The unlimited possibilities of smart hospitals.

How new technologies for video, audio and access control are improving hospital management and patient care.

AXIS®

COMMUNICATIONS

The healthcare industry is changing.

What is driving this? Technology.

Moving towards connected devices

When it comes to providing patient care, there's a direct relationship between technology evolution and quality breakthroughs. Technology advancements in IT hardware and hospital equipment have a direct impact on soft technologies, which include service improvements, more efficient processes and a tight bond between patients and their family members.

Consequently, medical institutions that pioneer and adopt new technologies are well-positioned to provide better care and more valuable service to patients and their families. More than that, new technologies may help diminish loss, identify potential risks, and improve operational efficiency.

Top among technology trends in healthcare is "remote patient monitoring" to establish a remote connection between physicians and patients. This includes teleconsultation as well as communication between various healthcare providers. Another strong trend is "clinical intelligence" to make comprehensive and long-term use of clinical data.

As the inventor of network video surveillance technology, Axis presents an updated overview of how network based technologies are driving these trends and making hospital management smarter. The solutions presented here are already adopted by pioneering institutions around the world, who dared to use technology to answer the challenges they faced on a daily basis.

By embracing future technology, these institutions create a positive impact on patient care today.

The image as a source of information

In the healthcare industry, images are used predominantly in two very different ways: either for medical diagnostic purposes, as in computed tomography and ultrasound equipment, or for physical security. Gradually, though, these possibilities are expanding.

Nowadays, images are one of the most comprehensive application tools at the disposal of healthcare establishments. Video surveillance cameras, which used to be only part of the hospital CCTV system, are becoming communication and data capturing devices on the network. This can enhance patient satisfaction, patient care and, above all, enable automatic,

efficient and safe processes. Seeing cameras as sensors opens up new possibilities, and each one of them responds to typical demands inside a hospital, clinic or nursing home.

Hospitals that have already embraced the versatility of network based video surveillance are leading the technology transition by combining cameras with access control and audio systems on their IT networks. In the future, hospitals will have video surveillance cameras that will capture data continuously to assess risks, generate automatic alerts, streamline processes, and analyze large volumes of data, with surgical precision.
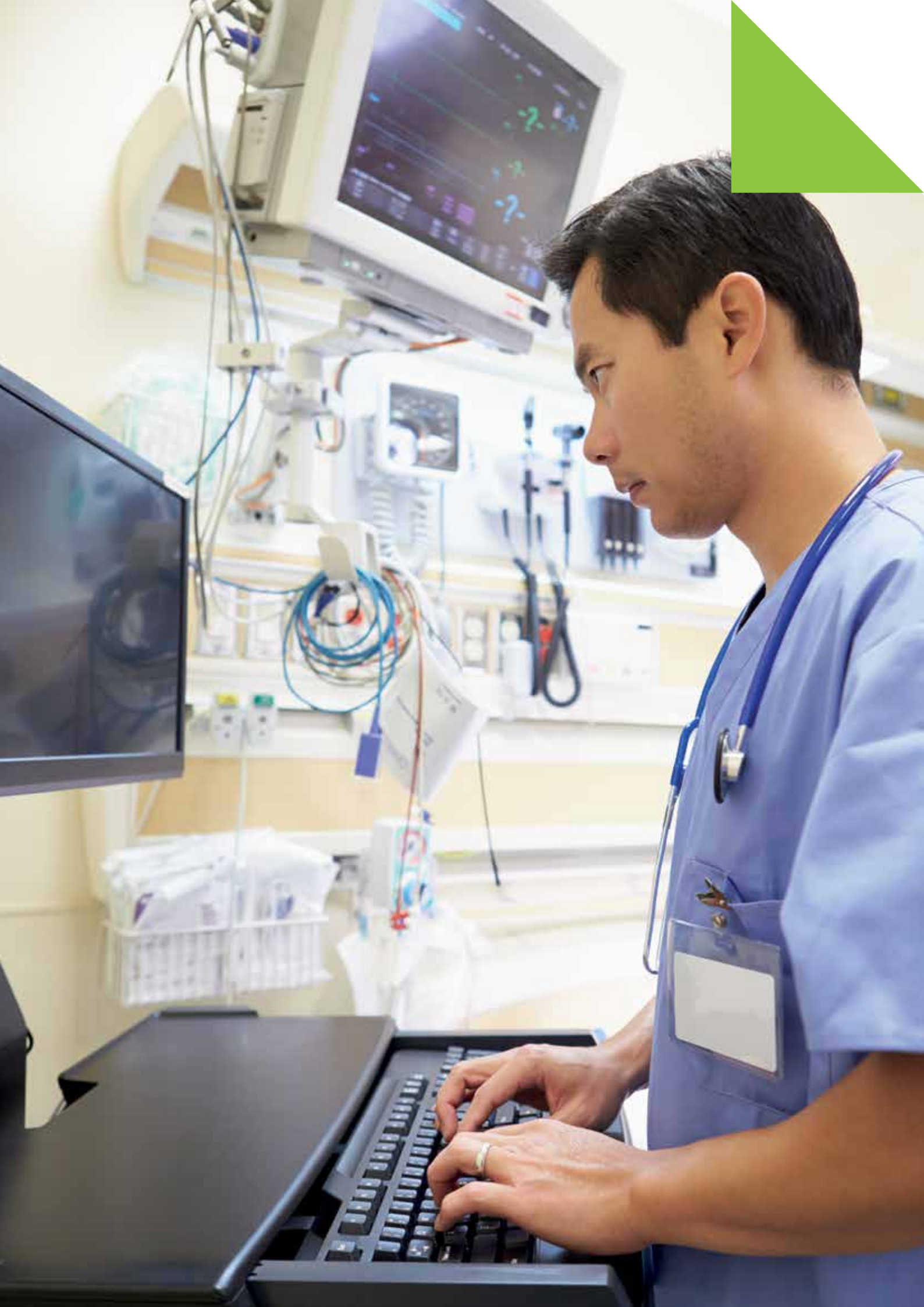
Technologies to improve patient care

In addition to addressing security issues, the hotel industry already uses cameras to improve the quality of customer service. Likewise, healthcare facilities are also gradually adopting this concept.

> How can my hospital monitor a growing number of patients with fewer staff?

Lack of government funding, reduced demand during recessions, and high administrative fees are creating economic pressure on hospitals to reduce staff - in some cases to the point where it compromises the quality of patient care.

And diminished patient care can lead to further hospital losses resulting from negligence lawsuits, loss of accreditation, and damage to the institution's public image. To address these challenges, hospitals rely increasingly on remote patient monitoring from "central monitoring stations" to ensure quality patient care and more efficient resource allocation.

From a management point of view, it makes perfect sense. That's because, for example, beds in Intensive Care Units (ICUs), need to stay within the visual field of nursing staff. In fact, the very concept of an ICU implies that the beds are visually monitored. But the physical layout of the building does not always allow for this. In some cases, the ICU has expanded and evolved so that some beds end up being placed away from the nurse's station.

> Can cameras also optimize clinical laboratory processes?

In some cases, cameras are used to optimize patient care processes. In the field of diagnostic medicine, for example, certain clinical procedures are performed under anesthesia - a multi-step process during which patients must be monitored from the onset of sedation, through the procedure itself, and afterwards during recovery. This process is like a production line - while one patient recovers, another is undergoing their procedure, and a third is being prepped. If the clinic does not have sufficient staff to physically monitor all these processes, patient monitoring can be compromised. However, by simply placing a camera in the recovery room, medical personnel can simultaneously prep new patients and remotely monitor recovering patients from another room.

> Are there any official recommendations for patient monitoring with cameras?

Yes. In several countries there are regulations which mandate the oversight of certain types of patients, such as senior citizens, either continuously or routinely throughout the day.

Some organizations dedicated to hospital accreditation, such as the Joint Commission International, advocate for video surveillance of all patient beds located outside the medical staff's field of view.[1]

The U.S. Food and Drug Administration, in its guidelines for use of beds in hospitals (A Guide for Modifying Bed Systems and Using Accessories to Reduce the Risk of Entrapment), notes that high risk units are defined by a combination of factors, including patient monitoring. Among those risks, the agency includes the limited use of technology such as cameras. By way of corrective action, the U.S. Food and Drug Administration suggests to "use monitoring systems such as video cameras, patient positioning monitors or bed exit alarms, and bed position devices. Increase monitoring of highrisk patients by assigning them to 'enhanced safety observation rooms,' if available, or to rooms close to the nursing station".[2]

Outside of hospitals, the use of cameras for patient monitoring is associated with a high standard of care in residential and nursing homes. That's what FssilverCare believes. This nursing home in South Korea uses the cameras to offer high quality nursing services and, at the same time, monitor residents who need continuous care (Photo 3 on the next page).

1 With upwards of 40,000 – 50,000 people on site every day, Massachusetts General Hospital relies on an extensive video surveillance system to help ensure patient safety.

2 The Lightfinder technology generates high quality color images even in low lighting. Thus, most of the lights can be dimmed for mothers and newborns to ensure quality sleep.

3 In nursing homes like this one in South Korea, the steady stream of visitors increases the need to monitor access in real time. Additionally, residents with paralysis and other neurological conditions require continuous monitoring since symptoms can manifest at any time.

Patients are extremely vulnerable to falls when they are recovering from sedation.

> What is the real impact of accidents involving patient falls?

Fall injuries are among the 20 most expensive medical conditions, according to CDC (Centers for Disease Control and Prevention), an agency of the Department of Health and Human Services of the United States. The average hospital cost for a fall injury is over $30,000, including fees for hospital and nursing home care, doctors and other professional services, rehabilitation, community-based services, use of medical equipment, prescription drugs, and insurance processing.[3]

"Risk for falls" is a common nursing diagnosis, related to a number of factors such as age, use of anesthetics and level of consciousness. In fact, patients are extremely vulnerable to falls when they are recovering from sedation as they instinctively try to remove intravenous devices and get out of bed.

Even caregivers themselves are at risk for falling and their temporary work leave can make daily routines even more challenging for their colleagues. Data from the U.S. Bureau of Labor Statistics show that the rate of falls involving healthcare and social assistance professionals is increasing since 2012, reaching a rate of more than 120 cases per 10,000 full-time workers, the highest among private industry sectors.[4]

There are a number of measures hospitals and nursing homes can adopt to minimize the risk of falling. Nevertheless, when accidents do happen, quick response is critical, especially for patients taking medications that interfere with their motor skills and attention.

The first few minutes are critical: falling can break bones, fracture a wrist, arm or pelvis, as well as cause head injuries. In fact, falls are the most common cause of traumatic brain injuries. And one in five falls causes some kind of serious damage.[3]

In addition, falls that occur on hospital premises can result in hospital lawsuits from both patients and healthcare professionals. The claims are based on the understanding that as a service provider, hospitals are expected to provide security to those under their custody. If it can be established that a lack of security has resulted in injury, it could lead to a conviction in court. And in addition to costly litigation, health institutions may also suffer from damaged reputations. A scratch on the patient may become a scratch on the hospital's public image.

> Falls that occur on hospital premises can motivate lawsuits for violating patient expectations for safety while under hospital care (strict liability).

> How can I optimize response time after someone falls, and minimize the consequences?

Early fall detection is key to ensuring the best patient outcome. Axis cameras with embedded video analytics from our global partners provide early detection which greatly reduces response time. The video analytic SlipFall from TechnoAware, an Axis partner, was created specifically to detect and signal when a person falls and remains on the floor for a pre-defined period of time.

This is especially useful when the person falls in a secluded room.

The alert message can be sent automatically to a control room, the central monitoring station, or to the care teams mobile phone, together with the video showing the situation in real time.

For cameras facing the bed, Axis offers a video analytic called Cross-Line Detection that generates automatic alerts as soon as someone crosses a digital line (for example, the boundaries of a bed). Therefore, if someone is leaning out of the bed, the embedded camera intelligence will detect it and send an alert with the corresponding video image to the nurses' station.

> How do I avoid unnecessary evacuations from false fire alarms?

It is not uncommon for a fire alarm to go off by mistake, forcing everyone to leave immediately. This can be especially problematic for patients, who typically have limited mobility or may be connected to monitors or IVs. The presence of cameras in the area of a suspected fire can determine whether there is an actual fire or if it is a false alarm.

Nevertheless, it is possible that, due to emergency procedures or technologies adopted by the hospital, the false alarm continues to ring creating disruption or even panic as people try to evacuate. The sound of fire alarms can easily exceed 90 dB (A), the equivalent to the sound of a motorcycle or truck at the point at which it passes someone on a busy street.[5]

That's when an effective audio system is needed to establish a direct communication between facilities managers and the building occupants. In case a false alarm continues to ring, the operator can use the microphone in the control room to reassure people and instruct them to ignore it.

> What is the importance of background music?

Beyond its purpose to communicate important messages, the hospital's audio system can be used for background music (by connecting it to a playlist from audio streaming services, for example). Not only does this comply with the global trend to create a more humanitarian and relaxing environment, it also addresses concerns over speech privacy.

Playing background sound or music is also a strategy that hospitals use to "mask" or "cover up" undesirable sounds. It is an effective strategy to ensure patient confidentiality by minimizing the risk of eavesdropping on a private conversation between a patient and his doctor or between two doctors in a corridor, for instance.

Axis IP cabinet or ceiling speakers connected to the network can be used both for internal or semi-outdoor areas. And each unit can be controlled individually or collectively to address different areas of the hospital.

Technologies to improve hospital management

When it comes to new technologies, there is no standardization between hospitals with regards to project ownership. A project conducted by hospital operations at one hospital could be headed by the security department in another, or the IT manager at a third. Even within the same hospital, a project can change hands several times.

This characteristic reinforces the understanding that technologies can have a much broader usability beyond that for which they were originally intended. Such is the case with the use of video surveillance, access control and audio systems to improve hospital management.

> For security reasons, some hospital areas are designed for one-way circulation. How can I be sure that there is no "wrong way" movement?

As data-capturing sensors, smart cameras can detect if one or more persons ignore the warning signs and make an unauthorized re-entry. They do this by using a video analytic called "Wrong Way". When wrong way movement is detected, the camera generates an instant alert to operators in the control room. Operators can then ask a security officer to intervene in the interest of public safety. In this case, the technology not only works automatically, but above all preventively.

The use of video analytics eliminates the need for continual video monitoring and provides reliable event notification. At the University Medical Center of Utrecht, in the Netherlands, Senior Security Advisor, Gijsbert van Zondagen, realized that, in order to optimize the security process, control room operators needed to watch the screens as little as possible. In his own words, "it might sound contradictory, but we have to observe and only act when anomalies occur".

> How serious a problem is the theft of medical supplies and equipment in hospitals and clinics?

Unfortunately, hospital equipment and supply theft is routine. Although estimates vary, it is generally accepted that losses range between $ 7,000 and $ 8,000 per bed per year.[7]

It is estimated that more than 3,000 items bought regularly by hospitals have domestic utility, including drugs, medical equipment and other supplies. Internal theft by hospital staff is a significant problem. Patients and their families also contribute to hospital shrinkage by packing extra supplies with them when they leave.

> Hospitals have a reliable record of all persons who accessed specific areas, and can easily conduct investigations.

But hospital theft is not limited to hospital goods. Theft of personal items belonging to patients, their families and hospital staff is also a risk. And some people enter the hospital with the sole intent to steal.

Patty Jean, Head, Clinical Nurse at the Clay Platte Family Medicine Clinic, in the United States, says "it's not uncommon in medicine for people to try to sneak in the backdoors to get what they need". Clay Platte replaced their old system (which relied on manual lock and key security) for a Physical Access Control solution using AXIS A1001 Network Door Controllers. The devices, connected to the network, ensure security at night, when the clinic is closed, and guarantees access only to authorized people. Physician-owner Dr. Nathan Granger says, "since we have installed the system, I haven't had to worry about people walking in uninvited".

> How do I reduce instrument and medical supply theft?

Installing high resolution cameras with a wide viewing angle in critical locations, is one of the most effective measures. Some cameras even have the ability to generate an automatic alarm if someone covers the lens.

But more can still be done. By installing an access control system, such as AXIS A8105-E Network Video Door Station, with integrated video surveillance, hospitals have a reliable record of all persons who entered or exited a specific area, and can easily conduct investigations. One simply needs to enter the name of the employee or patient in the system, and watch the video recordings of all movement involving that individual.

Many cameras also feature motion detection. They recognize when there is movement in the scene - for example, when someone enters an empty operating room – and start recording right away. This avoids overburdening the network with the data traffic of images that do not have relevant information – such as an empty rehabilitation room - thus reducing the need for data storage. More than that, the motion detection analytic makes it possible to quickly search camera video feeds and get a summary of the event that happened, eliminating the moments when the room was empty.

The same solution of access control and event triggered video recording can also be used in restricted areas such as hospital pharmacies, where visits may be infrequent and there are high value goods to protect. In such installations, the pharmacy door opens only if the person has permission to be there. Detecting motion, the lights then turn on and the camera begins recording.

> Can a security camera protect hospitals against narcotic theft allegations?

Yes. In the United States, CoxHealth hospital in Missouri uses cameras to monitor hallways, sensitive document storage areas and medication dispensaries. Since narcotics theft is a significant risk in hospitals, they've put cameras at a number of key distribution points where there is a lot of foot traffic, like medication cabinets, medical disposal areas and the pharmacy. The video clarity is so detailed that security can even compare the dosage being entered on a computer to the actual amount being dispensed. And with efficient compression technology, the hospital affordably archives three to four weeks of video typically needed for internal narcotics investigations.

> Can cameras installed in critical care and emergency departments help to enforce visiting hour policies?

Most hospitals have visitation policies governing the hours, and even the length of time, a critical patient may have visitors. However, it is not uncommon for family members to violate these limits, extending their visits, and overloading the staff. The presence of cameras in these environments often deter people from over-staying their visit.

> Can I quickly search video recordings to assess the quality of a patient's hospital care?

Yes. By integrating video surveillance with access control or other network based patient tracking systems, video can be tagged with a patient id and time marker for easy retrieval. If needed, it is then possible to quickly search through video footage to assess the quality of patient care or discover any irregularities.

> Can I use cameras to generate extra services for the laboratory or the hospital?

Yes. Digital signage technology created for retail can also be used in hospitals. Through the use of gender and age video analytics, smart cameras can identify physical characteristics of the people in front of them. It is then possible to generate digital signage content tailored to the demographic of your waiting room.

For example, if your camera analytics detect more children than elderly in the waiting room, your digital signage may promote children's vaccinations, children's examinations or other complementary pediatric services. This type of targeted advertising can increase hospital revenue.

> **Is it possible to use cameras to enhance process safety in environments such as the Central Sterile Services Department (CSSD)?**

Yes, and this is extremely beneficial. The Central Sterile Services Department (CSSD) is a critical environment because it receives dirty products with a high risk of contamination that require professional attention. It is also not unusual for accidents to occur involving needles or surgical blades that have been improperly mixed in with surgical instruments for sterilization. Therefore, CSSDs require continual review and oversight of its procedures to monitor, for example, how material is cleaned, to improve processes, and to protect staff. The CSSD environment itself however presents a number of video surveillance challenges. Sterilization equipment must heat to 60°C, generating steam that can corrode video equipment, especially those installed on the ceiling. And corrosive agents used in CSSDs, such as peracetic acid, enzymatic detergents and glutaraldehyde, can damage ordinary video surveillance equipment.

For these environments, Axis has created highly durable stainless steel cameras such as AXIS Q8414-LVS, and AXIS Q60-S, which are also nitrogen pressurized to prevent internal condensation. Using reliable visual validation in these environments can help detect faulty processes, improve staff and patient safety, and protect CSSD personnel from unnecessary exposure to intense heat and dangerous chemicals.

> **I do not have my own laundry. How can I supervise the transport of linens to and from the hospital?**

Some hospitals have their own laundry. Others choose to outsource the collection and administration of hospital linen, which is laundered off-site and returned. While on hospital premises, it is the hospital's responsibility to ensure that linens are segregated in different bags and transported in trolleys.

More than

3,000 items

purchased regularly by hospitals have domestic utility.

By installing high-resolution cameras in the delivery area, the hospital or clinic can have greater control over the process, and monitor hygiene protocol compliance. But the combination of artificial interior lighting with natural outdoor lighting in the truck loading area is challenging for ordinary cameras. However, Wide Dynamic Range, or WDR, is a product feature to ensure good image quality in variable lighting conditions.

WDR technology instantly compensates for lighting differences, so that the bright areas are not overexposed, and the details in darker areas are made visible. Indeed, WDR automatically balances this lighting difference to provide full scene detail, in both bright and dark areas.

4 Aware of the risk of narcotic theft, this American hospital has put cameras in a number of key distribution points where there is a lot of foot traffic, like medicine cabinets, medical disposal areas and the pharmacy. The clarity of the video allows them to compare the dosage being entered on a computer to the actual amount being dispensed.

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The LEAN concept calls for the optimization of processes to reduce risks, and is gaining adopters in the healthcare industry.

> How can I improve communications between surgical teams in the operating room and staff outside?

During surgery, interruptions and unnecessary entry in the operating room can increase surgical risks. So a two-way intercom is an efficient and sterile communication system between surgical teams inside the operating room and staff outside.

Intercoms traditionally rely on analog technology, but there are already IP intercoms, such as AXIS A8105-E. It's Powered over Ethernet (PoE), which eliminates the need for additional cabling. The surgeon can also use a pedal to make a call without using his hands.

> How can I supervise patient care inside an ambulance or a mobile clinic?

There are several reasons why a hospital would want to know what goes on inside an ambulance or a mobile clinic:

- Supervise the driver's operation and proper use of the vehicle.

- Record patient care during transport, and assess professional conduct and performance.

- Video evidence in the event of a malpractice lawsuit.

- Minimize unnecessary extra personnel in the vehicle.

- Remote monitoring and diagnosis of critical patients in transit, live, 24 hours a day, from anywhere in the world.

- Video recordings for continuing education of paramedics and other healthcare professionals.

Installed inside the ambulance, video surveillance cameras can record all medical procedure and techniques that occur during transport, in full HD quality and with audio capture, to ensure protocols were followed.

Some miniature cameras are especially suitable for discreet use in ambulances. Resistant to vibrations and shocks, Axis F series can be installed inside or outside of the vehicle, with a wide viewing angle. Images can be seen live from the hospital or anywhere in the world, and displayed for training purposes. Hospitals and clinics that rent ambulances and mobile clinics may encourage their service provider to adopt this type of video surveillance system.

The sudden entrance of light when the ambulance doors are opened can temporarily "blind" ordinary cameras. To deal with these common variations of light during patient transport, the F series offers a technology that makes an immediate light compensation (WDR with Forensic Capture), providing clear images the entire time.

And instead of installing separate video storage in the ambulance, which takes up space and is costly, images can be stored on an SD memory card inside the camera itself, which adds convenience and reduces cost.

Technologies for clinical and surgical monitoring

Just like other instruments at the disposal of the multidisciplinary team, cameras can be a tool to support clinical observation.

> **Is it possible to use a security camera for medical diagnostic purposes?**

Yes. In fact, it does not make much sense to call it a "security camera" when this product is useful for other purposes. Today, video surveillance cameras can also be used to monitor and assess patients. Some pioneering institutions are already doing just that.

One of them is UZ Leuven, one of the largest hospitals in Belgium (Photo 5). They have 1,995 beds and a staff of more than 8,800 professionals. Their Sleep Lab scientifically analyzes sleep patterns and behavior – and video plays an important role in supporting their analysis.

Two cameras (one of them with a microphone) are integrated with the polysomnographs in all ten rooms. During the night, from another room, the medical and nursing staff see in detail the images of patients sleeping in the dark, and hear the noises they produce. The twenty cameras offer visual support with a synchronization of less than one second between the signals being recorded by the polysomnograph. Healthcare professionals can even zoom in the cameras for greater detail. Pascal Borzée, Senior Nurse at the Center for Sleep and Waking Disorders, says this is very useful to remotely check whether a breathing irregularity has been caused by a poorly positioned mouth mask.

Another example of how cameras can serve as an innovative part of patient treatment comes from a child psychiatry clinic in Finland. At North Karelia Central Hospital (Photo 6), videos are considered an important tool in the treatment of relationship problems between parents and children, especially during the night. Therefore, the images need to be sharp even in the dark. Along with software from Milestone, an Axis partner, and professional microphones from Shure, high-quality Axis cameras produce clear image detail even when zoomed in for a close-up. Hospital personnel can then clearly see both the actions of the parents as well as the child's facial expressions.

> **I have an automated system for clinical monitoring of intensive care patients. Can cameras be integrated with this system?**

Depending on the automation system, yes. For this reason, it is important that the digital surveillance cameras chosen by a hospital or clinic have an open platform for integration. The main standard for interoperability between video surveillance devices is ONVIF. When the automated system sensors detect, for example, that a patient has urinated in bed, this alert can be transmitted to the assistance team together with a corresponding camera image.

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5 The Sleep Lab in this hospital in Belgium scientifically analyzes sleep patterns and behavior. Video plays an important role in supporting their analysis.

6 A reference in child psychiatry, this hospital in Finland uses videos as an important tool in the treatment of relationship problems between parents and children.
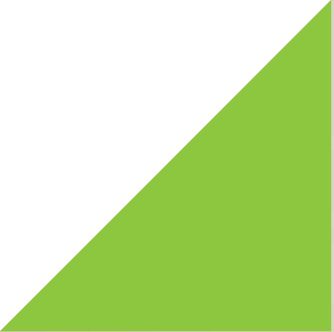
Technologies for pediatric care

> Is there a proven value in virtual contact between mothers and babies?

In some cases, important physical contact between mothers and babies in the early days of life, is not possible due to poor health or risk of infection to the mother, the baby, or both. Worldwide between 8% and 10% of newborns start life in the intensive care unit.[8] But technology can diminish the negative effects of forced separation.

It is known that physical separation between parents and newborns increases the risk of parental depression.

> Virtual contact via electronic devices may decrease the sense of isolation and alienation between parents and babies deprived of physical contact.

There is even a relationship between separation in the first 24 hours of birth and increased parental stress related to the Neonatal Intensive Care Unit.[9]

"Emerging evidence suggests that care practices supporting physical and emotional closeness between the parent-preterm infant decrease the prevalence of maternal depression similar to levels reported in mothers of full-term infants".[10]

Virtual contact via electronic devices may decrease the sense of isolation and alienation between parents and babies deprived of physical contact. Even the mother's voice can help in the physical and emotional development of the child.

In a study[8] conducted to measure the effects of using cameras to virtually connect parents and babies in neonatal ICUs, cameras were placed above the children's beds with individual video access via a password protected web browser. Although "virtual visitation" did not result in a significant reduction in the length of hospital stays, it was well received by families of newborns requiring prolonged hospitalization. In fact, the greatest impact was an increase in parental enthusiasm.

This study was conducted by an Axis customer, The Centre Hospitalier AlèsCevennes (CHAC) in southern France, over a period of more than one year in its neonatal ward. The results showed that mothers who could remotely view their child produced more milk than an isolated mother. Furthermore, the

7 A study by an Axis customer found that mothers who can remotely view their children produce more milk.

milk was tested to be of better quality and richer composition than that of a mother who could not see her child.

> How does the virtual connection between parents and newborns work?

Depending on the care team's protocol, images of the child can be transmitted continuously throughout the day or as scheduled. Parents can access the images via a web browser from their own electronic devices or from mobile devices belonging to the hospital.

There are real examples of both scenarios. Prompted by research that showed how the emotional bond in the relationship between mother and child plays a crucial role in the development and recovery of a newborn, the chief physician at the Olomouc University Hospital's newborn department in Czech Republic, sought new ways to ensure this link between mothers and babies. The solution? Cleverly installing small, low-weight cameras on special lamp catchers just above the top glass of 12 incubators.

The hospital did not need any special IT equipment or servers to operate the cameras. Each incubator had a corresponding single user with secure access to the child's family through an intuitive web interface (or via an app for viewing on tablet or smartphone). The staff authorized when video was accessible by the family, and could even make live video available after regular visiting hours. And, for privacy protection purposes, no images were recorded. The initiative was so successful that the hospital has future plans to provide tablets to hospitalized mothers so they can see their children from their own beds.

This is exactly what VU University Medical Center in Amsterdam, Netherlands did. A full HD camera was installed in the neonatal unit over each child's bed, allowing mothers to follow their babies online, in real-time, via a password protected browser, from within hours of delivery. The impressive high level of detail helps make the separation less difficult for mothers. And the nursing staff also has access to live images.

> Does live video access generate unnecessary calls from worried parents to the neonatal unit?

This was a concern for some VU University Medical Center staff before giving parents remote viewing possibilities. The nursing staff worried that, for example, images of crying babies, would prompt an increased number of calls from worried parents. However, their worries proved unfounded.

If the child had been removed from its bed for medical care or assessment, parents did not see an empty bed. Rather, they saw a message saying, "We are looking after your baby."

After the first few weeks, it became clear there was not a rise in worried parents calling because of the images they saw. In fact, there was an increase in parent satisfaction, who found the images reassuring. The service is highly appreciated, according to Margot van Elburg, Neonatology Team Leader at the VU University Medical Center.

8 This hospital in the Czech Republic installed small, low-weight cameras above the cover glass of 12 incubators.

Solutions to share knowledge

There are many reasons for a healthcare institution to share knowledge. Whatever the need, some of today's most modern technologies can provide a simple and efficient solution.

> Can I use cameras to support training and professional development?

Yes, and in ways that greatly enrich the practical experience. Universities, medical centers and technologically advanced hospitals are using network video to enhance student training and provide continuing education for their staff.

Fanshawe College in London, Ontario uses clinical simulation in order to provide realistic training scenarios for aspiring healthcare professionals. During simulation, students interact with actors or high-tech simulation mannequins portraying patients with clinical issues and independently provide care. The sessions are recorded using high resolution cameras and microphones to capture audio. Afterwards, students and teachers can reflect on and review their performance – ultimately improving their professional competence.

Carol Butler, Fanshawe's simulation lab coordinator, believes that this type of interactive learning allows students to put all the things they've learned together and actually apply it to a patient care scenario.

Video recorded clinical simulations are increasingly common for professional healthcare training, used also by the University of Wisconsin to assess the clinical skills of their undergraduate students. The Department of Communicative Disorders supervises each session either from the nearby observation room or remotely. Video cameras stream and record the sessions so that they can be viewed remotely in real time and archived for later review. Additionally, professors play video clips from various therapy sessions during class. (Photo 9).

> What are the advantages of streaming camera videos to an auditorium screen?

Viewing live camera images can enrich lectures in auditoriums and connect people all over the world. Hospital auditoriums and conference rooms are used to share knowledge between different hospital departments, other hospitals, scientific researchers, and a broader external community.

For leading hospitals, this open exchange of information meets three crucial needs.

- To keep its team updated in order to continuously improve service quality. The continuous development of healthcare professionals depends on experience sharing with colleagues from other institutions and other parts of the world. This type of collaboration is important for raising care standards.

- To improve the hospital's brand reputation, position its relevancy to investors, attract affiliated healthcare professionals, and promote it to other stakeholders such as the press.

- To support the hospital's social media communication.

> How can I broadcast seminars and other events from my auditorium to anywhere in the world?

AXIS V59 Network Camera Series was developed exclusively to meet the requirements for online event broadcasting with high quality audio and video. These are cameras created not for security purposes, but to generate content available on the web or to record sharable files.

For symposium broadcasts to a limited audience, online access can be controlled by password. On the other hand, if the institution wants to open an event to public participation, the video can be seen on the web without restriction.

AXIS V59 can be installed on tables, walls and ceilings, requiring only the use of a network cable. This flexibility allows the camera to be taken anywhere, where it can be controlled from a web platform with the use of desktops, laptops, tablets or smartphones.

> Is it possible to use a security camera for teleconferencing purposes?

Traditional surveillance cameras are not optimal for teleconferencing. Cameras developed exclusively for this type of data capturing and transmission, such as AXIS V59 series, with top quality audio and video, help bring together professional experts in different fields to discuss clinical cases, almost as closely as if they were all in the same room.

In addition, video conferencing systems can help hospitals and clinics reduce unnecessary business trips - saving on travel expenses, increasing staff productivity, and minimizing environmental impact through lower CO_2 emissions.

For symposium broadcasts to a limited audience, online access can be controlled by password.

9 Cameras can record therapy sessions and transmit live images to a supervisor's computer. Recorded videos can be used for comparison or to illustrate a point.

10 Medical students in Canada receive feedback on their performance during recorded simulations.

Technologies to control access

To secure patients, employees and physical assets, hospitals must regulate access of the people circulating on its premises.

Albert Einstein Hospital, in Brazil, was a pioneer in Latin America for integrated technologies to improve access control. It has combined access control, video surveillance, fire prevention and detection, and building automation.

Here, visitors must first register before gaining access to the hospital through a turnstile. When visitors pass through the turnstiles, cameras facing them record images in high resolution (HDTV, Full HD or 4K). After this initial registration at the entrance, all visitor movement through access points, such as doors, turnstiles and gates, is followed by other cameras.

In the event of an incident, the operator needs only to enter the visitor's name in the system to immediately view all images of his entry, details of his face and general appearance, and all associated recorded images - where he went, what he carried with him, who he was with and the time at which each action occurred.

> How can we encourage patients to remain active without jeopardizing their well-being?

Patients are not always confined to beds. In fact, encouraging patients to circulate in gardens and recreational areas can greatly improve their recovery or quality of life.

This is especially important in elderly care facilities, such as the Castel Girou retirement home in France. With more than 80 beds, the institution cares for patients over 60 years old with varying degrees of independence, including patients with Alzheimer's disease. All cameras installed in the building's hallways, park and entrances are equipped with a motion detection functionality for quick intervention in the event of an accident or a wandering patient. Patrice Cazaux, director of the Castel Girou home, says that "the residents have their own rooms and can move around unrestricted in a pleasant living space that includes more than 2 hectares of tree-lined park. The patients are perfectly safe. It is reassuring to the staff and especially to residents and their families"..

> How can access control help with emergency evacuation procedures?

In many cases, it takes time to locate patients when a visitor arrives or when staff needs to administer a treatment or medication. Taking too much time can be embarrassing (at best) or may jeopardize patient health (at worst). And in the event of an emergency evacuation, it is important to locate everyone quickly, especially people with diminished mobility.

The Rehabilitation Institute Hrabyně, in the Czech Republic, has a well integrated solution for patient tracking. They have integrated three systems: video surveillance, hospital information and access control. For every patient and visitor, the hospital information system registers them to a matched card using RFID chip technology. This data is then integrated with the access control system. Patients who have mobility problems are equipped with a special bracelet containing an RFID chip.

Based on these parameters, the system detects which parts of the hospital are accessible and which are restricted to this individual. Doors will either open or close based on these rights. From the control room, operators can see the name of the person who just entered from that area's video feed. All access points have an intercom system and are monitored by camera, so that an operator can visually inspect and communicate with the person before opening the door remotely.

The system also detects when a door has been open for too long. If not closed within a predefined period of time, an alert is sent and the video is displayed automatically in the control room.

> How can I ensure that no unauthorized person enters together with an authorized person?

This is called "tailgating"; someone with permission releases a door and enters with an unauthorized person. In the case of the Rehabilitation Institute Hrabyně, a camera placed above the entrance is triggered to capture images when an unauthorized RFID chip enters a restricted area.

For installations where there is no RFID technology integration or where there is no reliable process to ensure that access cards and bracelets are worn, the same camera placed above a restricted entrance can detect tailgating using a people counting video analytic. In this type of scenario, an automatic alarm is generated indicating the passage of more than one person in a single entry request.
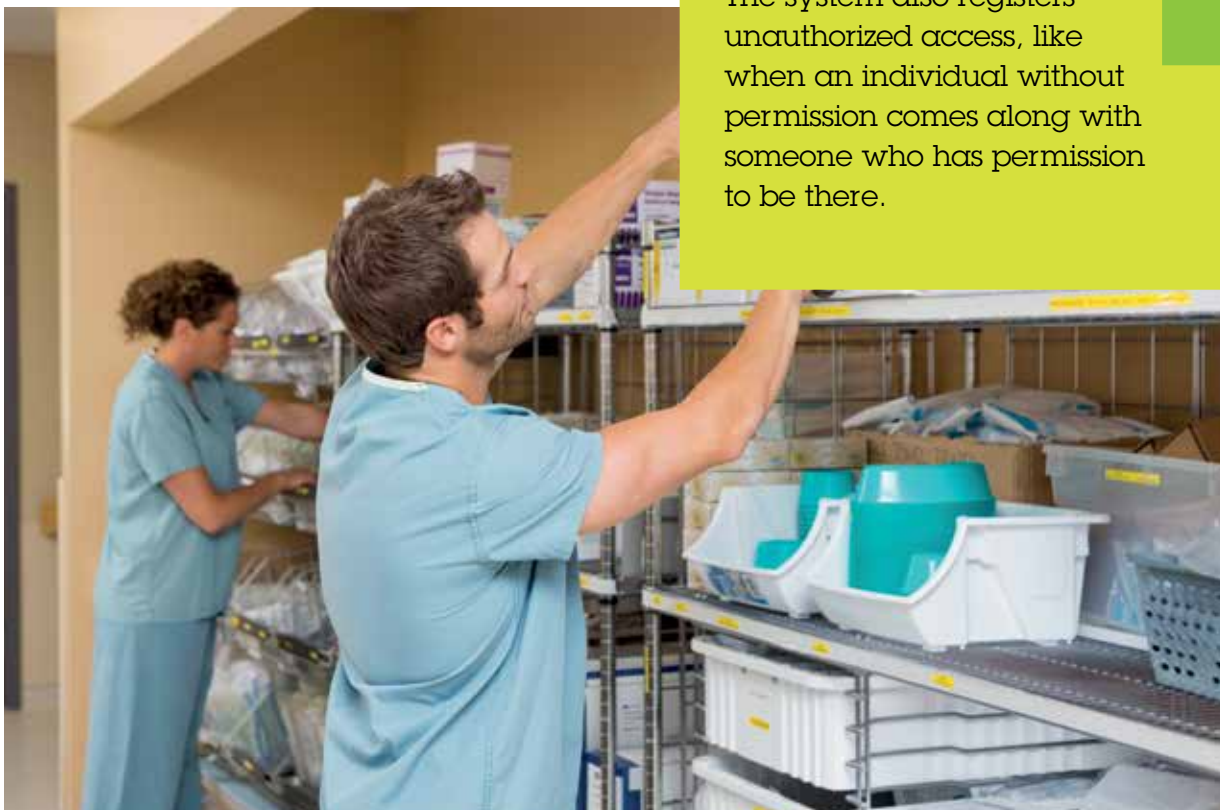
> The system also registers unauthorized access, like when an individual without permission comes along with someone who has permission to be there.

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> ### > Can an intercom replace a receptionist?

Restricted areas with a high flow of people, like an ICU, usually have a receptionist to control the arrival of patients, family and staff members. However, budget cut-backs have forced some hospitals to eliminate this professional, leaving this task to the nursing team. This overloads nurses, who often need to interrupt patient care or paperwork to leave their station and open a door. This can result in seriously ill patients left waiting on either side of the door.

A simple way to solve this would be to connect the patient monitoring center or central monitoring station to a video door station installed at the ICU entrance. The visitor arrives, presses a button, his image is projected to an IP telephone or VoIP communication system, a dialogue is established thanks to the two-way audio capability based on SIP protocol, and a nurse remotely opens the door.

> ### > How can I ensure that nobody misuses a colleague's badge to access privileged lounges or parking areas?

Some hospital professionals have the right to exclusive lounge areas or preferred parking privileges. To prevent the misuse of these privileges, it is possible to install an access control system consisting of an AXIS A8105-E Video Door Station integrated with facial recognition software, so the door is only released if the person with the badge is truly the card holder with access to the exclusive area. The doors themselves can be managed using an AXIS A1001 Network Door Controller.

> ### > How can I, in a non-invasive manner, confirm when my healthcare staff was at work?

In some countries, public hospitals are required to account for on-the-job presence of their health care professionals. However, depending on local legislation, healthcare professionals may not be required to actively record their work presence. And in some hospitals, certain professional categories are explicitly required to register their work shifts while other employees belonging to trade unions may not.

One way to address to this challenge is by using a facial recognition solution. By installing cameras at employee entrances and exits, a recorded image can register employee arrivals and departures with a date and time stamp. Video can then easily be searched by employee name or other relevant data.

11 In this Rehabilitation Institute in Czech Republic, patients and visitors are registered in the information system and receive a card with an RFID chip to track their location.

Technologies for security

A comprehensive risk assessment that takes into account specific needs for hospital operations, is fundamental for a successful security installation.

In addition to a traditional security risk assessment, one must also consider other factors such as product availability or obsolescence, after-sales support from the manufacturer, disruption to hospital operations during the security installation, and the impact of ongoing maintenance. But there are also a number of hospital specific considerations.

> Why is it critical to monitor hospital parking lots and drop-off areas?

Generally speaking, hospital parking lots are monitored to produce concrete evidence in litigation cases. For example, it is not uncommon for car owners to hold the hospital liable for supposed damages to their vehicle while in the hospital parking lot. This motivated CoxHealth Hospital, in the United States, to create a video surveillance project specifically for its 780 space parking facility. The institution installed 40 cameras with forensic quality video to support investigations and lawsuits. "We use the cameras to document typical incidents that occur in a parking garage such as thefts, fender benders and break-ins", says Joe Rushing, director of public safety and security for CoxHealth."We also use the Axis cameras to track suspicious individuals from hospital buildings to their vehicles and vice versa".

A more serious but less common occurrence is the arrival of a critically wounded patient - such as from a gunshot or knife wound - left outside an emergency room entrance by a person or persons who do not want to be questioned by law enforcement. Having forensic quality high definition video recordings can provide vital clues to help police identify and apprehend potential suspects.

> How can I monitor service units, research centers and administrative buildings that are geographically dispersed over a wide area?

"It is a city". This is how senior systems and technology manager, Robert Leahy characterizes Massachusetts General Hospital, in the United States, where on any given day, there may be 40,000 to 50,000 people on site.

To deal with this complex scenario, the hospital switched from analog video surveillance to IP technology. The open nature of the IP solution allows Massachusetts General to take advantage of video analytics, such as the Briefcam video synopsis software, to compress hours of video into just a few minutes. This helps the hospital perform sophisticated analyses and improve security and administrative operations. In short, a very clever solution.

> Ordinary cameras are not suitable for some hospital environments. How can I monitor these areas?

For food service and sterile hospital environments, Axis has PTZ (pan, tilt, zoom) cameras that are nitrogen pressurized and made of stainless steel.

Stainless steel resists the corrosive effects of chemicals and high pressure steam, while nitrogen pressurization technology prevents internal condensation. AXIS Q60-S cameras are an ideal option to remotely monitor operating rooms and laboratories which are thoroughly cleansed and sterilized.

Made with SAE 316L stainless steel – the same steel that makes up surgical instruments - the cameras feature a nylon dome, which is more resistant to most chemicals than other types of plastic. They are able to operate at temperatures ranging from -30°C to 50°C, and are IP66, IP6K9K, NEMA 4X and MIL-STD-810G 509.5 rated.

> How can I upgrade my video surveillance system with minimal disruption to hospital operations?

Modernizing an analog CCTV system does not have to mean scrapping the investment in legacy analog cameras. All analog systems can be digitalized with the simple addition of a video encoder, a small box that converts the analog signal into digital, without significant impact on hospital operations.

That's exactly what happened at Utrecht University Medical Center, one of the largest hospitals in the Netherlands. In addition to migrating their existing analog technology, they also expanded their system with new IP cameras installed on their existing network. Network cameras are simply another network device, and the Ethernet cable itself powers the camera, which greatly simplifies installation.

At Massachusetts General Hospital, in the United States, this simplicity was a clear advantage. Since the system integrator didn't have to install new cabling, it was possible to expand coverage quickly with little disruption to hospital operations and patient care.

Privacy and ethical issues

Viewing recorded images is usually the first step in an investigation. But there is a need to balance the advantages of video recordings and the right to privacy.

> What are the ethical implications of installing cameras to monitor patients?

A study that considered the ethical aspects of adopting video surveillance systems in psychiatric institutions came to the following conclusion:

"However, in the context of treatment of the helpless, surveillance is an integral part of the professional observation of patients. Nursing care is also intended to provide surveillance and maintain security [18,19]. Since only professionals (psychiatrist and/or nursing staff) are allowed to view the filmed data, it becomes an essential part of the treatment and not merely a security check".[11]

The study examines the relationship between aggression in mental health institutes and the effects of video surveillance, suggesting that the presence of cameras helps protect staff from patient aggression, and patients from abusive staff. The study also includes recommendations for the responsible and ethical use of video surveillance in these types of institutions.

For example, Axis cameras are used at Xiamen Xianyue Hospital, the largest mental hospital in Xiamen, China, which has over 2400 patients checking in and out annually. A total of more than 250 network cameras are used for traditional security purposes, as well as to monitor engagement between patients and hospital staff.

> What do accreditation organizations recommend regarding the installation of cameras and patient privacy?

The Joint Commission International, a leading global accreditation body, recommends that hospitals inform directly, or by posted signage, that security cameras are in use, and that the use of these cameras be respectful of the individuals served and take into account the individual's needs for privacy.

The patient's privacy standards recommended by the Joint Commission do not require express consent from patients for the cameras to be used — in other words, there is no need to sign terms authorizing the use of cameras. However, as regulations may vary between country or even state, they recommend consulting with appropriate local authorities.

> How can I configure my surveillance system to preserve patient privacy to the extent possible?

Camera images in hospital environments are sensitive by nature, as patients are mentally or physically vulnerable. And in some cases, it is essential to keep patient identity a secret. It is therefore the hospital's responsibility to guarantee this privacy and to configure its video surveillance system accordingly.

Axis products provide capabilities to protect content for compliance with data protection regulations. This includes encrypting technology, services that can be deactivated and so-called privacy masks:

- Depending on local legislation or hospital privacy policy, it is possible to turn off specific cameras when patients are receiving intimate care, for example.

- The institution may also choose to configure the video surveillance system to keep specific recorded images only for a short period (3 days for example). If recording is not needed at all, videos can be used for live view only (for example, from a nursing control station) and for generating automatic alerts when something happens.

- Finally, a system integrator can configure a privacy mask – selecting a specific area or areas where the camera shouldn't capture data – like putting an eye patch over a portion of the video.

It is important to consider the ability of a manufacturer to prevent cyber crimes and their commitment to solve eventual weaknesses.

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> **How can I guarantee that images will not be "leaked", especially of public figures or celebrities?**

Like any other computer or device connected to the hospital network, it is impossible to guarantee that cameras cannot be maliciously exploited. However, accessing a protected device requires time, resources and knowledge. The risk of a video surveillance system being attacked depends on its value to the hacker.

Theoretically, hospital video surveillance systems are at risk of attack, and it is important to consider the ability of a manufacturer to prevent cyber-crimes and their commitment to solve eventual weaknesses. Axis is committed to cybersecurity, and our products are designed to prevent interference or tampering. They also include features to detect and notify of any unauthorized product access.

To further reduce cyber risk exposure of hospitals and their patients, Axis offers a number of interfaces and capabilities including user authorization/authentication on multiple levels, password protection, SSL/TLS encription, IP filter and certified management.

Product safety is a priority for the 500+ Axis R&D technicians and engineers who develop Linux based firmware with robust and resilient interfaces. Axis also works with outside consultants and independent researchers to continue increasing the quality and knowledge about cyber threats and vulnerabilities.

Although unable to guarantee the inviolability of the system, Axis remains committed, from product design to after-sales support, to minimizing cyber risks on our products and services. If a vulnerability issue is detected, Axis provides software and firmware updates as quickly as possible, free of charge.

> **How can I monitor relevant hospital areas without creating an intimidating "Big Brother" atmosphere?**

Many hospitals are adopting the humanization concept - striving to create a comfortable, cozy atmosphere for patients and their families. Similarly, they want their video surveillance cameras to follow these architectural guidelines and be as unobtrusive as possible.

Discreet camera design can make all the difference in a hospital video surveillance project. A wide selection of form factors - including bullet style, dome and pinhole cameras - are available with high image quality. Various mounting options can make them as visible or as hidden as needed to align with hospital surveillance goals and aesthetics. The AXIS F Series and AXIS P12 Series cameras are among our most discreet models.

Another useful design feature for hospitals is vandal resistant camera housings. This is particularly suitable for psychiatric treatment departments where aggression and physical attacks may be common.

Some technologies can actually help to reduce the number of cameras needed in a hospital environment. This not only reduces the cost of the camera installation, it also reduces the number of software licenses needed, and it minimizes the disruption to hospital operations during installation. For both saving money and creating a comfortable atmosphere, the fewer cameras, the better. For example, Axis Corridor Format changes the camera's traditional 16:9 horizontal aspect ratio to a 9:16 vertical aspect ratio, perfect for optimizing coverage of long, narrow hallways without consuming bandwidth on unnecessary wall coverage. And with maximized vertical coverage, more of the hallway is captured with a single camera, thus reducing the number of cameras needed to cover the entire area.

12 The largest mental hospital in Xiamen, China, has 250 cameras.

Approximately

85%

of all Axis cameras
and video encoders
are PVC-free.

Technologies for sustainability

> Is it possible to extend my PVC-free policy beyond medical supplies to IT equipment?

Yes, and this is a worldwide trend in healthcare. For many years, hospitals have been trying to push the adoption of PVC-free products, such as intravenous catheters and blood bags.

That's because medical supplies manufactured with flexible PVC contain phthalates, chemicals used to make plastic flexible PVC. Some even contain more than 50% of a harmful phthalate called di(2-ethylhexyl) phthlate (DEHP), which transfers to patients exposed to these products - including babies in ICUs.

Several studies have established a connection between DEHP exposure and hospital patients, and a correlation between this exposure and hormonal problems.

In addition to medical and hospital supplies, PVC can also be present in equipment such as video surveillance cameras. In fact, the vast majority of camera manufacturers use this substance which negatively impacts the environment.

A report[12] prepared by Health Care Without Harm, analyzes the impact of PVC in both medical and personal care products (among others), and warns that, "depending on the

circumstances of use, 2% - 50% of the phthalate content can emerge from products over their service life".

That is why, since 2008, DEHP appears on the European Union's list of substances of very high concern for their toxicity. A number of international associations dedicated to health and environmental protection advocate for PVC-free products, including products that do not come into direct contact with patients. And it's a recommendation that many hospitals have adopted.

Since signing the United Nations Global Compact initiative in 2007, Axis follows its 10 principles relating to human rights, anti-corruption actions, environmental and working conditions. And since 2010, Axis produces sustainability reports in accordance with the Global Reporting Initiative (GRI).

When it comes to products, Axis recognizes that PVC causes damage to the environment and to people's health, and can release potentially harmful substances over a product's lifespan. Which is why we are working to eliminate PVC from all of our products. Currently, approximately 85% of all Axis cameras and video encoders are PVC-free, with a goal to reaching 100% in full swing.

References

[1] The Joint Commission: Rights and Responsibilities of the Individual (RI) (Ambulatory Health Care / Ambulatory Health Care). Informed Consent - Security Cameras. Retrieved May 2016 from: goo.gl/IaRV5j

[2] U.S. Food and Drug Administration: A Guide for Modifying Bed Systems and Using Accessories to Reduce the Risk of Entrapment. Retrieved May 2016 from: goo.gl/6mYWbB

[3] Centers for Disease Control and Prevention. Retrieved May 2016 from: goo.gl/wxLg

[4] Bureau of Labor Statistics: Nonfatal occupational injuries and illnesses requiring days away from work, 2014. Retrieved May 2016 from: www.bls.gov/news.release/pdf/osh2.pdf

[5] The Center for Health Design: Sound Control for Improved Outcomes in Healthcare Settings. Retrieved May 2016 from: goo.gl/KXsAQr

[7] Colling, Russell L., York, Tony W. Hospital and Healthcare Security, 5th Edition. Elsevier, 2010.

[8] CL Yeo, MD, Selina KY Ho, MD, KC Khong, RN, BHSN, e YY Lau, RN, BHSN. Virtual Visitation in the Neonatal Intensive Care: Experience with the Use of Internet and Telemedicine in a Tertiary Neonatal Unit. Retrieved May 2016 from: www.ncbi.nlm.nih.gov/pmc/articles/PMC3200097/

[9] Franck LS, Cox S, Allen A, Winter I. Measuring neonatal intensive care unit-related parental stress. J Adv Nurs. 2005; 49:608–15. [PubMed]

[10] Renée Flacking, Liisa Lehtonen, Gill Thomson, Anna Axelin, Sari Ahlqvist, Victoria Hall Moran, Uwe Ewald, e Fiona Dykes. Closeness and separation in neonatal intensive care. Retrieved May 2016 from: www.ncbi.nlm.nih.gov/pmc/articles/PMC3468719/

[11] Tali Stolovy PhD, Yuval Melamed MD MHA e Arnon Afek MD MHA. Video Surveillance in Mental Health Facilities: Is it Ethical? Retrieved May 2016 from: www.ima.org.il/FilesUpload/IMAJ/0/146/73129.pdf

[12] Aggregate Exposures to Phthalates in Humans, July 2002. Retrieved May 2016 from: https://noharm.org/sites/default/files/lib/downloads/pvc/Agg_Exposures_to_Phthalates.pdf

About Axis Communications

Axis offers intelligent security solutions that enable a smarter, safer world. As the market leader in network video, Axis is driving the industry by continually launching innovative network products based on an open platform - delivering high value to customers through a global partner network. Axis has long-term relationships with partners and provides them with knowledge and ground-breaking network products in existing and new markets.

Axis has more than 2,600 dedicated employees in more than 50 countries around the world, supported by a global network of over 90,000 partners. Founded in 1984, Axis is a Sweden-based company listed on NASDAQ Stockholm under the ticker AXIS.

For more information about Axis, please visit our website www.axis.com.

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