff stress and fatigue and increase effectiveness in delivering care
2. Improve patient safety
3. Reduce stress and improve outcomes
4. Improve overall healthcare quality

Recommendations and select evidentiary support:

1. Reduce Staff Stress and Fatigue and Increase Effectiveness in Delivering Care

There is a growing nurse shortage, and this directly threatens patient safety. And the existing hospital-based nursing force is aging. Registered nurses in the United States average more than 43 years old and will average 50 by 2010 and have a turnover rate averaging 20 percent per year (JCAHO, 2002).

A. Improve Staff Health and Safety through Environmental Measures
Poor ergonomic design of patient beds and nurses' stations leads to back stress, fatigue, and other injuries among nursing staff. Reducing staff stress by ergonomic interventions, as well as careful consideration of other issues such as air quality, noise, and light, can have significant impact on staff health. (p.4)

B. Increase Staff Effectiveness, Reduce Errors, and Increase Staff Satisfaction by Designing Better Workplaces
Jobs by nurses, physicians, and others often require a complex choreography of direct patient care, critical communications, charting, filling meds, access to technology and information, and other tasks. Many hospital settings have not been rethought as jobs have changed, and, as a result, the design of hospitals often increases staff stress and reduces their effectiveness in delivering care. While much research in the hospital setting has been aimed at patients, there is a growing and convincing body of evidence suggesting that improved designs can make the jobs of staff much easier.

Nurses spend a lot of time walking. According to one study, almost 28.9 percent of nursing staff time was spent walking (Burgio, Engel, Hawkins, McCorick, & Scheve, 1990). This came second only to patient-care activities, which accounted for 56.9 percent of observed behavior. At least four studies have shown that the type of unit layout (e.g. radial, single corridor, double corridor) influences amount of walking among nursing staff (Shepley, 2002; Shepley & Davies, 2003; Sturdavant, 1960; Trites, Galbraith, Sturdavant, & Leckwart, 1970), and two studies showed that time saved walking was translated into more time spent on patient-care activities and inter-action with family members. Sturdavant (1960) found that fewer trips were made to patient rooms in radial units as nurses were able to better supervise patients visually from the nursing station, though the average time spent with patients was the same in radial as well as single- corridor designs. Shepley and colleagues (2003) found that nursing staff in the radial unit walked significantly less than staff in the rectangular unit (4.7 steps per minute versus 7.9 steps per minute). However, Shepley and her colleagues noted that radial designs might provide less flexibility in managing patient loads. Trites and colleagues (1970) found that decrease in the percentage of time spent walking by staff in radial units was correlated to an increase in the percentage of time spent in patient-care activities. Also, the majority of the staff surveyed preferred to work in the radial units. Hendrich's research showed that decentralized nurses stations reduced staff walking and increased patient-care time, especially when supplies also were decentralized and placed near the nurses' station (Hendrich, 2003; IOM, 2004). Centralized location of supplies, however, could double staff walking and substantially reduce care time irrespective of whether nurses stations were decentralized (Hendrich, 2003) (5-6)

Workplace design that reflects a closer alignment of work patterns and the physical setting, such as redesign of a pharmacy layout, has been shown to improve work flow and reduce waiting times, as well as increase patient satisfaction with the service
(Pierce, Rogers, Sharp, & Musulin, 1990).

Other aspects of the environment, such as lighting levels and auditory or visual distractions, can also affect staff effectiveness while performing critical tasks such
as dispensing medical prescriptions."

2. Improve Patient Safety

A. Hospital-Acquired Infections

One critically important way that evidence-based design improves safety is by reducing risk from hospital-acquired infections. The research team identified more than 120 studies linking infection to the built environment of the hospital. Transmission of infection to patients occurs through two general routes: airborne and contact. The research literature shows that the design of the physical environment strongly impacts hospital-acquired infection rates by affecting both air-borne and contact transmission routes.

B. Reducing Infections Caused by Airborne Pathogens

C. Reducing Infections by Increasing Hand Washing

D. Reducing Infections with Single-Bed Rooms

E. Reducing Medication Errors

The research team identified three rigorous studies that link environmental factors, such as lighting, distractions, and interruptions, with errors in prescribing or dispensing medications (Booker & Roseman, 1995; Buchanan, Barker, Gibson, Jiang, & Pearson, 1991; Flynn et al., 1999).

F. Reduce Patient Falls

G. Improve Patient Confidentiality and Privacy

Confidentiality has emerged as a priority issue in light of research showing that physicians and nurses very frequently breach patient confidentiality and privacy by talking in spaces where they are overhead by other patients or persons (Ubel, Zell, & Miller, 1995). The seriousness of the problem is underscored, for example, by a study of an emergency department at a university hospital that showed that 100 percent of physicians and other clinical personnel committed confidentiality and privacy breaches (Mlinek & Pierce, 1997). HIPAA, the Health Insurance Portability and

Accountability Act of 1998, has further elevated the importance of providing reasonable safeguards to protect the confidentiality of staff conversations with and about patients.

3. Reduce Stress and Improve Outcomes

A. Reduce Noise

The research reviewed suggests that hospitals are excessively noisy for two general reasons (Ulrich, Lawson, & Martinez, 2003). First, noise sources are numerous, often unnecessarily so, and many are loud. Well-documented examples include paging systems, alarms, bedrails moved up/down, telephones, staff voices, ice machines, pneumatic tubes, trolleys, and noises generated by roommates. Second, environmental surfaces—floors, walls, ceilings—usually are hard and sound-reflecting, not sound- absorbing, creating poor acoustic conditions. Sound-reflecting surfaces cause noise to propagate considerable distances, traveling down corridors and into patient rooms, and adversely affecting patients and staff over larger areas. Sound-reflecting surfaces typical of hospitals cause sounds to echo, overlap, and linger or have long reverberation times (Blomkvist et al., in press, 2004; Ulrich et al., 2003).

The Role of the Physical and Social Environment in Promoting Health, Safety, and Effectiveness in the Healthcare Workplace

Anjali Joseph, Ph.D., Director of Research,
The Center for Health Design Issue Paper #3 November 2006

Abstract

Objective
To examine how the physical environment, along with other factors such as culture and social support, impact (a) the health and safety of the care team, (b) effectiveness of the healthcare team in providing care and preventing medical errors, and (c) patient and practitioner satisfaction with the experience of giving and receiving care.

Methods
Literature review of peer-reviewed journal articles and research reports published in medicine, nursing, psychology, ergonomics, and architecture periodicals and books. Different combinations of keywords were used to search for articles including workforce, nurses, health-care team, work environments, ergonomics, staff health, staff safety, medical errors, transfers, and communication.

Key Findings
There is an urgent need to address the inherent problems in the healthcare work-place that lead to staff injuries and hospital-acquired infections, medical errors, operational failures, and wastage. The physical environment plays an important role in improving the health and safety for staff, increasing effectiveness in providing care, reducing errors, and increasing job satisfaction. These improved outcomes may, in turn, help in reducing staff turnover and increase retention — two key factors related to providing quality care in hospitals. However, it has be-come increasingly clear that efforts to improve the physical environment alone are not likely to help an organization achieve its goals without a complementary shift in work culture and work practices. Proper design of healthcare settings, along with a culture that prioritizes the health and safety of the care team through its policies and values, can reduce the risk of disease and injury to hospital staff and provide the necessary support needed to perform critical tasks. Also, it is important to identify core systemic and facility design factors that lead to failures and wastage in healthcare, and then develop new solutions (e.g. acuity adaptability, standardized rooms) that address these problems within the context of culture changes and evolving models of care.

Conclusions
The physical environment along with social support, organizational culture, and technology can play an important role in improving health, safety, effectiveness and satisfaction of the healthcare team.

Review of Health and Productivity Gains from Better IEQ

William J. Fisk

Indoor Environment Department, Lawrence Berkeley National Laboratory, Berkeley, CA.

Proceedings of Healthy Buildings 2000 Vol. 4. 23-34.

Abstract

The available scientific data suggest that existing technologies and procedures can improve in-door environmental quality (IEQ) in a manner that significantly increases productivity and health. While there is considerable uncertainty in the estimates of the magnitudes of productivity gains that may be obtained, the projected gains are very large. For the U.S., the estimated potential annual savings and productivity gains are $6 to $14 billion from reduced respiratory disease, $2 to $4 billion from reduced allergies and asthma, $10 to $30 billion from reduced sick building syndrome symptoms, and $20 to $160 billion from direct improvements in worker performance that are unrelated to health. Productivity gains that are quantified and demonstrated could serve as a strong stimulus for energy efficiency measures that simultaneously improve the indoor environment.

Enhancing Patient Safety in a Healing Environment

Patricia C. Seifert, RN, MSN, CNOR, CRNFA, FAAN; Deborah S. Hickman, RN, BSN, MS, CNOR, CRNFA

Topics in Advanced Practice Nursing eJournal. 2005;5(1) ©2005 Medscape

Abstract

The concept of a healing environment traditionally has been defined in terms of clinical skill and technological resources. As both patients and their healthcare providers expand the concept of healing and how and where it takes place, there is a greater emphasis on other aspects of the environment — namely, aesthetic, ergonomic, and safety factors that help create a safe healing environment. This paper describes findings from environmental research that affect the safety and the satisfaction of patients and healthcare providers."

Physical Environment

One of the earliest proponents of the importance of the physical environment was Florence Nightingale (21).Her efforts on behalf of the British soldiers during the Crimean War focused on design engineering to improve lighting (especially with sunlight), ventilation, heating and cooling, sewerage facilities, and sufficient space for soldiers' personal belongings. The safety aspects of clean air and water were not inconsequential to Nightingale's patients or to her nurses; the effects of her improvements on patient outcomes were reflected in the mortality figures for 1855, which fell from 42.7 deaths per 1000 to 2 per 1000 within 3 months of Nightingale's changes (22).

More recently, environmental factors such as noise, air quality, light, toxic exposures, temperature humidity, and aesthetics have been scrutinized for their effects on both patients and workers (3).The combination of environmental factors with the growing consumer demand for safety, security, competence, and physical and psychological comfort has engendered the concept of a "healing environment." Healthcare designers in 1988 initiated the concept of a healing environment that could facilitate the healing process by identifying factors that improve access to people and resources, increase employee comfort, expand patient privacy (eg, by reducing noise and distractions), and provide flexibility and personalization in the delivery of care (23).In the past few years, healthcare designers and healthcare facilities have formed partnerships to incorporate healing environment design aspects into their renovation and new construction projects, and to measure the effects of these initiatives on patient outcomes. One of the best known of these integrative efforts is The Pebble Project.

Work Environment, Job Attitude, and Job Performance Relationships in Outpatient Healthcare Clinics. I. Facility and Position Differences.

Butler, Mark C. ; Jones, Allan P.
NAVAL HEALTH RESEARCH CENTER SAN DIEGO CA
30 DEC 1980

Abstract

Perceptions of the work environment were related to job attitudes and performance measures for personnel assigned to five outpatient healthcare clinics as part of a multistage, systematic investigation of organizational factors and practices that influence the delivery of healthcare. Specifically, the report presents (a) facility by facility comparisons and (b) differences due to the type of job (medical versus non-medical) and sex of the healthcare provider. Implications for healthcare delivery are discussed.

Culture, the built environment and healthcare organizational performance

Authors: Mallak L.A.; Lyth D.M.; Olson S.D.; Ulshafer S.M.; Sardone F.J.
Source: Managing Service Quality, Volume 13, Number 1, 2003 , pp. 27-38(12)
Publisher: Emerald Group Publishing Limited

Abstract

Healthcare organization performance is a function of many variables. This study measured relationships among culture, the built environment, and outcome variables in a healthcare provider organization. A culture survey composed of existing scales and custom scales was used as the principal measurement instrument. Results supported culture strength's links with higher performance levels and identified the built environment's role as a moderating variable that can lead to improved processes and outcomes. Job satisfaction and patient satisfaction were found to be significantly and positively correlated with culture strength and with ratings of the built environment.

Strategic real-estate planning can generate revenue: Organizations with less real estate on their balance sheet have produced higher financial returns than those with heavy investments in real estate - healthcare industry

Healthcare Financial Management, Dec, 2001 by Danny Hayes, Steve Hays

Healthcare organizations' real-estate holdings — property, plant, and equipment — typically represent one of the highest-cost categories for a healthcare organization, after salaries. For years, leading Fortune 500 companies have successfully managed their real-estate assets to minimize expenses. Although some healthcare organizations are taking steps to profit from real-estate holdings, many others are not. An Ernst & Young study of executives of the largest U.S. health-care organizations found that many of them are not optimizing real-estate holdings for the following reasons: (a)

- Healthcare organizations generally lack a strategic plan for the use of their real estate;
- The industry is not managing construction and expansion effectively despite having a surplus of space;
- Healthcare organizations are not, on the whole, adapting and reusing their facilities; and
- Organizations are not pursuing innovative real-estate strategies.

Job discontent fuels aggressive recruitment of nurses

Bull World Health Organ vol.79 no.12 Genebra 2001

A worldwide shortage of nurses has led wealthier nations to conduct aggressive campaigns to recruit nurses from poorer countries. While the nurses who leave may find higher wages and better working conditions in their new locations, the home countries they leave behind suffer the loss of highly trained health personnel who are not easily replaced.

One example of that movement is the United States' recruitment of nurses from the Philippines, whose government has a policy allowing nurses to migrate to other countries. According to Ms Cheryl Peterson, director of the International Nursing Center at the American Nurses Association (ANA), special schools with curricula and testing standards comparable to those in the US have been established Philippines' government to train nurses for work in the US. The problem, says Peterson, is that the US is not only recruiting graduates from these programmes but has also started tapping more highly skilled — and less easily replaced — nurses, such as those who work in emergency rooms.

Job dissatisfaction, hazardous working conditions, and low job status are behind the nursing shortage in Western countries, according to a study published in the May/June 2001 issue of Nurses Reports by Dr Linda Aiken, a professor of nursing at the University of Pennsylvania School of Nursing in the USA. The study surveyed 43 000 nurses from more than 700 hospitals in Canada, Germany, the UK (England and Scotland), and the US. Among nurses under the age of 30 who planned to leave nursing within a year, young English and Scottish nurses were the most discontented, with 53% and 46% respectively planning on leaving. Salaries were also considered inadequate by a large proportion of the nurses surveyed, with only 20% of English nurses and only 26% of Scottish nurses reporting that their wages were acceptable. In the U.S., according to ANA estimates, approximately half-a-million men and women with active registered nurse licenses have left the profession.

Changing Demographics: Implications for Physicians, Nurses, and Other Health Workers

U.S. Department of Health and Human Services Health Resources and Services Administration Bureau of Health Professions National Center for Health Workforce Analysis
Spring 2003
http://bhpr.hrsa.gov/healthworkforce/reports/changedemo/Content.htm

A new HRSA report on workforce trends predicts that the percentage of a physician's time spent treating elderly and minority patients will increase markedly in coming years.

The report reviewed and summarized literature on U.S. demographic projections and their implication for the health workforce. Selected findings focused on:

- *Aging Population:* The elderly (age 65 and over) currently represent 13 percent of the U.S. population, expected to rise to 17 percent by 2020. By 2020 almost 40 percent of a physician=s time will be spent treating the elderly. The health workforce also is aging and many health professionals are expected to retire at a time when demand for services is on the rise.
- *Racial and Ethnic Diversity:* Demand for healthcare services by minorities is expected to increase as the percentage of minorities in the U.S. population grows. Therefore, the time physicians spend treating minority patients is expected to grow from some 31 per-cent in 2000 to 40 percent by 2020. As the number of minorities grows their participation in the workforce will rise similarly, causing minority under-representation in healthcare to shrink.
- *Geographic Location of the Population:* The number of people living in urban areas is going up. At the same time, data show many Americans living in rural areas that are designated as physician shortage areas. Differences in population growth rates and healthcare workers' supply and demand highlight the importance of developing models that can provide state-level and substate-level workforce projections.

The role of leadership in overcoming staff turnover in critical care

Kelly Roy and Fabrice Brunet
Critical Care 2005, 9:422-423 doi:10.1186/cc3775

Abstract

This commentary discusses Laporta and coworkers analysis of a case study on the causes of and solutions for staff turnover in an intensive care setting. Staff turnover is a significant issue for healthcare leaders due to the shrinking workforce in Western countries and an increased demand for intensive care services as the population ages. The commentary considers reasons for turn-over such as burnout and generational diversity, and highlights the importance of a team work approach to address the issue of turnover.

Determinants of Hospital Staff Nurse Turnover

Carol S. Weisman, Cheryl S. Alexander, Gary A. Chase
Medical Care, Vol. 19, No. 4 (Apr., 1981), pp. 431-443

Abstract

Organizational and non-organizational determinants of staff nurse turnover are investigated in a panel study of 1,259 nurses employed in two university-affiliated hospitals. Findings are consistent with a causal chain in which perceived autonomy, job satisfaction, intent to leave the hospital and turnover are a sequence of outcomes reflecting the successive stages of a nurse's decision to resign. Both personal characteristics and job-related attributes are predictive at various stages of the process, although family status variables have no significant effects. Implications for hospital management of turnover are discussed.

Imported Care: Recruiting Foreign Nurses to U.S. Healthcare Facilities

Barbara L. Brush, Julie Sochalski and Anne M. Berger
Health Affairs, 23, no. 3 (2004): 78-87
doi: 10.1377/hlthaff.23.3.78

Abstract

As U.S. healthcare facilities struggle to fill current registered nurse staffing vacancies, a more critical nurse undersupply is predicted over the next twenty years. In response, many institutions are doubling their efforts to attract and retain nurses. To that end, foreign nurses are increasingly being sought, creating a lucrative business for new recruiting agencies both at home and abroad. This paper examines past and current foreign nurse use as a response to nurse shortages and its implications for domestic and global nurse work-force policies.

NIOSH Publication No. 97-117:Elements of Ergonomics Programs

A Primer Based on Workplace Evaluations of Musculoskeletal Disorders
March 1997
http://www.cdc.gov/Niosh/docs/97-117/default.html

This primer describes the basic elements of a workplace program aimed at preventing work-related musculoskeletal disorders (WMSDs). Management commitment, worker participation, and training are addressed along with procedures for identifying evaluating, and controlling risk factors for WMSDs. The text cites NIOSH ergonomics investigations to illustrate practical ways for meeting program needs. The primer includes a "toolbox," which is a collection of techniques, methods, reference materials, and sources for other information that can help in program development.

Table of Contents

Toolbox

General Workstation Design Principles*

1. Make the workstation adjustable, enabling both large and small persons to fit comfortably and reach materials easily.
2. Locate all materials and tools in front of the worker to reduce twisting motions. Provide sufficient work space for the whole body to turn.
3. Avoid static loads, fixed work postures, and job requirements in which operators must frequently or for long periods:
    a. Lean to the front or the side,
    b. Hold a limb in a bent or extended position,
    c. Tilt the head forward more than 15 degrees, or
    d. Support the body's weight with one leg.
4. Set the work surface above elbow height for tasks involving fine visual details and below el-bow height for tasks requiring downward forces and heavy physical effort.

5. Provide adjustable, properly designed chairs with the following features
    a. Adjustable seat height,
    b. Adjustable up and down back rest, including a lumbar (lower-back) support,
    c. Padding that will not compress more than an inch under the weight of a seated individual, and a
    d. Chair that is stable to floor at all times (5-leg base).
6. Allow the workers, at their discretion, to alternate between sitting and standing. Provide floor mats or padded surfaces for prolonged standing.
7. Support the limbs: provide elbow, wrist, arm, foot, and back rests as needed and feasible.
8. Use gravity to move materials.
9. Design the workstation so that arm movements are continuous and curved. Avoid straight-line, jerking arm motions.
10. Design so arm movements pivot about the elbow rather than around the shoulder to avoid stress on shoulder, neck, and upper back.
11. Design the primary work area so that arm movements or extensions of more than 15 in. are minimized.
12. Provide dials and displays that are simple, logical, and easy to read, reach, and operate.
13. Eliminate or minimize the effects of undesirable environmental conditions such as excessive noise, heat, humidity, cold, and poor illumination.

*Adapted from design checklists developed by Dave Ridyard, CPE, CIH, CSP. Applied Ergonomics Technology, 270 Mather Road, Jenkintown, PA 19046–3129.

Understanding Ergonomic Risk in Healthcare
Dwyer, W. Occupational Hazards 7/18/2006
http://www.ergotug.com/news.html

"There are eight common tasks completed by nurses, LVNs, CNAs, technicians and transporters that do pose significant ergonomic risk. They are:

1. Repositioning patients within a bed
2. Quarter turning a patient
3. Laterally transferring a patient from the bed to a gurney
4. Pushing beds or gurneys
5. Transferring a patient from a bed to a chair
6. Transferring a patient from a chair to a toilet
7. Transferring a patient from a wheelchair to a car
8. Assisting patients with gait"

Back pain at work: Preventing aches, pains and injuries
MayoClinic.com
http://www.mayoclinic.com/health/back-pain/HQ00955

"Many occupations — such as nursing, construction and factory work — may place significant demands on your back. Even routine office work can worsen back pain if you fall into risky habits.

Four work-related factors are associated with increased risk of back pain and injury:

- *Force*
  Exerting too much force on your back may cause injury. If your job is physical in nature, you might face injury if you frequently lift or move heavy objects.

- *Repetition*
  Repetition refers to the number of times you perform a certain movement. Overly repetitious tasks can lead to muscle fatigue or injury, particularly if they involve stretching to the end of your range of motion or awkward body positioning.

- *Posture*
  Posture refers to your position when sitting, standing or performing a task. If, for instance, you spend most of your time in front of a computer, you may experience occasional aches and pains from sitting still for extended periods of time. On average, your body can tolerate being in one position for about 20 minutes before you feel the need to adjust.

- *Stress*
  Pressures at work or at home can increase your stress level and lead to muscle tension and tightness, which may in turn lead to back pain."

25 Ways Ergonomics Can Save You Money
MacLeod, D. The Ergonomics Kit for General Industry Taylor & Francis, Second Edition, 2006
http://www.ergotug.com/news.html

1. Dramatic reductions in workers' compensation costs (60-90%).
2. Improved productivity.
3. Fewer mistakes and less scrap.
4. Improved efficiency with better working posture.
   Poor posture results in:
   a. Reduced strength
   b. Less accuracy
   c. Faster fatigue
5. Improved efficiency with less exertion.
6. Improved efficiency with fewer motions.
7. Improved efficiency with better heights and reaches.
8. Less fatigue.
9. Reduced maintenance downtime.
10. Protecting your human resources.
11. Identifying waste.
12. Fresh insights on your operations.

13. Ergonomics can offset the limitations an aging workforce.
14. Reduced turnover.
15. Reduced absenteeism.
16. Improved morale.
17. Promoting employee involvement.
18. Improved labor relations.
19. The rebirth of Methods Engineering.
20. Ergonomics can optimize the Lean Process.
21. 40,000 years of progress.
22. The goal of ergonomics is to make things more human compatible
23. Improving the human-system interface.
24. Everyone benefits from knowing the "rules of work."
25. Saving yourself from OSHA.

Testimony On Ergonomics And Healthcare Providers By Rachael Weinstein, R.N. Clinical Standards Group Director, Healthcare Financing Administration U.S. Department Of Health And Human Services before The Senate Committee On Health, Education, Labor, And Pensions Subcommittee On Employment, Safety, And Training
July 13, 2000
http://www.hhs.gov/asl/testify/t000713b.html

"According to the Bureau of Labor Statistics, in 1998 there were nearly 90,000 Musculo-Skeletal Disorder injuries (MSDs) with days away from work in the healthcare sector. And, more than fifteen percent of MSDs in private industry occurred in the healthcare sector, largely in hospitals and nursing homes. OSHA estimates that the workers' compensation for these MSDs cost $2.8 billion in 1996, and that the total costs to the economy of these disorders in this sector are $5.8 billion each year.

Healthcare workers, particularly, face work environments that present high exposure to MSD risks.

In addition to protecting workers, employers would reap financial benefits from the implementation of the ergonomics rule, with any incremental implementation costs outweighed by net savings. Worker absenteeism due to injuries, as well as workers compensation costs, should decline with improved ergonomic conditions in the workplace.

Looking specifically at the healthcare industry, Arun Garg, of the University of Wisconsin Milwaukee, conducted a NIOSH-sponsored study on the effectiveness of certain ergonomics programs in healthcare facilities in reducing injuries to healthcare workers resulting from manual lifting and transferring of patients. The programs, called "zero-lift" programs, were instituted in seven nursing homes and one hospital.

The eight facilities in the study replaced manual lifting of patients with modern, battery-operated portable hoists and similar devices for transferring patients from one spot to another, such as from a wheel chair to a bed.

The zero-lift programs were highly successful. All eight facilities showed marked improvements in the number of injuries, lost workdays, and workers compensation costs. For example, the number of injuries from patient transfers decreased by 86 percent, restricted workdays decreased by 64 percent, and workers compensation costs decreased by 84 percent. Overall, the eight facilities experienced decreases of 32 percent of all injuries, 62 percent in all lost workdays, 6 percent in all restricted workdays, and 55 percent in total workers compensation costs.

In addition, the ergonomics program produced numerous intangible benefits. For example:

- Patients experienced improved comfort and safety during transfers and patient care;
- Nursing personnel felt less fatigued and less back pain at the end of their shifts; and,
- More pregnant and older workers were able to perform their duties and stay on the job longer.

The benefits of ergonomics programs to healthcare providers abound; not just in theory, but in practice. For instance, the University Nursing Center of Enid, Oklahoma, cut the rate of work-related MSDs by 75 percent between 1996 and 1998, and reduced lost workdays by more than 85 percent through its ergonomics program.

...the Kennebec Health System of Augusta, Maine, reduced annual lost workdays from 1,097 to 48 after implementing an ergonomic program and mechanical lifting devices. As a result, their insurance costs went from $1.6 million annually to $770,293, a cost savings of more than $800,000 a year."

AHA Introduces Ergonomic Risk Management Program Designed to Improve Employee Safety and Staffing for Healthcare.
Business Wire 27-SEP-02
http://goliath.ecnext.com/coms2/gi_0199-2068931/AHA-Introduces-Ergonomic-Risk-Management.html

"In order to improve workplace safety for employees and patients in the healthcare community, AHA Financial Solutions, Inc., a subsidiary of the American Hospital Association (AHA), has awarded the exclusive AHA endorsement to the Diligent™ Ergonomic Risk Management Program. Representing a comprehensive ergonomic safety solution for healthcare organizations and backing their program with a financial guarantee, Diligent provides patient handling equipment and processes, on-site clinical consultation visits, and ergonomic training for employees."

A Series of eight (8) papers based on an experiment involving ergonomic seating and training

I. The Impact of Two Ergonomic Interventions on Health and Productivity: A Quasi-Experimental Field Study
Benjamin C. Amick III, Ph.D., Michelle Robertson, Ph.D., CPE., Anne Moore, Ph.D., Kelly DeRango, Ph.D., Cammie Chaumont Menéndez, MPH, MS

Abstract
The study examines the effect of office ergonomic interventions in reducing musculoskeletal symptom growth over the workday and the productivity consequences. The paper synthesizes results from more detailed analyses (Amick, 2003; DeRango, 2003; 2004). The intervention was a highly flexible chair and an office ergonomics training with educational follow-ups. In a public sector department of revenue services, the intervention resulted in a significant reduction in musculoskeletal symptom growth in a group that received both the chair and training compared to either a control group or a group that only received the training. The training group did not experience a significant reduction in symptom growth compared to the control group. Productivity (tax revenues generated) improved in the chair and training group by 18%, whereas the training-only group did not demonstrate a significant productivity increase.

II. The Health Consequences of an Office Ergonomics Training Coupled with an Ergonomically Designed Chair: Preliminary Results
Ben AMICK, III, Michelle Robertson, Kelly DeRango, Noe Palacios, Paul Allie, Ted Rooney, and Lianna Bazzani
Proceedings of the Conference WWDU 2002 World Wide Work - May 22-25, 2002 - Berchtesgaden pg 371-373

Abstract
In the Work Environment and Health Study, two primary research hypotheses are that each intervention will result in reduced musculoskeletal symptom growth over a) the workweek and b) the workday. Among the instruments being used to assess health outcomes are a short (1-minute) computer-aided self-interview (online CASI) Daily Health Diary (DHD). The worker completes this musculoskeletal symptom questionnaire at the beginning, middle and end of each workday. For the current employer involved in the study, We have found a significant increase in symptom levels over the workday at baseline ($p<0.0001$). In contrast, there has been no evidence of any baseline rise in the level of symptoms over the workweek. At 2 months post-intervention, analyses show that the chair and training group experiences lower symptom levels over the workday compared to either the training-only or control group. There was no group effect pre-intervention.

III. A Review of Health-Related Work Outcome Measures and Their Uses, and Recommended Measures

Benjamin C. Amick III, PhD, Debra Lerner, MS, PhD, William H. Rogers, PhD, Ted Rooney, BSRN, MPH, and Jeffrey N. Katz, MD, MS SPINE Volume 25, Number 24, pp 3152–3160 ©2000, Lippincott Williams & Wilkins, Inc.

Why Measure Work Outcomes?

There are many reasons for measuring work outcomes.

Five stand out:

- To assess productivity loss in clinical trials
- To evaluate the effectiveness of health services
- To target injury and reinjury prevention programs
- To evaluate the effectiveness of work reorganization projects such as ergonomic changes
- To improve provider–worker and provider–safety engineer interaction

Despite the growing recognition that work can contribute to the development of musculoskeletal disorders, 1.8 there are almost no data on whether and how physicians investigate the contribution of work to patients' health status or the influence of health status on work performance. This is particularly true of primary care, where much of the medical care for patients with work-related low back pain is provided. As more patients with musculoskeletal injuries show up in primary care settings, it will become important to document health-related work outcomes and incorporate into practice outcome tools that enable the physician to obtain a quick and accurate accounting of needed information about patients' work.

IV. Effect of Office Ergonomics Intervention on Reducing Musculoskeletal Symptoms

Benjamin C. Amick III, PhD,Michelle M. Robertson, PhD, CPE, Kelly DeRango, PhD, Lianna Bazzani, MPH, Anne Moore, PhD, Ted Rooney, MPH, and Ron Harrist, PhD

SPINE Volume 28, Number 24, pp 2706–2711 © 2003, Lippincott Williams & Wilkins, Inc.

Study Design

Office workers invited and agreeing to participate were assigned to one of three study groups: a group receiving a highly adjustable chair with office ergonomics training, a training-only group, and a control group receiving the training at the end of the study.

Objective

To examine the effect of office ergonomics intervention in reducing musculoskeletal symptom growth over the workday and, secondarily, pain levels throughout the day.

Materials and Methods

Data collection occurred 2 months and 1 month before the intervention and 2, 6, and 12 months postintervention. During each round, a short daily symptom survey was completed at the beginning, middle, and end of the workday for 5 days during a work- week to measure total bodily pain growth over the workday. Multilevel statistical models were used to test hypotheses.

Results

The chair-with-training intervention lowered symptom growth over the workday (P 0.012) after 12 months of follow-up. No evidence suggested that training alone lowered symptom growth over the workday (P 0.461); however, average pain levels in both intervention groups were reduced over the workday.

Conclusions

Workers who received a highly adjustable chair and office ergonomics training had reduced symptom growth over the workday. The lack of a training-only group effect sup-ports implementing training in conjunction with highly adjustable office furniture and equipment to reduce symptom growth. The ability to reduce symptom growth has implications for under-standing how to prevent musculoskeletal injuries in knowledge workers. [Key words: office ergonomics intervention, musculoskeletal symptom growth] Spine 2003;28:2706 –2711

V. The Productivity Consequences of Office Ergonomics Training and an Ergonomically Designed Chair

Kelly DeRango, Ben AMICK III, Michelle Robertson, Noe Palacios, Paul Allie, Ted Rooney, and Lianna Bazzani Proceedings of the Conference WWDU 2002 World Wide Work - May 22-25, 2002 - Berchtesgaden pg 368-370.

Abstract
Data on health outcomes and productivity from a longitudinal study of office workers is used to evaluate the economic consequences of an ergonomics intervention. Changes in monthly productivity per effective work- day (eight hours worked) and changes in hours of monthly sick leave are modeled as a function of pain, age, tenure on the job, and other relevant covariates. The impact of the ergonomic intervention on changes in reported pain is then quantified in order to calculate the economic impact of intervention.

VI. The Health Impact of Two Office Ergonomic Interventions

Benjamin C. Amick III, Ph.D., Michelle Robertson, Ph.D., CPE., Lianna Bazzani, MPH, Kelly DeRango, Ph.D., Cammie Chaumont Menéndez, MPH, MS, Ted Rooney, MPH, Ron Harrist, Ph.D., Anne Moore, Ph.D.

Abstract
In a quasi-experimental field study, workers who received a highly adjustable ergonomic chair and office ergonomics training were compared with workers who only received office ergonomics training or a control group. Workers completed daily health diaries at 2 and 1 month pre-intervention and 2, 6 and 12 months post- intervention. Workers who received a highly adjust-able chair and office ergonomics training had lower musculoskeletal symptom scores at the be-ginning of the day and no symptom growth over the workday compared to either workers who only received the training or the control group. These results support the significance of highly adjustable chairs and office ergonomics training in preventing musculoskeletal symptoms among office workers.

VII. The Productivity Impacts of Two Office Ergonomic Interventions: A Highly Adjustable Chair and an Office Ergonomics Training

Kelly DeRango, Ph.D., Benjamin C. Amick III, Ph.D, Michelle Robertson, Ph.D., CPE., Lianna Bazzani, MPH5, Ted Rooney, MPH, Ron Harrist, Ph.D.2, Anne Moore, Ph.D.

Abstract
In 2001 it was estimated 1 million individuals in the US lost time from work due to work-related musculoskeletal disorders. The purpose of this study was to use a well-designed office ergonomics intervention to validly demonstrate productivity improvements. Workers at a tax revenue office were divided into three groups: one group received a highly adjustable chair with office ergonomics training, a second group received only the office ergonomics training and a third group received the office ergonomics training at the end of the study. The workers were followed over 16 months. Multivariate statistical modeling was used to test hypotheses. It was found that the chair with training group had a productivity increase of 17.7%. The benefit-to-cost ratio was 24.6:1. These findings provide strong evidence of the benefits to using well-designed cost-effective ergonomic interventions in improving worker productivity.

VIII. The Impact of an Office Ergonomics Training on Worker Knowledge, Behavior and Musculoskeletal Risk

Michelle ROBERTSON , Ben Amick III, Kelly DeRango, Noe Palacios, Ted Rooney, Paul Allie, and Lianna Bazzani
Proceedings of the Conference WWDU 2002 World Wide Work - May 22-25, 2002 - Berchtesgaden pg 376-378

Abstract
An office ergonomics training program was created using an instructional systems design model. It was hypothesized that the training would impact worker's office ergonomics knowledge and skills. Moreover, these effects would translate into behavioral changes, such as rearranging workspaces, adjusting furniture, and changing computing work habits. A pre/post training knowledge test was administered to all those who attended the training. Observations of participant's workstation arrangements, chair setups and body postures were recorded. Results of the pre/post knowledge test revealed significant increases in knowledge about: ergonomics, the use of ergonomic workstation and chair features, improvement of body postures, company ergonomic practices and company resources. Observational results indicated that the two training groups exhibited higher level behavioral translation, such as rearranging workstations and adjusting chairs, and had lower musculoskeletal risk factors than the control group.

VIII. The Impact of Two Office Ergonomics Interventions on Visual Symptoms

Cammie Chaumont Menéndez, MPH, MS, Benjamin C. Amick III, PhD, Lianna Bazzani, MPH, Michelle Robertson, PhD, CPE, Kelly DeRango, PhD, Ted Rooney, MPH , Anne Moore, PhD, and Ron Harrist, PhD

Abstract

Eye injuries and visual strain are expected to increase as the economy becomes dependent on a growing number of knowledge workers whose productivity relies on their computers. To date there is paltry evidence that demonstrates how best to design a workstation to reduce visual symptoms incidence. The objective of the current study was to examine the effect of an office ergonomics intervention program focused on improving health and productivity. Office workers at a department of revenue were invited to participate. The workers were assigned to three groups: a group that received a highly adjustable chair with office ergonomics training, a group that received only the office ergonomics training, and a control group that received the office ergonomics training only at the end of the study. Five periods of data collection occurred: two months and one month pre-intervention, and two months, six months, and 12 months post- intervention. For each of the data collection periods office workers completed web-based surveys focused on work environment and health. Multilevel modeling was conducted to test the hypotheses. Consistent with the findings in overall symptoms growth and productivity, visual symptoms growth were lowered in the chair-with-training intervention group after 12 months of follow-up (p=0.0001).

Web Links and PDF Files

Best Practices for Site-Wide Hospital Ergonomics
Professor Alan Hedge, PhD, CPE
Cornell University
Dept. Design & Environmental Analysis
NECE Las Vegas Dec. 1, 2005
http://ergo.human.cornell.edu/Conferences/NECE05/AH-Best%20Practices%20for%20Site-Wide%20Hospital%20Ergonomics.pdf

Ergonomics Demonstration Project
Skilled Nursing Facility
October 2001
http://www.lni.wa.gov/wisha/ergo/demofnl/nursing-fnl.pdf

Overcoming Barriers to Implementing Ergonomics Programs in Healthcare:
Case Studies from the Field
Presented by Lynda Enos, MS, RN, COHN-S, CPE
http://www.iienet2.org/uploadedfiles/ergo_community/case_studies/264pres.pdf

Occupational Health & Safety Agency for Healthcare in British Columbia
Ergonomics Publications
http://www.ohsah.bc.ca/EN/459/

Teamworking in Primary Healthcare
Realizing Shared Aims In Patient Care
Final Report 2000
Published by the Royal Pharmaceutical Society
of Great Britain and the British Medical Association
http://www.rpsgb.org.uk/pdfs/teamworking.pdf

Helping Healthcare: A Hospital Ergonomics (Musculoskeletal Injury) Risk Assessment Project
Harrison Deanna
South Fraser Health Region, Langley Memorial Hospital, Langley, B.C. Canada, V3R 0Z7
http://www.ergonomie-self.org/self2001/v5/V5-013-R014-HARRISON.pdf

Dimensions of Care
Ergonomics for the Hospital Setting
by Craig Shepherd, OTR/L
http://www.systoc.com/tracker/summer01/ergonhosp.asp

Ergonomics Interventions Make Ohio Healthcare Facilities Safer for Employees
Human Factors & Ergonomics Society News April, 2006
http://www.hfes.org/web/DetailNews.aspx?ID=100

Whole Building Design Guide
Healthcare Facilities
http://www.wbdg.org/design/health_care.php

Department of Energy
Healthcare Buildings
http://www.eere.energy.gov/buildings/info/health/

Center for Health Design Releases Findings on How Design Can Improve the Standard of Care in Health-Care Facilities
AIA Architect 02/2005
http://www.aia.org/aiarchitect/thisweek05/tw0218/0218bp_pebble.htm

U.S. Department of Labor
NIOSH- HealthCare Wide Hazards Module -
Ergonomics: Ergonomic Equipment
http://www.osha.gov/SLTC/etools/hospital/hazards/ergo/ergoequipment/ergoequip.html

Hospital eTool
http://www.osha.gov/SLTC/etools/hospital/hazards/ergo/ergo.html

Ergonomics in Healthcare
http://www.ergonomicsinhealthcare.org/

ErgoSafe - Patient Safe Handling
http://www.ergosafe-products.com/ergonomics-health-care.html

Planetree
http://www.planetree.org/about/welcome.htm

Center for Health Design
http://www.healthdesign.org/

About the Author

Tim Springer, PhD, President and founder of HERO, inc., brings unequalled expertise in workplace consulting to every HERO engagement. Tim has been described as one of the top two or three experts in the world on issues of knowledge worker performance, office ergonomics, work behavior and the work environment. With 30 years experience in re-search and consulting, Tim is one of those rare people who can back up their academic credentials with consulting expertise and real world experience.

HERO, inc.

The Human Environment Research Organization, inc. — HERO — is a consulting practice specializing in research, ergonomics, workplace planning and workplace change management.

Beginning in 1982, our practice has been at the forefront of the evolution workplaces from bullpens and large private offices to open plan and cubicles to alternative work-places, hotelling, and telecommuting, HERO advises and assists organizations deter-mine their needs, develop alternatives, implement solutions and assess impact. Using an array of tools we collect and interpret information from and about users and their work behavior. The resulting functional requirements define effective workplace de-sign concepts. This approach yields high performance, high technology workplaces that work.

Our goal is simple — to make the things people use, and the ways and places they use them, as safe, comfortable, easy to use and productive as possible.