

Trend 10 – HEALTH CARE FACILITY INFRASTRUCTURE

INTRODUCTION

Health care systems may need to deal with aging buildings by renewing the infrastructure in order to meet infection control standards as well as the demands and needs of a changing population. As of 2006, Ontario's hospital buildings were, on average, more than 40 years old and may require significant investment to modernize and upgrade the facilities and expand capacity.¹ Ontario announced in 2005 that it would invest \$5 billion over a five year period to complete more than 100 hospital facility upgrade projects by 2010.² The plan was completed in 2008/09.³

SUMMARY OF KEY FINDINGS

Growing Challenges:

- Ensuring that the most appropriate health care facility design is used in new investments.
- Renewal/upgrading of older existing facilities.

Emerging Responses:

- Single-patient rooms may be safer and more efficient than multi-patient rooms, primarily due to decreases in hospital-acquired infection.
- Some small hospitals with a patient-centered design have resulted in improved patient satisfaction, increased profitability, and increase patient volumes.
- Green facility design and environmentally sustainable practices (e.g., using green cleaning products, making use of natural light, renewable energy sources) are emerging trends within health care facility design and construction.

GROWING CHALLENGES

Health Care Facility Design

- Given the age of most hospital buildings in Ontario, a major design challenge is to ensure that new buildings stay as relevant for as long as possible, given an average use of 40+ years.⁴
- Over the first 30 years of a facility's life, the construction costs of a hospital will represent 2-3% of the overall cost of the services it will deliver. Design costs represent between 0.3-0.5% of the whole life costs of a hospital, yet through the design process the largest impact can be made on 85% of the medical service delivery cost.⁵
- Facility design can play a role in shaping and supporting human lives, particularly for vulnerable patients with mental illness and/or dementia. These types of patients have special needs for a safe and secure physical environment. Planning a safe and supportive environment requires consideration of several architectural factors.⁶

Human Factors and Ergonomics

- There is a growing interest in developing a culture of safety within long-term care (LTC) homes. However, it has been suggested in a US conducted study that LTC homes in the US face numerous systemic barriers that prevent real advancements in safety and quality. These barriers include management organization, workforce shortages, high rates of staff turnover, and difficulties with moving away from a punitive system of incident reporting.⁷

- The Human Factors and Ergonomics Society noted that American nursing homes have been a particularly hazardous environment for health care workers.⁸
- Sleep deprivation is known to affect immune function, and loss of sleep in the critical care setting has been associated with a decrease in subjective quality of life measures.⁹ A recent study demonstrated that common hospital noises at typical decibel levels evoke repeated noise-related sleep arousals even in healthy young adults. The authors of the study also note that while national surveys identify hospital noise as an urgent quality of care concern, no benchmark for excellence has yet been established for sleep protection from disruption by noise for the inpatient population.¹⁰

EMERGING RESPONSES

Single-Patient Rooms and Patient Safety

- A recent commentary published in the *Journal of the American Medical Association* argued that single-patient rooms are safer and more efficient than multi-bed rooms.¹¹ The authors cite the following evidence:
 - A review of 16 studies concludes that single patient rooms reduce nosocomial infection rates and reductions in airborne-related and contact-related hospital-acquired infections.^{12, 13}
 - Some evidence suggests that single rooms are more efficient than multi-bed rooms. One estimate suggests that 85 single-bed rooms offer the same capacity as 100 beds in multi-patient rooms.¹⁴
- A study of adult patients admitted to a Canadian teaching hospital between 2001 and 2005 found that the number of roommate exposures per day was significantly associated with the chance of developing a hospital-acquired infection. Each roommate to whom a patient was exposed was associated with an 11% increase in the risk of *Clostridium difficile* (*C. difficile*) infection, a 10% increase in the risk of methicillin-resistant *Staphylococcus aureus* (MRSA), and an 11% increase in the

risk of vancomycin-resistant *Enterococcus* (VRE).¹⁵

- Current evidence on the design of Intensive Care Units (ICUs) also seems to favour the use of single patient rooms combined with strict infection control procedures and individual sinks in easily accessible locations to minimise nosocomial infections in patients and staff, but the benefits of single rooms for other outcomes (e.g. environmental factors such as noise and light) remains uncertain.¹⁶
- The Ward of the 21st Century (W21C), a new research facility in Alberta, Canada, has been created to study hospital design, including single-patient rooms.¹⁷ The focal point of the initiative is Unit 36, a state-of-the-art medical teaching unit opened in May 2004, which serves as a beta test-site for prototypical hospital design, approaches to the delivery of care, and innovative medical technologies.¹⁸
- In 2006, the American Institute of Architects called for single rooms in all new hospital construction.¹⁹
- According to Jane Bolin, an associate professor of health policy and management at Texas A&M Health Science Center School of Rural Public Health in College Station, single-patient rooms may be safer because infectious diseases like Severe Acute Respiratory Syndrome (SARS) may not have been transmitted between patients in the same room.²⁰
- However, some experts and nursing unions are concerned about the impact that a greater move to all single rooms may have on hospital patients. Possible disadvantages include: reduced social interaction, less surveillance by staff, increased failure to rescue and increased rates of slips, trips, and falls.²¹

Facility Infrastructure

- Evidence-based design is a current trend in facility infrastructure where relevant and proven design innovations that optimize patient safety, quality, and satisfaction as well as workforce safety, satisfaction, productivity, and energy efficiency are taken into consideration when a health care facility

project is planned.^{22 23} For example, the benefits of the single patient room emerged through evidence-based design.²⁴

- Kaiser Permanente—a large healthcare provider in the US—operates a facility that serves as a rehearsal ground to perfect proposed facility designs before they are rolled out to Kaiser's hundreds of hospitals and clinics. Simulations involving doctors, nurses, architects, and actors recruited to serve as patients have enabled Kaiser to slash expenses in a variety of areas, including patient record keeping and facility construction, while maintaining levels of doctor, nurse, and patient satisfaction.²⁵ The centre also creates mockups for home-based care that include patient monitoring devices and other new technologies.²⁶
- A review by Lega and DePietro (2005) identified an international trend for large, multi-specialty hospitals to adopt a common design scheme of an integrated and care-focused organization.²⁷ This design is characterized by four traits:
 - Clinical integration: designing facilities with similar units grouped together with multi-disciplinary care teams delivering care.
 - Resource integration: newly built hospitals designed to maximize resource pooling (i.e., sharing of beds operating rooms, equipment, staff, etc by all specialties), flexibility, and modularity of spaces.
 - Focus on the patient (e.g., patient groupings in wards not based on specialities, but on similar prevalent care needs).
 - Engagement of clinicians (e.g., multi-skilled and cross-training).
- The authors also found that “newly built hospitals are designed to maximize resource pooling and patient grouping, flexibility and modularity of spaces.”²⁸ In contrast, older hospitals require restructuring because of space constraints and buildings being built around fixed and focused spaces.²⁹
- In smaller hospitals like the Griffin Hospital (Derby, Connecticut), experimentation with new, non-traditional designs aims to improve patient satisfaction, increase profitability, and

increase patient volumes (inpatient and outpatient).³⁰

- The Griffin Hospital began by reconstructing its birthing centre using a customer oriented approach, ultimately extending this redevelopment to the rest of the organization.³¹
- The Griffin Hospital reports that the additional costs are very small, given that 60 to 70% of budgets are salaries and medical supplies.³²
- Cost savings on staff turnover and better control of salaries more than make-up for the extra costs.³³
- In Kitchener, Ontario St. Mary's General Hospital needed to significantly redevelop its facility to enable it to keep pace with its transforming role in the community. For example, the original surgical suite and day surgery were located four floors apart. The redevelopment solution was to group all surgical procedures on level two of the hospital addition. Improvements such as this, along with easier access to clinical areas and light filled interiors have meant dramatically improved patient and staff experience.³⁴

Green Facility Design

- LEED is a green building rating system that provides a suite of standards for environmentally sustainable construction. Below are some examples of how adhering to LEED standards and implementing environmentally conscientious practices can reduce expenditures and improve staff and patient outcomes.
 - The Richard J. Lacks Cancer Centre in Grand Rapids, Michigan, a certified LEED Silver building, saved \$1.2 million on an original \$40 million construction budget by using LEED building standards.³⁵
 - The Dell Children's Medical Center in Austin, Texas was the first hospital to be LEED platinum certified. Inside the facility, sunlight reaches 80% of the available space, motion and natural light sensors shut off unneeded lights, and the efficiency measures save

enough power to fuel about 1,800 homes.³⁶ The CEO of the facility expected that the additional construction costs associated with building a green hospital would be recovered within 5.9 years, thanks to reduced energy utilization.³⁷

- Boulder Community Foothills Hospital in Boulder, Colorado achieved a 30.6% reduction in energy use, 53% reduction in potable water use and 64% waste diversion.³⁸ Boulder Community also implemented an environmentally preferable purchasing practices program to identify safe and environmentally smart products. Collaborating with manufacturers, the hospital modified their processes to eliminate bulky packaging. Switching to hard reusable containers saved an estimated \$100,000 in yearly expenses.³⁹
- By pursuing LEED for several of its buildings, New York-Presbyterian Hospital reduced its energy use by 11%, saving the hospital upwards of \$1.77 million annually.⁴⁰
- The Providence Newberg Medical Centre in Oregon is a gold LEED certified building. The \$70.6 million building uses only green electricity from a combination of wind, geothermal and hydroelectric power. The building circulates fresh outdoor air into the building and uses natural light and smart lighting sensors.⁴¹
- Going green can mean more than being energy efficient.⁴² Oregon Health and Science University Hospital opened a health convenience store for staff and visitors which sells organic and locally grown food, products free from hormones, high fructose corn syrup, trans-fats and artificial colourings and dyes. Dominican Hospital in Santa Cruz, California buys locally from producers and has an on-site garden that provides produce and flowers for the facility.⁴³
- A cost benefit analysis of green buildings in the state of California determined that a minimal upfront investment of approximately two percent of construction costs typically

yields life-cycle saving of over ten times the initial investment.⁴⁴

- In a sustainable hospital report sponsored by McGill University, it was determined that most of the green buildings studied for the report had a cost premium of below eight percent and many were two percent or less, with some indicating no cost premium.⁴⁵
- Green hospitals can improve patient health and outcomes. By allowing more natural light, installing environmentally friendly wall and floor coverings and using green cleaning products, hospitals often see the following benefits: fewer medical errors, decreased pain medications for some patients, shorter patient stays, increased staff retention, lower rates of asthma, and improved patient outcomes.⁴⁶

Human Factors & Ergonomics

- According to one review, well designed and sustainable health care facilities may improve the health and well-being of health care workers and result in improved staff recruitment, retention and performance. Well-designed facilities are located near to where staff live, provide sufficient daylight and ventilation, and minimize walking distances.⁴⁷
- The first large-scale ergonomics intervention study involving nursing homes resulted in a 37% overall decrease in work-related musculoskeletal injuries among workers in 111 Ohio facilities.⁴⁸ In work reported in the *Proceedings of the Human Factors and Ergonomics Society 49th Annual Meeting*, researchers noted that the decrease in back injury rates alone (44%) far exceeded the national rate reported by the US Bureau of Labor Statistics (17%).⁴⁹
- In this same study, nursing homes were given devices such as adjustable beds, patient lifts, and transfer devices.⁵⁰ After the two year study period, researchers noted "significant evidence that ergonomic interventions in health care facilities led not only to reduced musculoskeletal injury rates but also to fewer lost work days and lower turnover."⁵¹

- Well designed buildings can have a profound effect on health care workers. At the Barbara Ann Karmanos Cancer Institute in Detroit, Michigan, the renovation of in-patient nursing units resulted in a reduction of the nurse attrition rate from 23% to 3.8%.⁵²

International Success Factors

- The project to build and develop the Infectious Diseases Institute at Makerere University, Kampala, Uganda is a collaborative initiative among Ugandan and US entities, including private sector organizations, universities, ministries, and individuals. Project success factors fall into three categories:⁵³
 - Planning at the design stage to address functional requirements.
 - Input and feedback from clinical and building professionals to ensure that the building was appropriate to local conditions.
 - Rigorous project management.
- In this project, processes were established to manage physical infrastructure development with stakeholders on different continents all contributing expertise to address functionality, quality control, fiscal accountability, and ultimate sustainability.⁵⁴
- Columbia Asia, a private American firm with hospitals across Asia has made a push into India, utilizing a model of building design that has few frills and is standardized and connected like spokes to a hub. The firm focuses on providing services to those earning between \$10,000-20,000 a year within wealthy cities. The hospital does not have an expensive foyer or high tech imaging machines, but does boast integrated health information-technology (HIT) systems, including electronic health records.⁵⁵

Collaboration and Sharing of Expertise

- The third Annual Canadian Healthcare Infrastructure Summit was held in February 2010. The high-level “think tank” type event was designed to “bring together top decision-makers from all sectors of healthcare infrastructure development to share their experiences in a collegial and

educational environment.” The summit is designed to allow participants to learn from leading practitioners and infrastructure experts about the latest strategies, techniques, best practices and case studies from other hospitals.⁵⁶

- At the 2009 conference, representatives from the Peterborough Regional Health Centre shared their insights about the process, design, and construction of their newly opened hospital. The entire construction process was monitored closely by all stakeholders to ensure it was completed on time and on budget, requiring an open process to engage the community. Some of the key engagement strategies were:
 - setting up a committee of neighbours living near the construction site
 - having senior administrators join community groups and city planning committees
 - soliciting community input about the design of the hospital
 - early tours of the site by staff and the community
 - using the local media to provide ongoing coverage of the construction.⁵⁷

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