4. ELV and ICT systems

This document is intended for the Architect/Engineer (A/E) and others engaged in the design and renovation of DHA facilities. Where direction described in applicable codes are in conflict, the A/E shall comply with the more stringent requirement. The A/E is required to make themselves aware of all applicable codes.

The document should be read in conjunction with other parts of the Health Facility Guidelines (Part A to Part F) & the typical room data sheets and typical room layout sheets.

4.1 Introduction

ELV and ICT systems play a key role in efficient and safe operation of any Healthcare facility. With the advent of multitude of systems and approaches and fast evolving technologies it is not prudent to mandate specific design criteria in this guideline for ELV and ICT systems. The following section provides general guidance to the designer during the design of various ELV and ICT system in healthcare facilities from a functional point of view.

The LAN Infrastructure shall provide IP connectivity for several services, which may require being isolated from one another from an application point of view while sharing the same physical network. The applications include but not limited to Voice, Data, CCTV, Video, Public Address, Digital Signage, Nurse call, Central Clock, queuing systems, HIS, PACS and others. The IT infrastructure shall be flexible high capacity network capable of providing virtualized services to IP unicast and multicast applications. The IT network must be highly dependable and provide sub-second recovery in the event of any component, node or link failure.

4.2 ICT Network

The following key objectives to be considered for the Medical Grade Network (MGN) design and its implementation for healthcare facilities. Follow standard ISO/IEC 11801 – "Information technology, Generic cabling for customer premises"; with respect to structured cabling.

1. High Availability & Resiliency: Due to the mission critical nature of many of the systems that will run on the IT network, fault tolerance and resiliency are mandatory requirements in all aspects of Design. The solution must be designed with No Single Points of Failure: link redundancy, power redundancy and core switch redundancy are essential. The network should be available at all times and should not be severely affected in the cases of component failures. LAN switches must support state of the art and latest LAN technologies.
2. Security: The network design shall have capability for virtualizing and segregating users and services in isolated zones over the same physical network. In addition, the proposed solution should be capable of protecting network from traditional IP hacking and IP exposure. IT security to be considered during the design and implementation and to be verified as part of completion sign-off.
3. High Performance: The Network should be able to support latency sensitive applications by using low latency switches that can support optimal topologies to reduce number of hops through the network. In addition, the proposed network should be fully active-active load sharing with no idle hardware or links.
4. Convergence: It is recommended that a highly resilient converged Network Infrastructure is planned for healthcare facilities than several individual semi-resilient networks. Each virtual network shall have own firewalls to avoid hopping from one virtual network to another.
5. Scalability: The network shall be designed in a way that allows for smooth future growth and scalability. Scalability is required to guarantee the support for future applications, users,

traffic, technologies, etc. without the need for major upgrades, or restructuring. Future technologies such as 40G & 100G may be considered.

6. Simplicity: The network design solution shall provide automated end to end configuration of services with minimal human intervention. SDN (Software Defined Networking) and configuration automation technologies shall be capable to expand to the campus and remote sites where users and network devices exist.
7. Manageability: Manageability is an essential requirement. All aspects of the solution should provide a method of Centralized Control via SNMP Management as well as the normal switches management features through console interface, web-interface. All management features should be integrated in the switches whether on the backbone or the edge switches. Simplicity of the design is an important advantage. Intelligent patch panels are recommended for large facilities with over 3000 network points.
8. Open Standards: The network design and technology shall be based on open Standards and only use IEEE or IETF certified protocols to allow interoperability with other vendors supporting the same standards such as HL7 and DICOM. Proprietary protocols and mechanisms are not desirable.
9. Product & Technology Reliability and Maturity is a critical factor that should be considered during the implementation. Vendor's technologies and approaches must be proven in live implementations prior to their deployment in any healthcare facilities.
10. Multicast Enabled Architecture: The IT network shall support multiple virtual IP multicast routed domains with complete traffic separation between them.
11. Medical Devices security and tracking: The network shall be capable of providing security and ease of mobility and tracking for expensive medical equipment that may need to be relocated across the healthcare facility, and to provide automated SDN based deployment

to centrally manage, configure, and secure those devices.

12. Bandwidth requirements to be carefully considered when determining the topology of the network and data storage requirements. Bandwidth and data storage requirement to be calculated based on the systems and number of modalities anticipated in the facility. Systems such as PACS require high amount of bandwidth requirement while systems such as Laboratory Information Systems or Central Clocks may require only limited bandwidth.
13. Fully redundant and resilient converged network is preferred over a number of individual networks supporting different systems. However, high bandwidth systems such as CCTV together with access control may be in a separate network.
14. All ICT and ELV equipment located in the clinical areas shall be specifically designed for the intended application especially with respect to safety and infection control.
15. Data storage capacity shall be planned for a minimum of 6 years operation of the facility during the initial build. Additional off site storage is also recommended.
16. The main data storage and server room for the facility shall not be located below grade level.
17. A typical network topology that will provide enhanced level of availability and network redundancy is illustrated below.
18. When public WIFI access is provided in the facility, this should be implimented though Captive Portals.
19. Where cloud storage is considred it should be compiant to TRA information security policies.

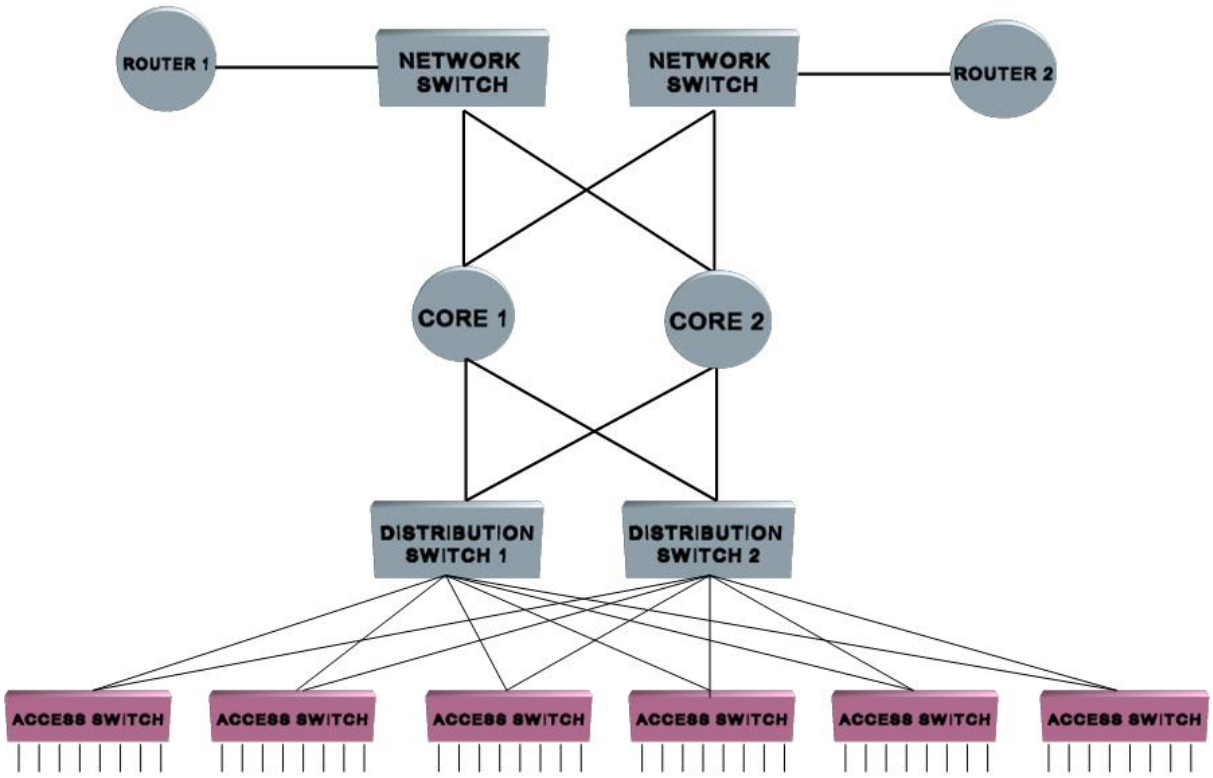

Figure E.4.1 - Typical IT Network Topology

4.3 Nurse Call Systems

1. Nurse call system shall be provided in all healthcare facilities to suite the level of care provided in the facility. This guideline recommend that the component terminologies and its basic functions are standardised as follows.

   Annunciator - Desktop Console (AN-DC): This unit is intended to be located at the nurse stations for receiving calls and alarms from different patient and staff locations. This unit is recommended to have bi-direction speech capability with patient privacy in mind.

   Annunciator - Room Lights (AN-RL): These are colour coded lights above or beside each main entrance to the area/room where the Nurse Calling devise is located, to assist the responder to reach the originator of the call quickly and efficiently.

   Annunciator - Corridor Display (AN-CD): Corridor displays, alphanumerically indicating the origin and nature of a call from the patient or other staff member greatly help in

efficiently responding to an emergency call. Depending up on the specific configuration of the clinical department corridor displays may be required. This can be either dedicated linear LED displays or can be integrated into strategically positioned IPTV screens if seamless integration of the two systems are implemented.

Patient call with handset (PC-H): These devices shall be located in in all patient locations where the patients are likely not attended by a staff member continuously. This unit shall comprise of a fixed unit at the bed head with Staff Assist button, Speaker, Microphone and Emergency Call buttons in addition to the jack for plugging the patient handset. The patient handset shall have a minimum of easily identifiable nurse call button to originate a call to the associate nurse station, speaker and microphone for bi-direction communication with nurse and reading light control. The handset to be durable, simple and easy to use and disinfect.

Patient call without handset (PC): These units shall be used in areas where all functioning of PC-H (above) is desired other than the function of the handset. This will be a wall mounted unit.

Patient call – En-suite [Toilet] (PC-E): These units are used to initiate an emergency alarm call from the patient toilets to the associated nurse station. These call buttons are to be easily visible and recommended to be located at low level in the patient toilets reachable from shower area as well as from WC. One or two buttons shall be provided depending up on the configuration of the toilet. These units shall be water proof and designed to be located at wet locations. Ceiling mounted call units with pull cords are not recommended.

Staff Assist Call (SAC): These devices are intended for staff at a patient location to seek additional help from other staff members. This button may be integrated with a common

face plate providing other functions or can be on a separate face plate depending up on the product design by the manufacturer.

Staff Presence (SP): This is an optional device that can be provided at the entrance to a patient bed room for activation by a staff member to indicate someone is already attending to the patient. The annunciator room light above the door shall indicate the nurse presence. This module can be either an independent button or can be integrated to other modules forming part of any workflow solution the end user may optionally include for efficient functioning of the facility.

Emergency Call (EC): Emergency Call buttons are intended for clinical staff to escalate an emergency by alerting other relevant staff members for additional help. Activation of the emergency call (EC) button shall generate an audible tone-based alarm, at the associated staff station and other designated mobile devises, along with alphanumeric display indicating the nature and location of the call. The emergency call button can be a separate unit or integrated into a console including buttons for other nurse call system functions. Emergency calls should only be cancellable from the patient location where the call was originated.

Wireless Handset (WH): Wireless handsets to receive nurse call system audio calls and alert text messages are recommended for use of staff members on the move within departments. A minimum of two wireless units are recommended at each supervision station; this quantity to be increased based on the number of anticipated staff members on the move within the department.

2. Refer to the RDS (Room Data Sheets) included under Part B of this guideline for the recommended Nurse Call System devices for various clinical locations.
3. Additional optional functions to facilitate workflows and patient monitoring may be provided

as part of the nurse call systems.

4. There shall be interface between the fire alarm system and nurse call system to discretely alert the respective Nurse Stations of any fire detection events.
5. Where IP based communication is used by the Nurse Call system, the Nurse Call System may share the facilities' hospital grade IT backbone network.
6. It is recommended that the nurse call system has the capability to relay alarm text messages from the Nurse Call system to mobile devises such as IP Phones in the facility or over mobile phone data networks and over facility WIFI network.

4.4 Central Clock Systems

1. Central Clock Systems are recommended in critical care and relevant public areas of the hospital for unified time referencing. The system comprises the following components in general.

   Master Clock Unit: The function of this unit to accept time references inputs over GPS and NTP and relay time reference signals to time display clocks located at various locations in the facility.

   Clock Displays: These devises will display the unified time based on the input received from the master clock unit. The clock display can be either analogue or numerical. This guideline recommends clocks with numerical displays where medical procedures takes place, while analogue displays in public areas (where provided).

   Due to reliability considerations it is recommended that clocks are wired type powered using POE. Where POE facility is not available local power supplies or battery cells may be considered.

   Clocks with additional functions such as elapsed time displays are required in operating

theatres. The reset button for these elapsed clock function to be located at an accessible height.

2. Refer to the RDS (Room Data Sheets) included under Part B of this guideline for the recommended locations of clock displays.

4.5 CCTV and Access Control

Healthcare premises pose unique changes to ensure security due to the presence of people under mental stress, high value equipment and sensitivity of medical data. To mitigate this risk a carefully designed and implemented CCTV and Access Control system to be provided for healthcare facilities. The coverage and complexity of the system will depend up on the type of facility. The following section provides a brief on general considerations to be made while designing CCTV and Access Control Systems for healthcare facilities.

1. CCTV system design and installations shall meet the requirements of local law enforcement agencies with respect to equipment standards, coverage, monitoring and data storage requirements. In addition, the requirements given hereunder shall be considered during the design.
2. Patient privacy to be considered while deciding the location of CCTV cameras. Cameras shall not be installed in areas where patient privacy may be compromised.
3. CCTV coverage shall include the following areas but not limited to;
    - Inside medication rooms.
    - Outside medication rooms covering entrance door.
    - Inside laboratories
    - Inside blood storage rooms
    - Common corridors

- All entry and exits
- Emergency Room waiting areas and reception
- Pharmacy, medication dispensing areas
- Loading dock and receiving areas
- Cash counters
- Waiting areas
- Nursery
- Body storage areas
- Individual department main entrance doors
- Staff/Nurse stations
- Staff rooms
- Inside enclosed fire exit stairs
- Outside public toilet main entrances
- Inside Hot Labs
- Nursery
- Entrance to technical rooms
- Inside main MEP plant rooms
- In lift lobbies and inside lifts
- Sterile Supply Unit
- Also refer to RDSs provided under Part B of the this HFG.

4. In addition to the CCTV system cameras provided for the general security surveillance, there may me CCTV real time monitoring required in imaging and radiotherapy areas from the respective treatment control rooms. Such monitoring systems are not required to be

connected to the central CCTV system. These monitoring systems are recommended to be provided as part of medical equipment scope of supply and be positioned as per respective medical equipment manufacturer's recommendation.

5. All security system equipment including cameras shall be provided with UPS backup. CCTV cameras may be powered using POE. Associated network switches shall be provided with UPS power backup.
6. Primary CCTV surveillance for any required area shall be provide by means of fixed cameras, where additional secondary means of surveillance is required, such as main entrance hall, shall utilize PTZ cameras.
7. Electronically access controlled doors in the fire escape route shall be interlocked with the fire alarm system through normally closed contacts in the fire alarm interface units.
8. It is recommended that the security management system software have the capability for real time integration of the CCTV, access control, asset management and infant protection systems.
9. It is advisable that the CCTV system covering outpatient waiting areas have the capability to display live video from the waiting areas on the consultant's computer workstation in a web browser to provide the Consultant Doctor a visual reference to the waiting areas when required.
10. Access control system employing RFID cards/tags and readers that use encrypted message transfer are recommended. Finger print biometric readers requiring touch to scan the finger prints are not recommended in healthcare facilities due to infection control reasons.
11. The access card reader or door open switch for electrically operated swing doors located in the circulation corridors shall be placed 2400mm before the door to facilitate ease of operation while transferring patients on stretchers or beds.

12. Separate IT network may be considered for the IP CCTV network and access control due to operational and security authority requirements.
13. Where RFID based or RTLS asset management systems are provided, it is recommended that asset management system is interfaced with access control system to avoid items moving out of designated areas.
14. Infant Protection System employing trackable tags shall be implemented for maternity wards and nursery. Such system shall be interfaced with access control system to lock down in case of any security breach.
15. Electronic access control is recommended for the following areas. However, the exact provisioning of the access control to be based on the specific security strategy and work flow employed for the project based on the proposed layout of the facility. The following list act only as a general guide.
    - Fire exist doors leading to fire exit staircases.
    - Medication rooms
    - Clean utility
    - Dirty utility
    - Electrical, mechanical and ICT rooms
    - IT server room/data centre
    - Imaging rooms
    - Department entrances
    - Staff only corridors
    - All entries and exits to outside
    - Pharmacy

- Cash counters
- Entrances to back offices, insurance offices
- MRI Zones
- Radiotherapy areas
- Entrances to staff only areas
- Medical records
- Isolation rooms
- Nursery
- Air lock area between dirty and clean areas in Sterile Supply Unit (SSU) (with interlock so that only one door can be opened at a time)

16. Discrete Panic Alarms to be considered, as a minimum, at cash counters, emergency department reception and main reception. Expanse of the panic alarm coverage should be reviewed based on the security assessment for the facility and further alarms to be provided based on the assessment.
17. Where electronic access control is provided in fire escape routes suitable failsafe interlock to be provided to ensure the locks are released or lock overriding facility is available in case of any emergency. Such doors to me alarmed and monitored from the main security room.

4.6 Patient/Medical Equipment Monitoring

Many of medical equipment used these days are having the facility to transmit alarms and monitoring data over IP networks for clinical use and for equipment maintenance purposes. For safe and efficient operation of healthcare facilities such monitoring information should be efficiently managed and should be readily retrievable. To facilitate this, data outlets to be provided throughout the facility near to all locations where such medical equipment are intended to be used. In addition,

wireless LAN coverage to be available throughout the facility for connecting mobile monitoring equipment likely to be hooked to patients. Refer to the RDS (Room Data Sheets) included under Part B of this guideline for the recommended number of Data Outlets at various locations.

1. It is recommended that medical equipment requiring monitoring including fridges and freezers are provided with wired data appoints for connection to centralized medical fridge/freezer monitoring system than a wireless monitoring system.
2. It is highly recommended that patient tagging system employing trackable tags (RFID / RTLS) are implemented for psychiatry and geriatric wards. Such system shall be interfaced with access control system to lock down in case of any security breach.

4.7 Intercom Systems

Audio or Audio/Video intercom system to be provided as required to suite the workflow and security strategy employed by the designer. IP based solutions are recommended for better operational flexibility. The intercoms functioning in conjunction with the access control system shall have facility to unlock the associated doors.

Intercoms are recommended for;

1. Entry doors normally locked by electronic access control system and required to be occasionally accessible for persons without valid access cards. (Between unsecure side and designated door operator)
2. Radio therapy rooms. (Between control room and patient in treatment position)
3. Computed Tomography (CT), rooms (Between control room and patient in imaging position)
4. Magnetic Resonance Imaging (MRI) rooms (Between control room and patient in imaging position)
5. Isolation rooms (Between outside the entry door and patient position)

6. Loading docks
7. SSU (Sterile Supply Unit), between dirty and sterile area

4.8 Patient Infotainment Systems

Suitable patient entertainment facilities are recommended in patient bedrooms and at locations patients are likely to be stationed for extended period.

1. The patient infotainment provisions may include but not limited to facility to view main stream television channels, video on demand, patient education videos, hospital department information, dietary menus, Audio/Video Communication etc., based on the type of the facility.
2. The interface to access the infotainment information can be suitably positioned medical grade Smart Television Screen connected to IPTV network. In addition, optional medical grade PDA, networked over wireless LAN, of suitable size may be provided. When portable PDAs are provided appropriate docking, station incorporating changer and security lock is recommended. The docking station to be fixed adjacent to the patient location. The PDAs may be tagged with asset management system for additional asset tracking. When PDAs are provided it should not be shared with staff for accessing clinical data due to infection control reasons. Where wireless PDAs are opted for patient infotainment, the wireless access coverage and bandwidth requirements to be carefully coordinated to ensure a seamless user experience. A suitable mounting mechanism to be provided, preferably mounted on the bedside table.
3. Use of mobile phones to be carefully regulated in healthcare environment. A total ban on mobile phone throughout the entire healthcare facility may not be practical nor required. However, use of mobile phones should not be allowed near critical life support medical

equipment and critical care areas. Healthcare facilities shall develop their own mobile phone usage policies considering the above and display necessary signages at mobile phone restricted areas.

4.9 Queue Management System

Queue management systems are recommended be provided in areas such as outpatient waiting, pharmacy and other areas where visitors / patients are having to wait for their turn. The queue management system shall be a consolidated solution integrating different waiting areas of the hospital so that tokens can be transferred from one system to other. The proposed solution may have the following components and functions.

1. Token dispensing station shall be either standalone or at suitable location attended by the staff members for better efficient utilization of the system and work flow.
2. Waiting area display: This can be a suitably sized LED panel screens to display the token number along with associated counter or room number. These screens are recommended to be integrated with IPTV system of the facility to play television or patient education content. Sufficient number of waiting area displays shall be provided for ease of viewing. Auditable automatic token number announcements could be avoided for maintaining a quieter ambiance.
3. Counter/room number display: This can be suitably sized displays conveniently placed near the induvial locations such as pharmacy counters to display the counter number and attending token number. Individual electronic counter displays may be provided for areas such as pharmacy or registration counters, however electronic counter displays may not be suitable for areas such as consulting rooms; in such cases normal (passive) alpha-numeric room number signage can be provided near the entry doors.

4. It is recommended that the calling station used by the staff are software based, and can be operated from computer workstation screens, rather than dedicated hardware with keypad. Standalone calling station units shall be used at locations were computer workstations are not used.
5. The system management software should have capabilities such as real time monitoring dashboards, overall performance reports, individual employee performance reports, service quality levels, SMS alerts etc.
6. It is recommended that the Queue management system also have the facility to accept and record customer experience feedbacks by incorporating suitable hardware and software.

4.10 Asset Management Systems

1. Depending up on the Enterprise Resource Planning (ERP) for the healthcare facility electronic means for tagging assets are highly recommended. The asset management system may employ any combination of the following technologies.
    - Real Time Location System (RTLS)
    - Radio Frequency Identification (RFID) - Active and/or Passive
    - Bluetooth Low Energy (BLE)
2. The choice of technology employed largely depended on the type and size of healthcare facility. The choice of asset tracking technology to be decided during the early stage the facility design, so that appropriate infrastructure is made available. Whilst, designers are encouraged to embrace modern innovative technologies for improved patient care delivery it is important to ensure that the selected solution is proven and reliable. Designs shall pay special attention to ensure only healthcare grade tested solutions are deployed in healthcare environments.

3. Healthcare facilities having maternity and neo-natal departments shall be provided with infant protection system. This system shall be interfaced with the access control system to set off alarms and activate selected door locks.

4.11 Health Information System (HIS)

1. Dubai Health Authority is responsible for Health Information Interoperability Standards in the Emirate of Dubai. All Health Information System (HIS) software deployed in the healthcare facilities shall follow the Health Information Interoperability Standard issued by DHA.
2. The objectives of the Interoperability Standard are as follows;
    - To serve and establish a cooperative partnership between the public and private sectors to achieve a widely accepted and useful set of standards that will enable and support widespread interoperability among healthcare software applications in a city-wide eHealth Information Network for the Emirate of Dubai.
    - To harmonize relevant standards in the healthcare industry to enable and advance interoperability of healthcare applications, and the interchange of healthcare data, to assure accurate use, access, privacy and security, both for supporting the delivery of care and public health.
    - Interoperability contributes to enhanced healthcare delivery facilitating continuity of care and better decision making while delivering cost savings. Interoperability is seen by the Dubai Health Authority as a state of readiness to deal with new technologies, clinical practices and changes in policies. DHA's aim is to provide a standardized coding system for describing the specific items and services provided in the delivery of health care in the Emirate of Dubai. Refer to the DHA interoperability standard for further details on standardization of coding.

- Compiling population health data for research, analysis and improvement measures to enhance the health level of the population of Dubai.

3. The HIS system provided for the healthcare facilities shall be HL7 and DICOM compliant, to enable seamless exchange of data between the healthcare facility HIS, other healthcare facilities and EMR system of Dubai.
4. The basic de-identified information that will have be shared with DHA, will include but not limited to services provided, lab reports, radiology reports, admission and discharge and other information updated by DHA from time to time. Certain information may remain confidential at each facility as informed from time to time by the DHA. As a minimum the HIS must have the above-mentioned capabilities until such time as the DHA declares the detailed requirements. The health information record sharing with other health facilities is subjected to the consent from the patient with option to opt-in or opt-out anytime.
5. HIS Coding and terminology employed by the healthcare facilities to describe specific items and services for delivery of healthcare shall be in standardised in accordance to latest version of Health Information Interoperability standard from DHA.
6. Whilst EMR system increase the safety and efficiency of healthcare delivery, concerns related to patient data privacy to be carefully addressed. In additional to data encryption the key to preserving confidentiality is to allow only authorized individuals to have access to the information.
7. Authorization levels and accountability to be clearly defined in healthcare facility HIS manuals and thoroughly implemented. Assigning user access privileges is a major aspect of medical record security. Strong privacy and security policies are essential to secure patient's information.

8. Cloud service provider for the healthcare facility shall have the following;
    a. Cloud based data storage must be local and within the boundaries of the UAE. Any exceptions has to be approved by the Minister of MoHAP in coordination with relevant Healthcare Authority.
    b. Cloud service provider must be classified as Tier 3 or above.
    c. It is recommended that the Cloud service provider has HIPAA (Health Insurance Portability and Accountability Act) - compliant business associate agreement (BAA). This is optional for the first two years and it will become compulsory afterwards.
9. Information Governance and Risk Management Framework shall include third party auditing for;
    a. Implementation plan for ISO 270001 with a grace period of 2 years.
    b. Data sharing agreements.
10. Electronic Medical records of the healthcare facilities shall have;
    a. Certified by DHA (within 2-3 years) of hospital opening.
    b. Government's data submission requirements shall be fulfilled.
    c. Audit trail and Role-based access is required.
    d. PHI encryption to be employed.
    e. Third party review (Dubai Electronic Medical Record Adoption Model, EMRAM).
11. Data Breach Reporting procedure shall be implemented based on the following.
    a. Healthcare facilities shall report any healthcare data breach incidents that are caused by theft, loss of computers of devices, cyber-attacks, negligence, etc.

b. Patients can also report suspected data breach incidents or miss-use of their protected healthcare data

c. DHA has the right to investigate these incidents and apply the articles of the Federal Law no. 2019 on ICT usage for Healthcare.

12. All healthcare facilities existing as well as newly proposed are required to enhance the HIS system of their facilities to comply with the DHA interoperability standards by end of year 2020.

4.12 Fire detection and signalling

Fire detection and signalling to be provided as per local civil defence requirement. This include fire detection and alarm systems comprising detectors, sounders, alarm speaker and strobes. In addition, the following healthcare specific design recommendation to be considered during the design.

1. Critical care areas where patients are not normally mobile and likely to be connected to medical equipment are not required be provided with audible means of alarm sounders or speakers to avoid panic. Such areas shall be provided with discrete means of fire alarm notification at the corresponding nurse stations, by providing fire alarm repeater stations at the nurse/supervision stations. In addition, interface shall be provided between Nurse Call System and Fire detection system to alert staff of any fire alarm incidents.
2. Alarm speakers or strobes are not required in operating theatres. Associated nurse station to be alerted of a fire condition though discrete means.
3. Fire alarm and signalling system cables used in the health care facilities shall be “enhanced” grade not standard grade.

4.13 Public Address System

Public address System is recommended in healthcare facilities for broadcasting call for prayer, background audio, announcements etc. in areas such as waiting areas and circulation corridors. Staff paging over public address system is not encouraged. Discrete staff paging over wireless network is recommended.

1. Acoustics characteristics of the built environment shall be taken into consideration while designing public address systems to ensure audio intelligibility. Zone wise volume control shall be provided so that different volume levels can be set depending on the areas. Volume control knobs shall be placed near respective supervision stations. IP based solutions are recommended over conventional analogue systems.
2. The public-address system to be zoned to suite the operational requirements of the facility. Such zoning to be agreed with the stake holders during the initial phase of the design to ensure cabling is designed to suite.

4.14 System Testing, Commissioning and Operation

The system commissioning is an important phase in the project timeline and is critical in confirming that the design parameters are met by the installed system and the system meets the minimum code requirements and commissioned as per manufacturer recommendations.

For medium to large scale healthcare facilities an independent commissioning agent should be employed by the facility owner/client to oversee and integrate the commissioning process.

The following points should be kept in mind while preparing for commissioning of the systems for healthcare facilities.

1. Method Statements
2. Testing and Commissioning plan

3. Testing and commission shall be carried out by respective system manufacture's trained and authorized represented.
4. All testing and commissioning records to be included in the O&M documents. It is highly recommended that an online solution is deployed for O&M documentation for ease of retrieval and reference.
5. Training on the systems installed should be conducted by the authorized representatives of original equipment/system manufacturer.
6. Routine maintained activities shall be carried out as per the respective system manufacturer's recommendation and easily retrievable records are maintained in the facility. Deployment of online software-based facility management solutions incorporating necessary maintenance modules are highly recommended depending upon the nature of the facility.