A Guide on The Internet of Things and the Effect on Healthcare Facilities

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The Internet of Things and the Effect on Healthcare Facilities

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About this Guide

The rate of change underway in the interface and connectivity of infrastructure systems and equipment to information technology networks is moving at a pace that couldn't be imagined just a short time ago. Advances in computing power, data logging, on-board memory, energy consumption, wireless connectivity systems, and their cost-effective adoption into healthcare systems and equipment appears to be nearly limitless. These changes, while surely providing astounding new capabilities for improvement in patient procedures and satisfaction, can be complex and taxing on existing healthcare infrastructure systems and budgets.

This guide will present several innovative technologies, including those that exist in the healthcare environment already or anticipated to be in place soon; discuss their impact on infrastructure needs; and provide recommendations on how to upgrade current infrastructure systems. The guide will also discuss planning for the future to make the most effective use of these technologies.

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As a firm Principal and Market Leader, Jason serves as the primary contact to clients throughout project development. He understands all phases of a particular project, coordinating closely with the entire project team, both internal and external. As part of his position, Jason ensures that all client requirements are met by developing a strong client relationship, from project inception through construction closeout. He has extensive experience in electrical investigation as well as the design and construction for a broad range of facilities, with a particular focus on healthcare facilities. Jason's focus as Market Leader is to successfully meet all project goals while satisfying the needs and requirements of the client.

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In his role as Senior Associate and Electrical Engineering Manager, Cameron serves as head of the electrical discipline within the technical team. With a diverse project-based background that includes lead electrical engineering and project management, he has served as a team leader, mentoring and training junior level staff. Cameron monitors all aspects of a project's progress, ensuring timely and cost effective completion while also developing the electrical engineering standards within the team. As Electrical Engineering Manager, Cameron's goal is to exceed all client expectations by delivering integrated solutions to every engineering effort.

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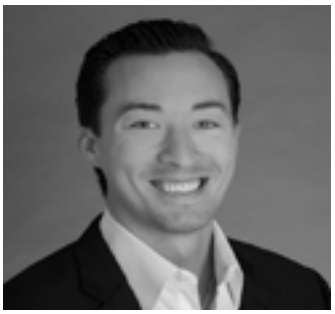

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MECHANICAL | ELECTRICAL ENGINEERS
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1 Background

The Internet of Things (IoT) is a network of physical devices embedded with electronics, software, sensors, etc. that are connected and exchange data. IoT creates opportunities for efficiency improvements, economic benefits, and the ability to focus efforts where they are needed by gathering information quickly and increasing the ability to access, process, and use that information. However, it should be cautioned that more data can become burdensome or overwhelming if it is not properly organized and automated so that people are able to effectively utilize the information. The integration of systems to a single interface agreed upon by the users and that organizes the information in a way that makes it easy to analyze and understand is key to the success of utilizing IoT devices and integrated systems. When applied specifically to healthcare and the patients, IoT provides an enhanced ability to monitor the health and needs of patients while improving the experience of the patient, by allowing them to control their environment when in an unfamiliar location.

The rate of new IoT devices in use has been dramatically increasing over the past few years and it is anticipated that 20.8 billion IoT devices will be in use worldwide by 2020 according to Gartner Inc.[1] This forecast is based upon the current trend of the quantity of IoT devices increasing by approximately 30% a year over the past 4 years. IoT devices have become more common in our everyday use and, as a result, consumers' expectations have risen. Whether a hotel or hospital, consumers and patients desire - and have come to expect - the same capabilities they have at home when they visit or stay elsewhere.

In the newer payment models, patient satisfaction has an ever-increasing importance, and IoT is one way in which facilities can differentiate themselves from their competitors. The value of building integration for system controls, scheduling, patient needs, and patient monitoring for healthcare facility staff are opportunities to quickly collect information to a single interface

"When applied specifically to healthcare and the patients, IoT provides an enhanced ability to monitor the health and needs of patients while improving the experience of the patient, by allowing them to control their environment when in an unfamiliar location."

and leverage that information, so both staff and patients can make informed decisions resulting in the best care possible. Additionally, the implementation of Electronic Health Records (EHR) has increased the ability to efficiently collect, organize, store, and reuse information. The additional data sources provided by IoT beyond those typically associated with patient records only further help hospital staff care for their patients.

IoT provides opportunities not only for hospital staff to better anticipate the needs of patients, but also for patients to control their environment and comfort without having to rely solely on staff - providing the comforts of home in an unfamiliar, and sometimes uncomfortable environment.

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IoT TECHNOLOGIES

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2 IoT Technologies

The first requirement of incorporating building systems together is the ability for the systems to be "connected".. In most retrofit situations this would typically mean wirelessly (e.g. Wi-Fi) connected devices. However, as more systems are integrated within a building, wireless access points may not be the best approach. A combination of wired and wireless infrastructure will be required to improve reliability or minimize the number of wireless access points. This will allow for the transmission of mobile or low-volume data associated with systems such as nurse call or lighting controls to be transmitted via Wi-Fi. Other more data intensive or critical systems, such as telemetry or video streaming, can be wired. The overall goal of IoT is to increase the amount of data that can be shared across different platforms and systems.

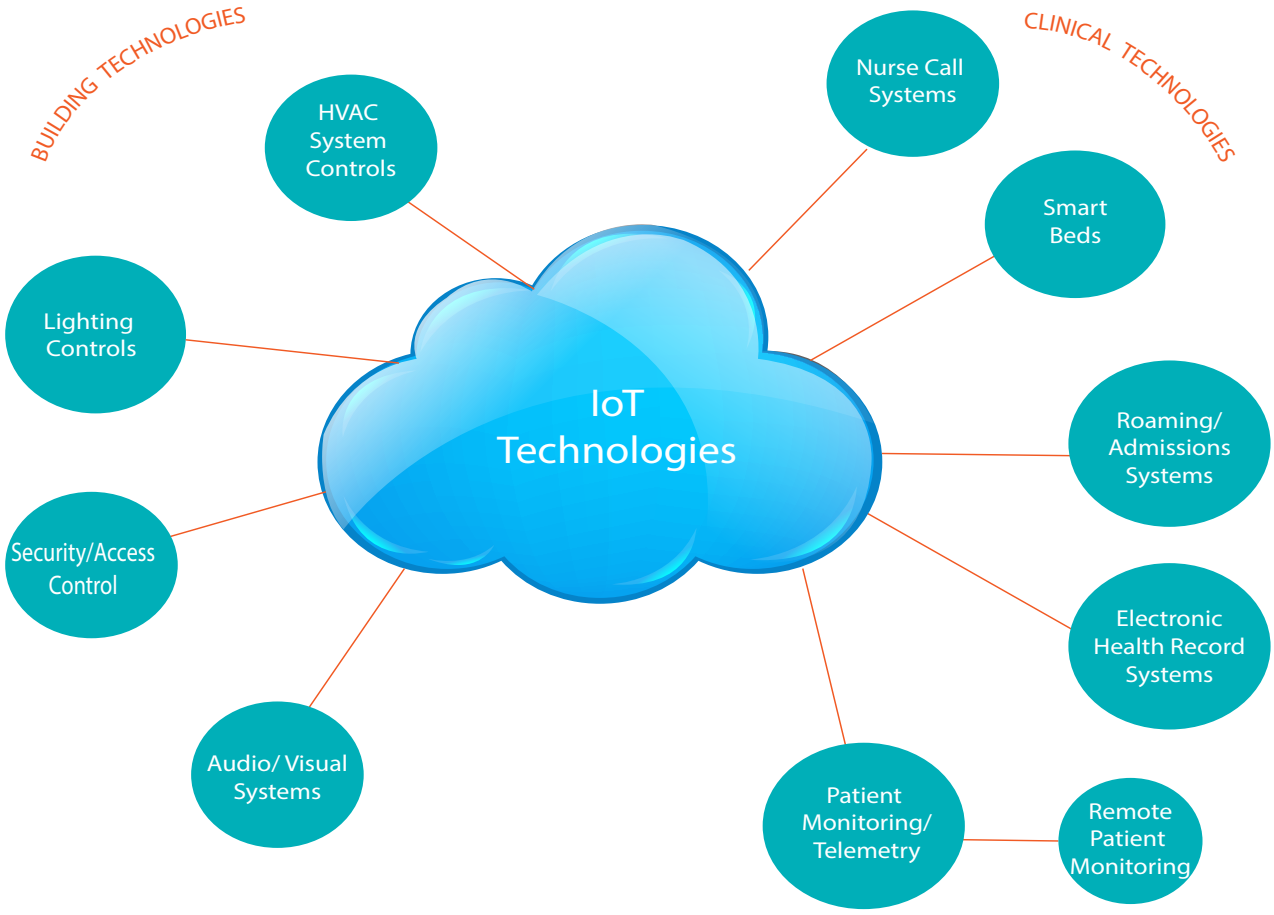

Figure 1: IoT Technology Cloud

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Available Building Technologies

HVAC System Controls

Environmental comfort (most often temperature) within the patient room or exam room can often be a source of discomfort for patients and something that nurses and facility staff spend a lot of their valuable time correcting. Patients of different acuities have different needs;, which makes environmental control needs different from room to room. Even within a single room, the patient zone, staff zone, and visitor zone all have different, and often competing, needs as well. When integrated systems are used, the patient is given the opportunity to control the climate within their own space, leaving the healthcare team to focus more on patient care. Similar to IoT devices offered for residential use, major manufacturers include integration options that can allow the patient to outline their preferences for rooms. It's reasonable to anticipate that in the future, patient preferences will follow them as they move through different departments and rooms in a facility.

Lighting Controls

The most simplistic form of lighting controls is on/off functionality. However, with improvement in technology, lighting controls have become more sophisticated to include lighting zone control, dimming, daylight harvesting (photo sensing), color changing, etc. When the variety of lights are integrated and "connected", it allows the patient to have full control of the lighting within the room. Several manufacturers offer IoT lighting systems that can be accessed via a tablet or smart phone app to give the patient full control of the lighting within the room. Further controls are available that would allow for individual light control throughout the room utilizing addressable light fixtures integrated with the lighting control system.

Security / Access Control

Security and access control systems are an underutilized source for integration. Traditionally, security and access control systems have been "closed" systems that don't share their data with other systems. Additionally, they are typically used exclusively by security staff and not shared with medical staff. However, when utilized within a fully integrated atmosphere, security (CCTV) and access control can be integrated with the admissions system for room tracking / utilization and monitoring of patients giving hospital staff additional information that can be utilized to give the patients the best possible care. For instance, there are some patient monitoring software programs that are integrated with cameras in a patient room that have the ability to determine if a patient is getting out of bed or close to the edge of the bed. The software will then transmit an alarm signal through the Nurse Call system to alert staff so that they can provide assistance if **necessary.**

Audio / Visual / Paging Systems

Audio / Visual Systems such as privacy / white noise, paging (music systems), and television (cable) can potentially be integrated and incorporated into patient rooms. The controls for the patient room televisions can be integrated into the controls for nurse call, which is common practice today. A more advanced system can have the ability to control the television, HVAC, lighting, shades, etc. from a single interface that the patient has readily available to them, either by an app on their phone or a touch screen provided by the healthcare facility. White noise systems, integrated with the building's PA system, provide a higher degree of privacy for patients when speaking with the doctors and nurses about their care.

It should be noted that paging systems are being utilized less and higher acuity healthcare facilities instead are utilizing direct messaging to staff through facility-issued cell phones or other devices. This has proven to allow patients to rest / sleep better as they are not being disturbed by announcements broadcast throughout the hospital. But in outpatient settings where general paging is still necessary, combined systems provide multiple functions with a single set of devices, wiring, and equipment.

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Fire Alarm / Mass Notification

Healthcare facilities, particularly hospitals, are often designed with selective evacuation procedures in lieu of general evacuation, primarily due to a portion of the patient population incapable of self-preservation. Fire alarm / mass notification systems are typically seen only as a single purpose, life safety system. However, when integrated within a building, it gives the ability to provide better patient care in emergency situations. When integrated, the healthcare staff will know where the activation of a device occurred and therefore have all the information they will need to either evacuate patients or shelter in place. Additionally, knowing where the activation occurred, they can find the safest route out of the facility to avoid the area of incident. This includes giving them access to the security system, patient monitoring, etc. all within one location. For instance, when smart beds (discussed below) are integrated and monitored at the nurse station, the hospital staff would be able to determine which patients are still in bed as well as understand patient vitals, prior to entering the rooms. This is critical information that allows them to focus their efforts and get patients safely out or shelter in place as necessary.

It should also be noted that recent changes in NFPA 72 permit the integration of a paging system with the buildings fire alarm system with approval from the local authority having jurisdiction. This is a potential cost savings if a facility requires a paging system and wants to incorporate a voice evacuation fire alarm system.

Available Clinical Technologies

Nurse Call Systems

With patient safety and comfort paramount to a hospital's success, nurse call systems have evolved to keep up with the demands of both the patient and staff. Patients can now utilize a single device (usually a handheld multifunction remote) to control bed positioning, room lighting, television, and nursing staff signaling. Nursing staff can also have this information transmitted in a variety of ways, including directly to their secured smart phones or dedicated pager, allowing them to carry fewer devices but maintain awareness of their patient's needs. Getting information more quickly and directly, they can respond faster and work more efficiently.

Smart Beds

Smart bed technology is one method of patient monitoring that is utilized to help provide better patient care. With smart beds, data is recorded regarding patient movement patterns and sensed weight to deliver information in real-time to nursing staff, allowing them to know when a patient is out of bed or attempting to leave their bed. This helps to reduce patient falls by alerting staff immediately and allowing them to assist the patient with their needs. Smart bed integration with nurse call systems allows for an efficient flow of information to nurse staff so that the information can be used to improve patient care.

Smart beds are most often provided as a wireless option, however, when used in more critical areas such as an ICU, it is recommended that the beds be wired. Although the wireless transmission doesn't require high data consumption, the wired connection can be monitored for a break in the connection to report an alarm to the nursing station. The nurses can then acknowledge the alarm if it was expecting a patient transit or check on the patient if it was not anticipated.

Rooming / Admissions Systems

Smart beds are also integrated with rooming / admissions software systems to aid the facility in tracking occupancy and to aid nursing staff in care of patients. When beds can relay their exact location, hospital greeters can get a patient's family to them most quickly and directly; room cleaning and turnover for the next patient can happen most efficiently; and a patient's care and medication can be tracked more accurately.

Electronic Health Record Systems

Electronic Health Record (EHR) systems allow for the electronic recording of patient information into a central database that can be accessed by authorized medical staff and used to automatically send alerts to specific medical staff. When paired with patient monitoring systems, the monitoring data can be recorded instantaneously and become readily accessible to multiple medical staff. Additionally,

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the information can be summarized such that it can be better analyzed by medical staff for more rapid diagnosis and treatment.

EHR systems may represent the biggest opportunity for IoT logging. With their primary function being data tracking, various systems that were previously independent can share data to the EHR system for trending and analysis. For instance, intravenous pumps can automatically document administration of medications in the EHR and alert a nurse if the infusion becomes obstructed. Similarly, ventilators interfaced to the EHR can alert a physician of incorrect ventilator settings that could potentially harm a particular patient (e.g. Mayo Clinic AWARE system).

Although updates for EHRs can be real time, there are instances when this might not be the best solution. Unanalyzed information could be seen by a patient that they might not understand, causing more stress than needed. Test results such as disease diagnosis may require interpretation or for the news to be delivered by the doctor to ensure the patient has all the proper information and options.

Patient Monitoring / Telemetry

Hospitals are always looking to reduce a patient's length of stay, decrease patient readmissions and increase patient care quality as a whole. Patient monitoring devices help to achieve each of these goals by providing a constant stream of data regarding a patient's health status directly to a central station. This allows for nursing staff to recognize trends in a patient's key health statistics to help prevent an emergency incident and have quicker response times if an incident should occur. Advances in these systems allow patient vitals monitoring to be more portable, allowing patient's more mobility while they are healing. Patient vital information that once required wired connection to a bed, wall, or piece of stationary equipment, now can be sent wirelessly from an exterior healing garden.

Specialty Systems

eFlag

In some cases, organizations have a specialty patient care system they've developed to accomplish a particular goal in their care for their patient's. One such technology is an electronic exam room flagging system (eFLAG) developed by Reliant Medical Group. During their organization-wide care transformation project, Reliant Medical Group developed the eFLAG system (refer to case study at the end of this paper). The eFLAG system is not just an electronic version of the color-coded, swinging plastic flags at exam rooms, it is integrated with the EHR (Epic Systems Corp.) to allow the EHR to control the room status, to let eFLAG utilize the EHR's communication system to notify staff when they are needed, as well as provide real time data for operations and capturing data for later analysis.

Remote Patient Monitoring

Driven by patient demand, improvements in technology, and the need to deliver healthcare outside the traditional hospital setting, remote patient monitoring is being utilized successfully. It is most effectively used with chronic conditions such as cardiac patients, diabetes, or the frail elderly. Tracking vital signs or activity, doctors can be notified when patient parameters are outside of normal range and even have the ability to predict medical events for a patient and give them prompt care. Some of these monitoring devices required active patient participation (e.g. stepping on a scale or wearing a special watch), while others passively monitor their activity (e.g. pressure sensors in beds, door sensors on refrigerators, or motion sensors in living spaces).

IMPACTS

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3 Impacts

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Impacts to Facility

The Internet of Things (IoT) will significantly impact all industries, but especially data and sensor-driven ones like healthcare. According to a recent analysis by Deloitte, more than two-thirds of medical devices will be connected to the internet by 2023, compared to just 48% of devices connected today. The capabilities of IoT devices to provide improved, continuous data streams from patients will help proactively identify issues and reduce readmission rates. Digitizing the patient room will offer an immersive experience for patients where they can access their favorite streaming services at their bedside and have full access to their Electronic Health Records (EHR), associated research, risks and benefits of procedures, and more. Artificial Intelligence (AI) and Machine Learning (ML) will continually monitor and analyze large data sets, giving healthcare practitioners on-demand access to critical, evidence-based insights on their patients.

Connected devices – sensors, wearable devices, lights, thermostats, digital displays, and much more – are how users will interact with the Internet of Things in your healthcare facility. However, it is the enabling infrastructure that facilitates this interaction. Enabling infrastructure is the physical systems that your facility will install that allow devices to be connected, data to be analyzed, and information to be secured.

Structured Cabling, inclusive of backbone and horizontal cabling, is the first enabling infrastructure that will require thoughtful planning and investment to support the IoT. The Internet of Things leverages Internet Protocol (IP) as its principal method of communication, which places demands on the capacity and resiliency of your facility's structured cabling system. The massive amount of data generated by connected devices and the need for instant analysis of that information will require a structured cabling system that is robust, redundant, and scalable to meet the needs of IoT devices. While many healthcare facilities have placed greater emphasis on wireless connectivity in recent years, the quantity of data that IoT transmits, and the required uptime of that data create a greater need for hard-wired structured cabling.

Facility Staff Impacts:
Standardized control systems

System Integration (HVAC Controls, Lighting Controls, Access Control/Security, Mass Notification, Fire Alarm, etc.)

Predictive Maintenance
Predicitive celaning

Clinical Staff Impacts:
Optimized room scheduling

Patients more self sufficient

Heightened focus on patient care

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In addition to the demands IoT-generated data places on your facility's network, the expanding capabilities of Power over Ethernet (PoE) will necessitate investment in hard-wired structured cabling infrastructure. PoE technologies are deployed in healthcare facilities today through VoIP phones, IP cameras, and wireless access points. However, the IEEE's upcoming ratification of Type 4 PoE will allow for up to 100 watts of power to be delivered from a single network port. With Type 4 PoE, IoT devices will benefit from secure, high-speed data transmission over a hard-wired connection as well as cost-effective power DC distribution from a network switch. In a healthcare setting where large data sets will be transmitted across the network, we can expect to see a higher usage rate of hard-wired connections that leverage PoE technology.

As the volume of data created in a healthcare facility increases, so too does the inefficiency of streaming all this information across the network to a cloud or centralized data center for processing. Edge Computing is a strategy that decentralizes computing, moving information processing from IoT devices and other systems closer to where the data is created. Doing computing closer to the edge allows data to be analyzed in near-real time, improving the experience of patients, clinicians, and staff who are interacting with the data. As an example, an ICU that uses smart IOT sensors to monitor patients actively will be generating real-time data that needs to be processed, analyzed for patterns and suggested impact and returned to clinicians on the floor so they can respond to changes in a condition immediately. Edge computing would support this environment by keeping the computing and data analysis functions close to the ICU, avoiding the latency issues that would impact the system if the data had to pass across the internet to a large cloud data center.

Edge data centers will not look like the massive cloud facilities seen today or even be as large as the existing data center in your facility. They will be smaller, purpose-built spaces located throughout your facility that house a specific amount of computing, storage, and networking. However, due to the criticality of the Edge systems, healthcare facilities will need to understand how to properly size and deliver reliable, redundant infrastructure to these systems.

The adoption rate of network-connected devices in healthcare facilities is rising rapidly. Healthcare leaders should be working now to develop structured cabling and edge computing strategies for their facilities, as having to react and attempt to catch up to an IoT deployment will be costly and ineffective.

By Todd Boucher, RCDD, DCEP. Principal & Founder @ Leading Edge Design Group

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Impacts to Projects

Project Design

As discussed in the impacts to facility section, the more connected devices a building has the more robust the buildings tel / data infrastructure must be to carry the additional data. As such, the design of the tel / data infrastructure becomes critical to the design and should be discussed early and often throughout the project design. The early discussions for the IoT systems need to include all project stakeholders, which includes the owner representatives, engineers, architects, contractors, system integrators, etc. It is especially important to get the owners IT department involved so they understand the impacts to the system. All too often the owner's IT department is left out of the conversation until late in the design process, especially during renovations when the impact to existing infrastructure is expected to be "small."

During the early project concept discussions, choosing the technologies to be integrated is an important step in the design process. All stakeholders must be involved during this process to identify goals for integration, the impacts to patient care, and develop the business case for the systems to be integrated. Understanding the full impact on initial cost, operating cost, and the potential return on investment is critical for the owner to decide on the technologies to move forward on.

"During the early project concept discussions, choosing the technologies to be integrated is an important step in the design process."

As part of this design process, the first step should be a brainstorming session to develop an options matrix of all the technologies to be considered. Once the options have been developed the team will evaluate all options based upon pro's / con's, cost information (initial vs. operating), and future maintenance needs. The technologies should then be chosen based upon the advantages that they would provide the owner. Additionally, a healthcare facilities Patient Advisory Council (or other similar board) usually weights in on what is most desirable or useful for the patient population. With the feedback from all groups, including the ability to get budgeting pricing information from the construction team, the healthcare facility will be able to develop budget cost information. This will also help in developing future capital project budgets to plan for the expansion of the IT or electrical systems to account for future projects.

Another challenge is anticipating the near and long term technology developments. The natural life-cycle of a construction project, even in today's fast-paced market, means that the finished space is often put into use multiple years after its design began. The speed of change in technology and development of IoT make it crucial to have a forward-thinking design approach that maximizes the flexibility of systems as well as the physical infrastructure installed. The more

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adaptable the infrastructure is, the more likely it will be able to accept the technologies that don't exist today. Engaging vendors during the design process can help to help ensure the technologies used will be able to adapt or grow along with the facility. There is often a fear that getting a vendor involved during design will lead to noncompetitive bidding and the owner paying more. To combat this, it is recommended that multiple vendors be considered during the initial design / brainstorming process so that the owner can negotiate and work with the vendors to get technologies that will ultimately meet both their programmatic and budget goals.

Project Construction

In addition to the design being flexible and infrastructure being adaptable, the construction process must be structured to allow changes along the project's construction timeline. As new systems are invented and identified, the project team will need to implement smart design updates without negatively impacting the construction progress. As with many challenges, good communication is key to success; and the importance to talk about the strategy to implement changes and updates before they present themselves.

IoT Project Strategy

- Early brainstorming sessions to define goals and desired technologies for the project
- Involve all stakeholders (Owner, Engineer, Architect, Contractor, etc.) in early decision making process
- Choose Technologies based upon owner advantages and patient preference
- Involve system integrators early on in discussions with the Owner
- Frequent discussions on tel / data infrastructure throughout the design process
- Designs systems to be expandable for future opportunities (Future Proofing)

Figure 2: IoT Project Strategy

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MANAGEMENT OF SYSTEM INTEGRATION

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4 Management of System Integration

When a project includes IoT system or building integration, there are two major questions that need to be addressed:

- Who performs the initial integration?
- Who maintains the building integration system(s) (upgrading, troubleshooting, etc.)? Will this be internal within the hospital or will an outside source be contracted?

These questions often lead to a fear that the Owner will be "locked in" to a particular vendor, and they won't be able to competitively bid for (initial or future) service contracts. Although it is not currently common to have open platform software that would integrate the IoT devices, it has started to become available on a limited basis. As the open platform software becomes more available, the use of integrated systems will potentially increase more rapidly as this is an option that is desired by Owners.

Commissioning is another key success factor when these systems are incorporated into a facility. If the systems aren't properly configured such that the required information is being provided to the building Owner, the additional data points of information become a hindrance to the operation of the building. Therefore, in order to ensure the Owner is getting what they expected, properly commissioned systems are necessary and should be scheduled periodically to maintain the system. Each system will have its own maintenance, testing, and retro commissioning schedule, but these should be evaluated during design to understand what is needed to get the most out of the systems.

"The use of integrated systems will potentially increase more rapidly as this is an option that is desired by owners."

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CASE STUDY

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5 Case Studies

Fully Integrated Patient Room

Background

The patient and family spend the most time in their patient room and design teams are constantly striving to make it the most comfortable and effective healing environment possible. IoT provides many opportunities to make the patient room environment and experience better by giving the patient control as well as many of the comforts of home. Although it is often difficult to include individual patient controls to semi-private rooms, a private room can provide the patient with full control of their environment from a single access point.

This graphic example shows both current and potential integration possibilities to enhance patient care, and the patient experience. The room includes many of the technologies that we discuss throughout the body of the guide but is centered around the patient experience. Some of the features highlighted in the graphic include the following:

- Single Patient Control Interface
- Environmental Controls (Lighting and temperature)
- Access to patient EHR and specific care plans developed by their "care team"
- Smart TV's providing services similar to hotel rooms
- Medical equipment integrated with other systems (CCTV, nurse call, TV, etc.) to give the healthcare staff better information to treat patients and provide the patient better access to healthcare staff

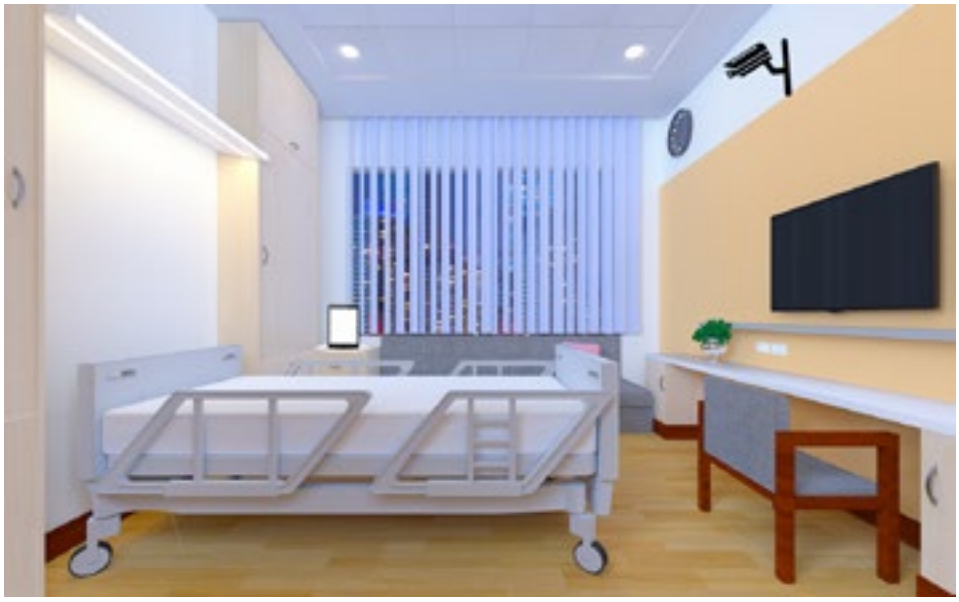

Figure 3: Fully Integrated Patient Room. See appendix for enlarged photo with detailed descriptions.

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Reliant Medical Group

Background

During their organization-wide redevelopment, Reliant Medical Group, a multispecialty group practice, saw an opportunity to improve the patient and clinical staff experience while improving billing by developing an electronic room status communication system known as eFLAGs. This patent-pending, UL-listed, FCC-approved eFLAGs system is not just an electronic version of the color-coded, swinging plastic flags at exam rooms. It seamlessly interfaces with their EHR in order to take advantage of EHR data, workflow integration, communication tools, billing, and analytics/reporting.

Technologies Implemented

Each exam room is equipped with a "tag-you're-it" button just outside the room that physicians and staff press when they enter or leave the exam room. This button cycles the room through several statuses that are displayed by a multicolor LED "light wand" over the doorway. The light blinks when someone is required to come to the room, and blinks faster if the patient has been waiting too long. A second "light wand" displays a color representing which provider's patient is in that exam room as a result of opening the patient's electronic record on that exam room's computer. The eFLAGs system determines when the room is empty and ready for cleaning using an occupancy sensor and a door sensor.

Each room also has a "Code Blue" button which is pressed to announce the room's location throughout the facility when there is a medical emergency. It also causes the "light wands" outside the rooms in that same hallway to flash sequentially, leading the responding "code team" to the room. This is important in large facilities because "code teams" are more familiar with a department's location than a specific room within the department.

The team room area, where physicians and staff have their workstations, is equipped with a 48" monitor that displays the floorplan with all of the room statuses. Not only does it show how long patients have been waiting, but because of the EHR integration it is able to alert when a physician has been with a patient longer than the scheduled appointment time. At a glance, staff know which rooms are available, which rooms need cleaning, where each physician is, and whether the physician might need assistance with a patient that is about to put them behind schedule.

Lastly, cameras at the check-in station take temporary photos of each patient. The medical assistant uses the photo to visually identify a patient in the waiting room and approach them, eliminating the need to call out the patients. The photos help to maintain patient privacy and are automatically deleted each evening.

Integration with the Electronic Health Record

Both the eFLAGs system and the check-in cameras are interfaced to the EHR, allowing the physicians and clinical staff to use the same tool for all patient care. For instance, the medical assistant uses the EHR to see when a new patient has arrived. In that same EHR view, they can see the photo that was discretely taken by the check-in camera. Similarly, the nurses and medical assistants that carry smartphones to receive communications from the EHR, are also alerted by the same app when the physician presses the "tag-you're-it" button, so they instantly know that the room is ready for them. Furthermore, the integration with the EHR automatically displays orders that the physician just placed, so they can address them quickly and efficiently.
Because the EHR integration is bidirectional, the EHR is able to change the room lights, allowing for alerts as a byproduct of normal care. For instance, when the medical assistant puts the patient into the exam room and opens the patient's record, the EHR sets the physician's color on the second "light wand." Similarly, if the physician enters the room but forgets to press the button, the EHR recognizes the physician logging into the exam room computer and changes the first "light wand" to the correct color. In fact, any room status or alert can be set by typing commands into

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the EHR, meaning that the system can accommodate physicians and staff with disabilities who otherwise would not have been able to reach the old colored plastic flags.

Results

Physicians and staff love the system because it fits so well with their workflows and communicates what to do next exactly when they need to know it. Patients are delighted by the fact that they get personal attention in the waiting room and follow up by the medical assistant when they have been waiting in the exam room too long. Indeed, one of Reliant's senior physicians admitted that he was resistant to trying the eFLAGs system because he was comfortable with the plastic flags, but now after using it for a few months, he can't imagine seeing patients without it!

Managers have also been able to use the timestamp data collected from the eFLAGs system in order to determine how much time staff are spending with patients, or how long physicians spend with patients for different visit types. It also allows for the system to automatically display accurate wait times to check-in staff, as well as graphically display wait times to patients in the waiting room.

Lessons Learned

Integrating systems makes it possible to leverage existing data and tools to make the experience of patients, physicians, and staff more natural and efficient. They can all do their daily work out of one system, seeing data incorporated from other systems, with additional actions being accomplished as a byproduct of work that was already being done.

Case study written by Dr. Garber from Reliant Medical Group and Jason Butler from Fitzemeyer & Tocci.

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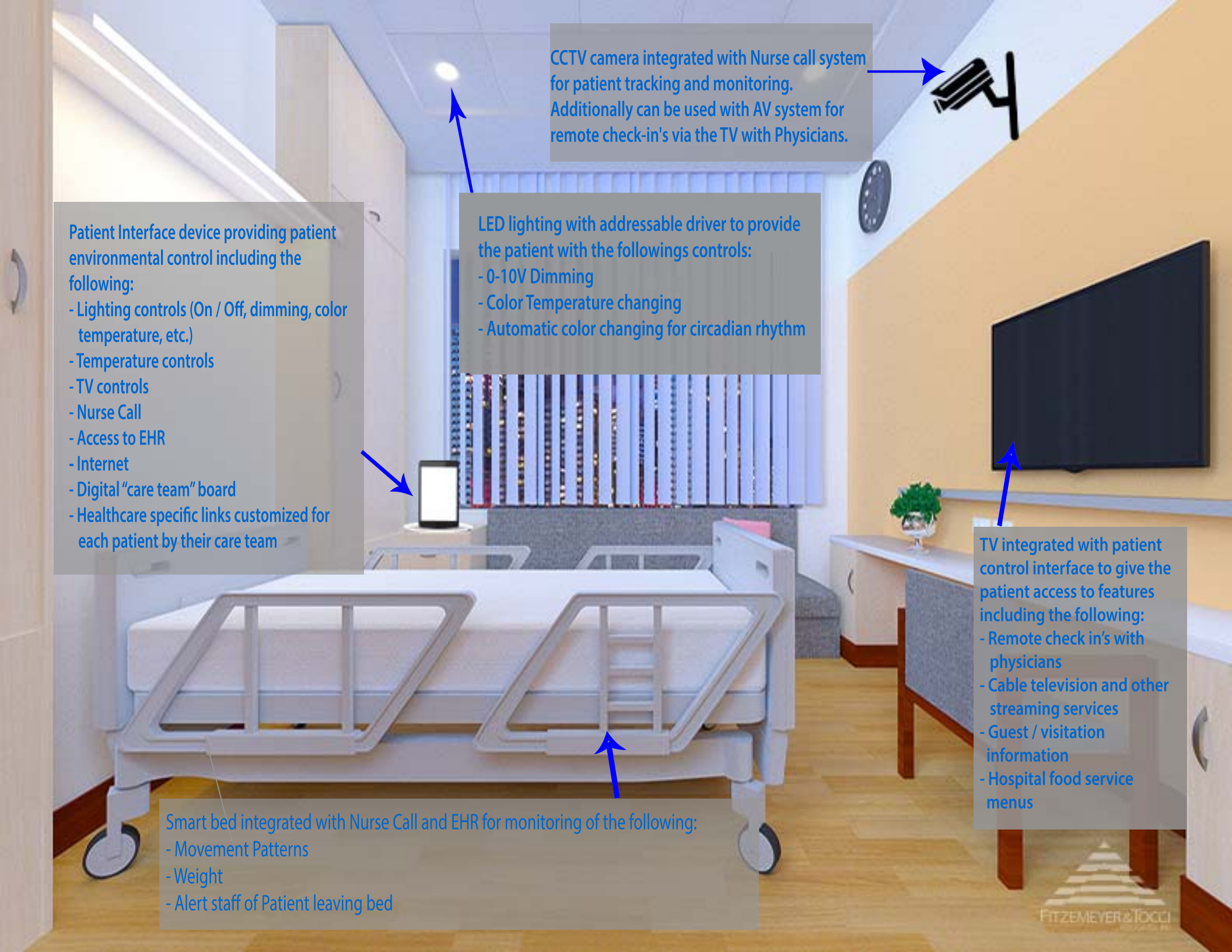
APPENDIX

300 UNICORN PARK DRIVE, 5TH FLOOR, WOBURN, MA 01801 (P) 781.481.0210 (F) 781.481.0203 (W) www.f-t.com


CCTV camera integrated with Nurse call system for patient tracking and monitoring. Additionally can be used with AV system for remote check-in's via the TV with Physicians.
LED lighting with addressable driver to provide the patient with the followings controls:
- 0-10V Dimming
- Color Temperature changing
- Automatic color changing for circadian rhythm
Patient Interface device providing patient environmental control including the following:
- Lighting controls (On / Off, dimming, color temperature, etc.)
- Temperature controls
- TV controls
- Nurse Call
- Access to EHR
- Internet
- Digital "care team" board
- Healthcare specific links customized for each patient by their care team
TV integrated with patient control interface to give the patient access to features including the following:
- Remote check in's with physicians
- Cable television and other streaming services
- Guest / visitation information
- Hospital food service menus
Smart bed integrated with Nurse Call and EHR for monitoring of the following:
- Movement Patterns
- Weight
- Alert staff of Patient leaving bed