

SMART HOSPITAL WHITEPAPER

Your Building: An Instrument of Care



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1. Introduction and Insights

1.1 Helping doctors cure and patients heal

Come 2030, Asia will be home to more than 60 percent of the total population aged 65 years or older worldwide, according to consulting group Deloitte.¹ By 2042, there will be more over-65s in Asia than the combined populations of Europe and North America, generating higher demand for healthcare services.

The healthcare industry is responding to the changing healthcare needs of an aging population. There is a shift from acute and episodic care towards integrated systems that provide a coordinated continuum of care for better management of chronic diseases. This includes an integration of specialized areas such as prevention, diagnosis, consulting, nursing, rehabilitation and health management.

For hospitals, this means adopting “smart” strategies to improve operational efficiencies and costs. However, hospital administrators need to consider the following issues when embarking on the journey towards building smart hospitals.

- What are the real needs of patients?
- What would help doctors and nurses perform their duties better?
- How would processes be optimized?
- Can various hospital systems “talk” to each other?

This Whitepaper provides a reference framework for further discussions on smart hospitals. Issues and recommended strategies to make smart hospitals sustainable and scalable will be highlighted.

1.2 Insights

A recent survey on the healthcare industry findings by Johnson Controls revealed five insights on user expectations, needs analysis and obstacles hindering the development of smart hospitals.

Insight #1: Low satisfaction with current “smart” experience at hospitals

There is a significant difference in the satisfaction level among the various user groups on the current “smart” experience in hospitals. Doctors/nurses ranked the highest on the satisfaction scale, in part a reflection of the various IT initiatives adopted within hospitals that have dramatically improved the efficiency of the medical staff. Despite the introduction of systems such as online/self-service registration and patient queue management, however, the patient group is the least satisfied - a reminder that the process of patients seeking medical care is an overall experience, rather than the experience of a single service or function.

Among the various users, there is a low consensus about the ability of smart hospitals meeting their needs. For instance, majority of both patients and doctors/nurses expressed a strong need for a comfortable environment for improving the quality of care/work experience, but just over 10 percent in each group believed that this need can be met by smart hospitals. The expectations of end users are mostly limited to the current applications/technologies, and they lacked the understanding that smart hospitals will ultimately meet end users’ needs and solve their problems.

[1] Source: https://www2.deloitte.com/content/dam/insights/us/articles/4202_VOA-3_Aσίας-growth-on-the-cusp/DI_VOA3.pdf

Insight #2: Front-end technologies seen as more important functions of smart hospitals

An overwhelming emphasis has been placed on patient-related technologies. Nearly 75 percent of hospital administrators, doctors/nurses and patients believed that front-end applications and services (such as online registration, diagnostic services, patient care and treatment) are the most important functions of smart hospitals. A closer analysis revealed that hospital administrators placed a high premium on improving operational efficiency, while facility managers are more focused on building automation. Doctors/nurses are more about improving service efficiency in areas such as patient management and indoor navigation systems.

Without the support of unified and stable backend platforms – such as infrastructure, process and data – the front-end applications will be isolated, disconnected and unreliable. If too much attention is focused on front-end applications, while neglecting back-end platforms, then smart hospitals will face problems from the onset which will be exacerbated with time.

Insight #3: Gap in perceived and actual needs

A smart hospital should be built with an accurate understating of the needs of its medical staff and patients. However, that is not always the case. The results showed a gap between what hospital administrators perceived to be the needs of patients and doctors/nurses, and the needs that these groups actually expressed.

For example, environmental comfort and order, which are generally the priorities of doctors/nurses, are not highly ranked by hospital administrators. Such a gap in perceived and actual needs may result in insufficient investment that address the true needs of the users, that is, patients, doctors and nurses.

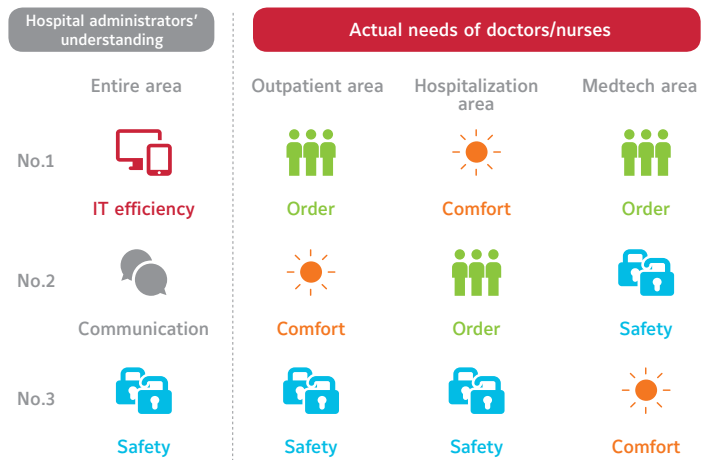


Fig. 1-1 The needs understood by hospital administrators versus the real feedback of doctors/nurses

Insight #4: Differing needs among hospital users and within functional space

The needs of different user groups differed significantly for various functional space in the hospital, which in turn led to difference in opinions when it comes to prioritizing areas for improvement in these space.

The outpatient area and hospital wards are two primary hospital touchpoints for patients. In the outpatient area, order and waiting time are the most important improvements for patients; whereas in the hospital wards, environmental comfort and response speed are their top priorities.

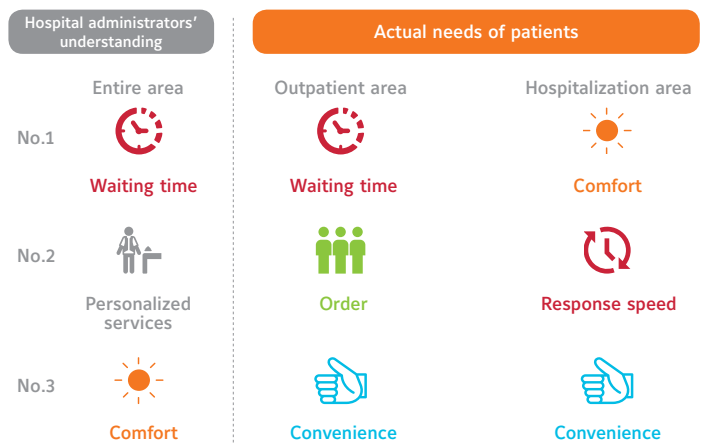


Fig. 1-2 The needs understood by hospital administrators versus the real feedback of patients

In addition to the outpatient area and operating theaters, the medtech and operating theaters are two areas frequently used by medical staff. In the outpatient area and the medtech area where there are usually large crowds, the medical staff ranked order, environmental comfort, and safety as the top three categories for improvement. In wards and operating theaters - areas where specialized services are provided - doctors and nurses indicated that improving efficiency and reliability, for example through intelligent care, and guaranteed equipment performance as the most important categories for improvement.

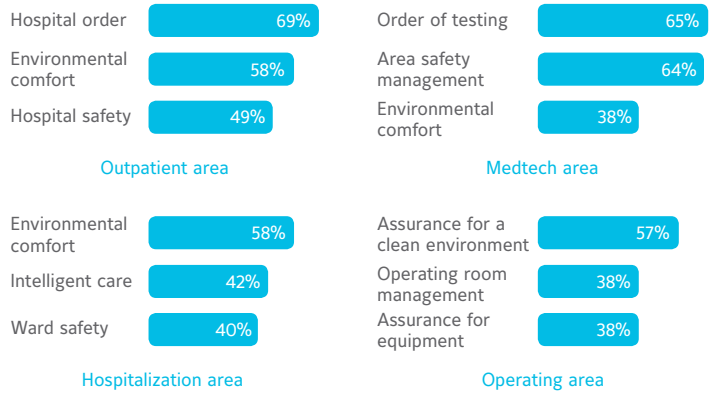


Fig. 1-3 Ranking of needs of doctors/nurses for different areas

Insight #5: Lack of top-level design and system incompatibility are obstacles to smart hospital development

Differing views on what are smart hospitals (concepts), how to build them (systems), and how to evaluate them (standards) are some challenges to the development of smart medical facilities in the region. The lack of unified standards makes it difficult for hospitals to develop holistic, top-level designs. In some cases, they are pushed into making piecemeal investments in building intelligent systems in specific, individual areas, resulting in fragmented, non-unified plan. Furthermore, many IT/intelligent technologies are not fully compatible with each other; thus each upgrading or retrofitting may create the need to build new systems from scratch.

The key to driving adoption of smart hospitals in Asia is to find effective solutions to these problems.

It is clear from the survey that there is no one-size-fits-all solution for an effective smart hospital. Various needs of the different user groups have to be taken into consideration. Equally important is to plan and customize different functional space based on the functions and what are required of them by the different groups. When taken together, these considerations will improve the overall experience of patients, doctors and nurses.

2. Building a Smart Hospital: What Does It Take?

“Enabling patient-centered care through strategic technology integration is what we offer to the healthcare industry in Asia. It’s about providing the building systems, equipment and know-how to create and maintain quality, healthy, sustainable environments. Our comprehensive portfolio helps hospitals save time, reduce risk, reduce costs and improve building performance.”

– Raymond Kang
Head of Healthcare Vertical Market, Singapore, Johnson Controls

Healthcare organizations face increasing pressure to deliver uncompromising patient care while improving clinical outcomes and operational efficiency. Challenges such as increasing patient satisfaction, ensuring compliance, keeping abreast with technological advances are common issues in hospitals.

Furthermore, with the buzz around smart technology and the Internet of Things (IoT), what do these innovations mean for the healthcare industry? How would hospitals and patients benefit from connected technologies without compromising data protection? More importantly, how would smart technology produce better outcomes?

Indeed, hospitals are complex integration of myriad systems. It is only when organizations really understand how clinical, IT and facility systems can work together that the challenges be more effectively addressed.

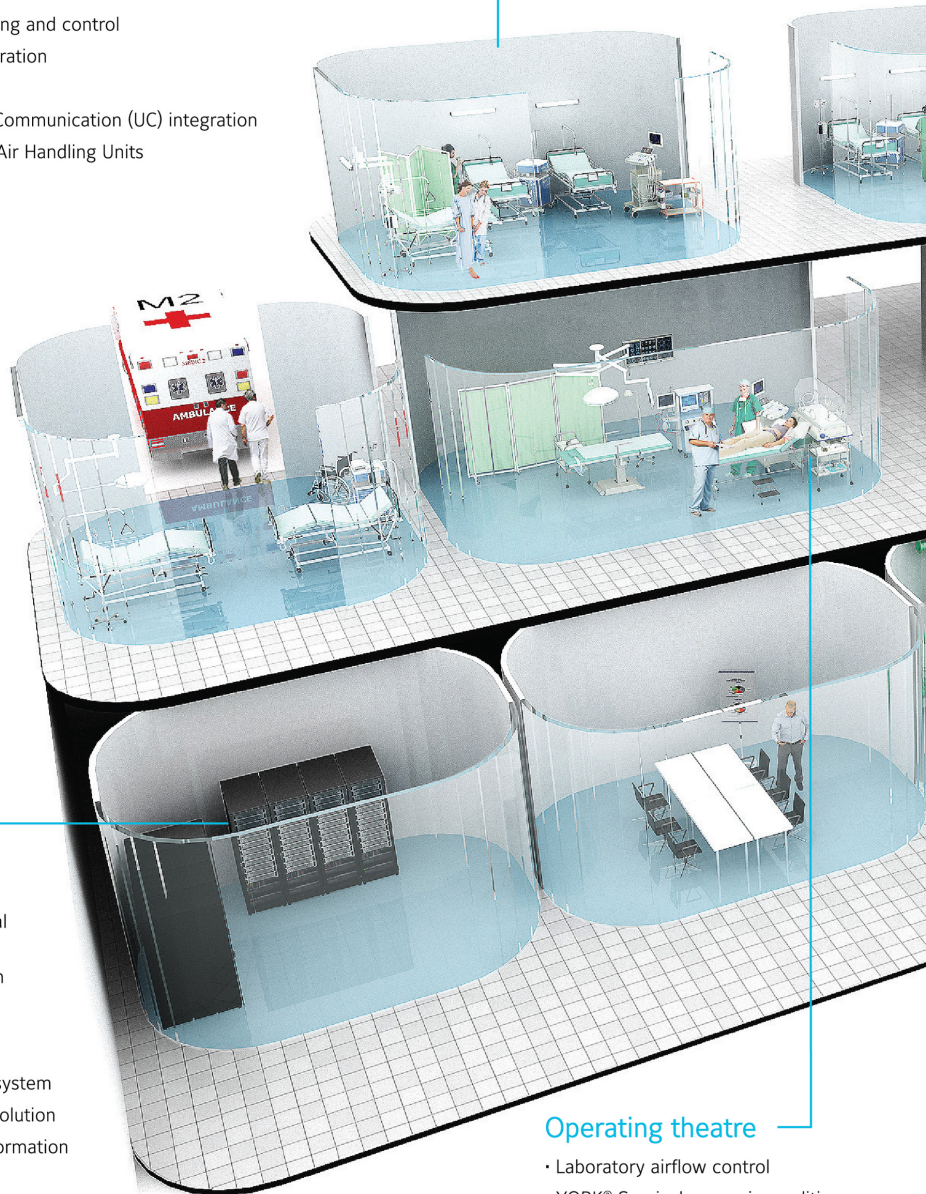
2.1 Creating smart healthcare environments

When a patient enters your building, the healing experience begins. In the era of the electronic medical record and bedside infotainment, your patients and medical staff expect the best.

Your building can become an instrument of care if facilities, business, security and clinical systems are integrated in the right way. An enterprise-wide perspective is needed to manage the planning, design, supply, installation, integration, commissioning and services of systems and clinical solutions like nurse call, and supporting infrastructure.

General ward

- Environmental monitoring and control
- Bed management integration
- Fall management
- Nurse call and Unified Communication (UC) integration
- YORK® Hygiene Room Air Handling Units



Data center

- Metasys® Environmental Management System
- YORK® Computer Room Air Conditioners
- Fire detection and suppression system
- Security management system
- Air flow management solution
- Data Center Facility Information Management (DCFIM)

Operating theatre

- Laboratory airflow control
- YORK® Surgical room air conditioners
- Healthcare Environment Optimization
- Nurse call integration
- Unified Communications integration

Fig. 2-1 Making your building an instrument of care

Energy and sustainability

- Energy audit and management
- Green Mark consultancy for hospitals
- Indoor Air Quality (IAQ)

Admission

- Admission Discharge Transfer (ADT) integration
- Environmental control for room
- Real Time Location Services (RTLS) integration
- One-queue-one-bill workflow

General area and back of house

- Surveillance monitoring and control
- Access control
- Fire detection and protection
- RTLS tracking and asset management integration
- Environmental monitoring and control
- Incident reporter
- Lighting controls
- Operations and Maintenance

Chiller plant

- YORK® Water-cooled centrifugal chillers
- Chiller Plant Optimization and control
- Metasys® Energy management system
- Measurement & Verification (M&V) system complying to SS591
- Remote monitoring

 **YORK**[®]
INSTALL CONFIDENCE.

 **METASYS**[®]
MASTER YOUR ENVIRONMENT.

It is critical to begin with the end in mind. Be it building a new medical facility or retrofitting an existing one, all departments of the hospital have to be considered in technology-related initiatives. Integration for integration's sake can lead to alert fatigue, poor work flow and unnecessary complexity for clinicians and patients.

Successful integration requires systems convergence at two levels:

- Physical convergence to ensure different systems share the same infrastructure (for instance, networks and servers); and
- Logical convergence to ensure systems exchange data in the same operational process or workflow.

Unfortunately, the construction industry has not kept pace with advances in technology; while IT integrators often lack expertise in construction such as core building systems, job site coordination or construction scheduling. Different systems are installed in silos, usually by different subcontractors – often twenty or more. Because responsibility is fragmented across so many different parties, it is almost impossible to deliver the converged environments necessary to meet the needs of modern facilities with complex operational processes and large flows of people.

2.2 Master system integration - the value of an integrated delivery process

Johnson Controls offers Master System Integration (MSI) where we assume a single point of responsibility upfront to bring an enterprise-wide perspective of the process. The MSI Methodology has been refined over a decade and has been proven in the delivery of smart hospitals globally. The Methodology has the following steps:

- Integration review
- Integration/Technology navigation (a unique structured, interactive process with healthcare facility's cross-functional teams to assess and prioritize healthcare technology needs and investments)
- Integration design
- Integrated delivery process
- Integration commissioning

Johnson Controls adopts a vendor-agnostic approach. With over 100 industry infrastructure, application and device partners to provide the right technology, manage the installation and guarantee the performance, we have established competitive pricing with these partners by leveraging our extensive supply chain management process.

Johnson Controls will develop a technology plan that will maximize the life-cycle cost of technology budget decisions, in addition to risk mitigation and minimizing barriers for future expandability. This is achieved by making design decisions around core infrastructure such as structured cabling, network infrastructure and specialty system interoperability.

Healthcare organizations are always looking for ways to use project dollars more effectively, whether retrofitting an existing facility or in new construction. Johnson Controls expertise with facility, clinical and IT integration enables our customers to realize more value from their technology investments.

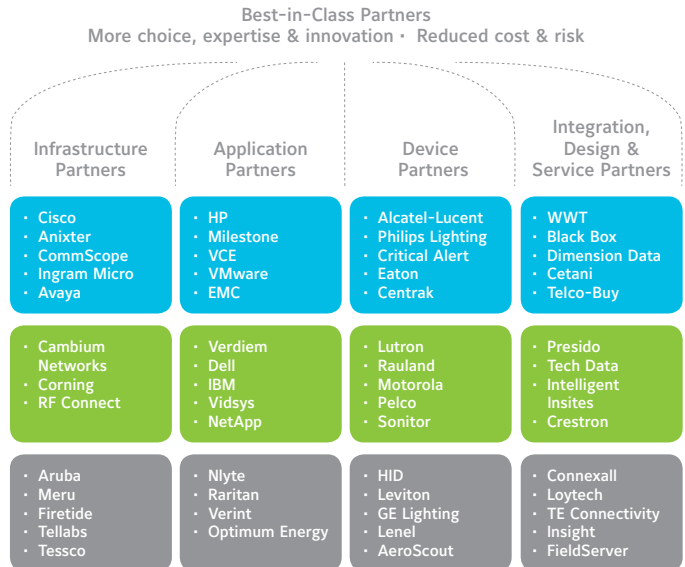


Fig. 2-2 Johnson Controls' best-in-class technology partners

3. Use Cases

3.1 Optimized emergency response process saves lives in mere minutes

Survival rate of "Code Blue" patients up by threefold in Southeast Asia-based Hospital A

Basic information on the hospital:

Hospital type: General public hospital
Floor space: more than 150,000 square meters
Number of hospital beds: more than 1,000
Location: Southeast Asia

Three-pronged vision to:

- Adopt a patient-centric approach in facilities design, processes and service delivery
- Create a flexible, modular and integrated emergency service process
- Build a sustainable urban medical center

Improved patient queue management

Good outpatient experience is vital at Hospital A, which is focused on providing wellness services. The patient registration has been streamlined, with varied options available - either through self-service kiosks, service desks, online services and even tablets - and taking into consideration how patients reach the premises - via public transit, car or by foot.

The reception process has been automated. Each patient who has made an appointment will receive a text message via their smartphone's automatic identification feature. Through the RFID-based identification and queue management system, the patient receives a recommended optimized care service path that can be printed out or downloaded to the smartphone. With optimized patient ranking, the queue management system can predict the waiting time for patients, and delivers the updated information to their smartphones. After the consultation, patients receive their bill and pay at the last service point or any self-service kiosk. Ultimately, the outpatient service process is optimized such that each patient only needs to get in line once for each appointment and to pay for their bills, respectively.

Shortened response time to Code Blue activation

Every minute counts when a patient is in critical condition. When Code Blue is activated, the emergency response team now reaches the patient who needs resuscitation in mere minutes. The team members will have priority access to elevators, and the Building Automation System (BAS) automatically adjusts the air conditioning, lighting and other systems in the ward to a condition most suitable for treatment. In the event of an operation, the BAS will prepare the operating theater and prepare the elevators for speedy transfer of the patient.

The newly integrated emergency response system has brought about dramatically results:

- A threefold increase in survival rate of patients with cardiac arrest
- Better monitoring of patients who show signs of deterioration up to 6 to 8 hours before they go into cardiac arrest, allowing medical help to get to them faster - and improving the chance of survival

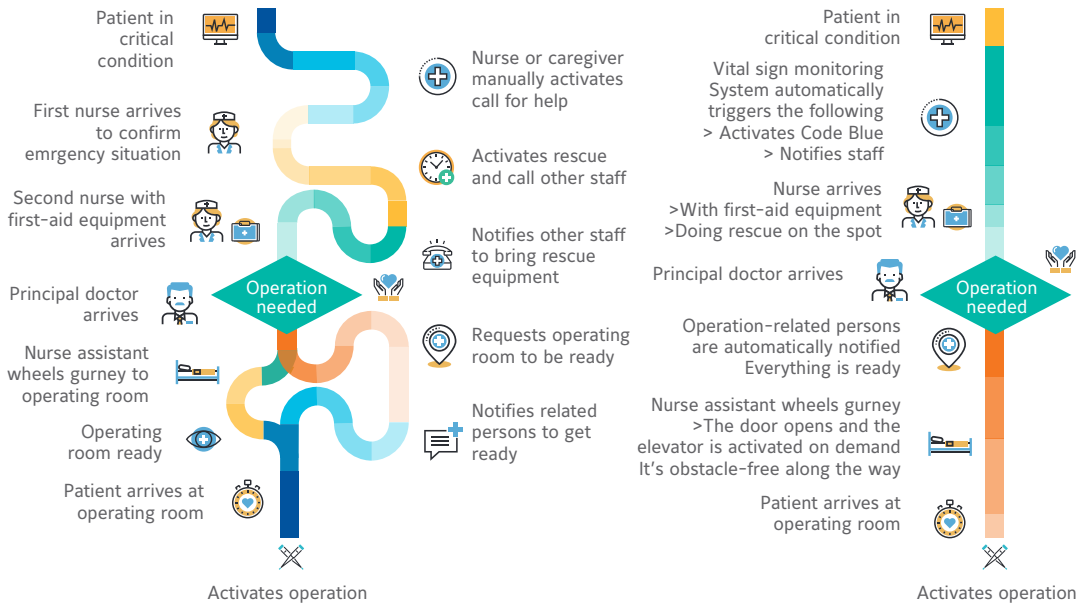


Fig. 3-1 Optimized emergency response process for Hospital A

Efficient operation in green sustainable environment

Hospital A has integrated some 30 systems - including building, IT, treatment and diagnosis systems - through middleware, with more than 90,000 integrated hardware points. Thanks to unified and integrated operational UI, as well as ongoing optimization and improvement, Hospital A has been certified by the local green standard system.

3.2 Retrofitting: Transforming the hospital to an energy-efficient facility

Shaves 20 percent off overall energy consumption

Basic information on the hospital:

Hospital type: Public hospital
 Floor space: 100,000 square meters (head office)
 Number of hospital beds: more than 1,200
 Location: Downtown in a Tier-1 city, China

Vision to:

- Be one of the best international hospitals that embodies the Red Cross spirit of "Humanity, Universality, and Voluntary Service"
- Improve service quality
- Strengthen brand reputation

Multiple buildings constructed over time; plethora of equipment and systems operating independently; variance in skillsets of staff in charge of operations and maintenance of the facilities – these are but some common scenarios in most established public hospitals. Hospital B was no exception.

The facility suffered from operational inefficiencies and inability to provide comfortable environment for its occupants. For instance, multiple air conditioning brands and control systems were in use - but all operating independently of each other, and some were even under manual control. The outpatient area was overcrowded and did not have sufficient ventilation which resulted in frequent complaints and low patient satisfaction.

Retrofitting

Things changed when the hospital decided to retrofit its existing facilities to transform itself into a smart hospital. A step-by-step implementation strategy was adopted to optimize the operations and maintenance of all the buildings within the head office campus. There was no disruption to the medical services during the retrofitting project.

A series of upgrading took place which included the following:

- Upgrading of the automation system of the outpatient building, including computers, software, network control engines to boost the overall system capacity and processing capability
- Integration of disparate systems such as, water pump, fan coil, building automation, variable refrigerant volume air-conditioning, into the *Metasys*[®] system for centralized management and monitoring to optimize environmental control and operational efficiency
- Addition of more than 60 units of IoT-based air conditioning units to improve the ambient temperature within the outpatient areas

Transformation

Hospital B has seen tremendous improvements following the installation of the upgraded *Metasys* platform. This included:

- Significant reduction in overall energy consumption by nearly 20 percent
- Fewer patient complaints about the ambient conditions of the outpatient area during summer
- Enables integrated management in areas such as clean environment, energy and property for greater efficiency

For these improvements in efficiency, Hospital B was named a national "Pacesetter for Public Institutions in Energy Efficiency" in 2018.

About Johnson Controls Healthcare Business

At Johnson Controls, we create smarter, healthier, productive and more comfortable built environments that deliver energy savings, operational savings and sustainable solutions. We enable you to deliver an optimized healthcare environment. When clinics and hospitals are comfortable, connected and integrated, patient outcomes improve and satisfaction increases.

Our smart hospital solutions organically combine building technologies (building IoT), medical technologies (medical IoT) and hospital business processes (IT systems). Through strategic planning, assessment and an integrated approach for operations and maintenance, Johnson Controls' smart healthcare solutions will help you achieve your healthcare vision and mission. Since 2003, Johnson Controls has provided smart hospital solutions to over 200 public and private hospitals.

Managing a building's environment so that it's comfortable safe and yet energy efficient is complex. That's why customers in more than 150 countries look to Johnson Controls – a leading provider of equipment, controls and services for heating, ventilating, air conditioning, refrigeration, fire and security systems. We deliver solutions that increase energy efficiency, lower operating costs and create environments where people can work, learn, play and live comfortably.