"How A Hospital Information System Is Used By Healthcare Staff"

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Abstract
Hospital Information System (HIS) is vital to decision making and plays a crucial role in the success of the organisation. Computerisation of the medical records and documentation has resulted in efficient data management and information dissemination for the users. Managers, Clinicians and other healthcare workers can now access the information without delay or errors. Present study reveals, that the existing system in Brij Lal Hospital and Research Centre requires up gradation to meet the requirements of the managers and the clinicians. Participants feel HIS assists in decision making, and medical audit. Participants felt that the existing HIS resulted in longer time for OPD consultation and delay in investigation results. Majority of the participants feel that HIS helps in education and research. This test trice to cover giving an insight to the Hospital Information implemented and used by health care staff at the Brij Lal Hospital and Research Centre, Haldwani, one of the best medical facility in the region, which is not being fully utilised to provide quality service. The HIS has enabled the hospital to collect, process and retrieve patient care and administrative information from various departments for all hospital activities.

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I. INTRODUCTION

HOSPITAL

The word "hospital" comes from the Latin ' hospes" which refers to either a visitor or the host who receives the visitor. From "hospes" came the Latin "hospitalia", an apartment for strangers or guests, and the Medieval Latin "hospitale" and the Old French "hospital." It crossed the Channel in the 14th century and in England began a shift in the 15th century to mean a home for the elderly or infirm or a home for the down-and-out. A hospital began as a charitable institution for the needy, aged, infirm, or young. Hospitals are the key institutions in providing relief against sickness and disease. They have become an integral part of the comprehensive health services in India, both curative and preventive. Significant progress has been made in improving their efficiency and operations. "Hospital" only took on its modern meaning as "an institution where sick or injured are given medical or surgical care" in the 16th century.[1]

Quaternary care

Requires highly specialised skills, technology and support services. One hospital would provide the majority of such services to residents of Metro.

Tertiary care

Specialised consultative care, usually on referral from primary or secondary medical care personnel, by specialists working in a centre that has personnel and facilities for special investigation and treatment. (Secondary medical care is the medical care provided by a physician who acts as a consultant at the request of the primary physician.)

Secondary care

Provided by a specialist health care provisional usually after referral from a primary care physician.

Primary care

Basic or general health care traditionally provided by doctors trained in: family practice, paediatrics, internal medicine, and occasionally gynaecology. [1]

HOSPITAL INFORMATION SYSTEM

The health care industry accounts for about three per cent of the Rs.30000 crore domestic market for IT products and services. The increasing awareness of the benefits of IT and its application in the health care industry has triggered this segment to grow, at around 20 per cent per annum.[2]

Fierce competition and customers' demand for better service delivery standards in the health care industry are increasingly compelling hospitals to continuously improve their services. In this context, a Hospital Information System (HIS) enables hospitals to serve the rapidly growing number of health care consumers in a cost-effective manner.[2]

It provides an effective solution to hospitals that plan to reduce the costs of administrative and clinical transactions, and at the same time, provide better service to their consumers. A Hospital Information System (HIS) aids hospital administrators by significantly improving operational control and streamlining operations. HIS also enables improved response to demands of patient care because it automates the process of collecting, collating and retrieving patient information. Clinical pathways mapped to the system improve diagnoses and treatments offered. HIS has revolutionised health care delivery by providing doctors and hospital staff with the decision support system that they require delivering patient care, which is comparable to global standards. The benefits that a HIS offers in patient care and hospital[2]

administration are innumerable. By enabling an automated and intelligent flow of patient information, HIS enables hospitals and doctors to better serve their patients. Additionally, HIS provides a host of direct benefits such as easier patient record management, reduced length of stay, reduced test requests, lower staff turnover, greater organisational flexibility, reliable and timely information, easier resource management, minimal inventory levels, reduced wastage, reduced waiting time at the counters for patients and reduced registration time for patients. The indirect benefit would be an improved image of the hospital and increased competitive advantage. Management Information System (MIS) optimises the resources to be deployed and helps in prioritising the developmental activities of the hospital. Corporate players wanting to target the medical tourism segment must look at HIS solutions that comply with international standards. This would open up a market for high-end HIS solution that complies with international standards such as Health Level Seven and Health Insurance Portability and Accountability Act.[2]
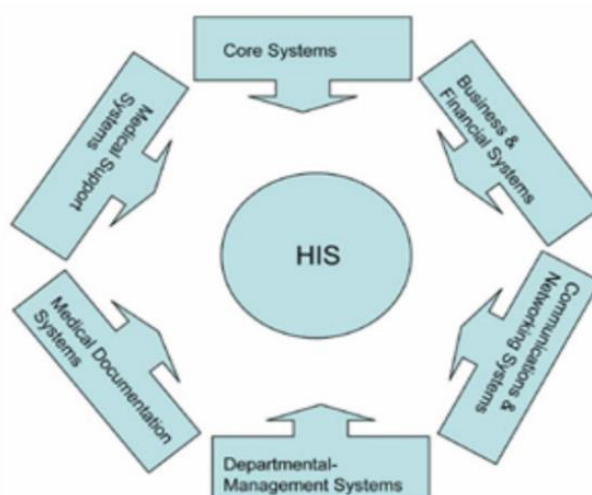
SIGNIFICANCE OF HIS

It is estimated that "hospital errors result in up to 98,000 deaths annually," including 7,000 just by missing drug-interaction problems. Amazing numbers, isn't? This figure is of United States, a developed country. Can you imagine this number in a developing country, like India'?

Patients are entitled to the safest possible environments of care. Automating tasks that are likely to cause errors can reduce the possibility that errors will occur. Health care is growing increasingly complex, and most clinical research focuses on new approaches to diagnosis and treatment In contrast, relatively little effort has been targeted at the perfection of operational systems, which are partly responsible for the well-documented problems

with medical safety. If medicine is to achieve major gains in quality, it must be transformed, and information technology will play a key part, especially with respect to safety. Now days there are huge invention and development in the field of hospital information system. In the last decade, Healthcare Information system has grown at the rapid phase. So now it is became essential to study this technique and how they can improve the patient's safety and care. It is also necessary to study the usability and adaptability of these techniques among the end-users and doctors.[2]

By capturing the adaptability and significance of the new techniques in HIS we can recommend that techniques to implement, which in-turn will improve the patients safety and care level. Also this will improve the hospital credibility in terms of patient satisfaction and in long run financial aspects.[2]

WHAT IS HOSPITAL INFORMATION SYSTEM

"A hospital information system (HIS) is a comprehensive information system dealing with all aspects of information processing in a hospital as well as the human or technical actor involved in their information processing role operating in a federated model"[2]

Hospital Information System is an integrated, computer-assisted system designed to store, manipulate, and retrieve information concerned with the administrative and clinical aspects of providing services within the hospital.[2]

A Hospital Information System (HIS) can be defined as an open system, which attempts to integrate and communicate the outside and inside flow of information within a hospital and provide the functions common for all applications.[2]

We can create a model of HIS conception—reality gaps, which we will call the **'ITPOSMO '**model because of its seven dimensions:

Information **T**echnology **P**rocesses
Objectives and values **S**taffing and skills
Management and structures
Other resources: money and time

OBJECTIVES OF HIS:

• Significance of HIS in improving patient safety and care

• Applicability of new Techniques in HIS

• Effective Utilisation of HIS by end users

• End User's Awareness about current HIS

• End User's understanding about current HIS

HOSPITAL INFORMATION SYSTEMS FEATURES AND FUNCTIONALITY

A HIS is usually considered by most as a broad-spectrum system that addresses all the parts of a hospital such that there is a single integrated system. Some of the more mature markets in the world like those in Europe and the USA have, on the other hand, evolved with IT systems developed to meet the needs of specific Depts. in the healthcare institution like Cardiology, Endocrinology, and Gastroenterology etc. However, the benefits of a single integrated HIS are now being appreciated by many.[2]

HOSPITAL INFORMATION SYSTEMS TECHNOLOGY CONSIDERATIONS

A hospital information system is a complex software system that works on hardware of appropriate specifications. It can be considered akin to an enterprise resource planning (ERP) software for businesses. All software systems are designed and architected as dictated by the requirements to be delivered for end-users.
Architecture of HIS: Software technology is constantly evolving and improving. Thus, a technology that is in vogue presently could easily be a thing of the past in a few years. Most large newer software systems have one of two designs:

• 2-tier client-server architecture: - Here the software is programmed such that the processing logic works in a client computer (a computer on which an end-user works), and the data storage happens in a server computer (a computer that, usually setup in a dedicated central room in a healthcare institution). Since the processing logic works on the client computers, they are also called thick or fat clients.

• 3-tier architecture: - here the software is programmed in such a way that no processing logic works on the client computers and all o fit works in the server computer called application server. Storage of data is done in a server called database server. Since the processing does not happen in the client computers, they are

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called thin clients. Technically, software designed in this way is easier to maintain and more easily adaptable to changes that may be required as feature enhancements. This is regarded superior to 2-tier architecture.

The operating system is the basic technological platform on which the HIS is developed. This could be Microsoft Windows or UNIX (or Linux) on computers with Intel processors. The interface (Screens/graphical user interface [GUI]) for end users may be developed using web technology or desktop-computer based technology. The programming language varies accordingly - for example, in Windows based systems, it could be J2EE, and d-html etc. for web-based systems, or it could be Visual Basic for desktop-computer based systems. A database for data storage in a HIS can be one of various types like Oracle, Microsoft SQLL server, Informix, Sybase etc. (these are called Relational Database Management Systems [RDBMS]). [2]

Hardware technology for HIS:
The client computers in a HIS installation are desktop computers similar to household personal computers. The servers are high-end computers with a lot of high performance capabilities (to handle high speed as well as high load in terms of amount of transactions for data processing). Thus, clients are used by the end users in the hospital, while servers are the ones that host (hold) the application. Hardware 'configuration' for any particular institution wanting to go in for a His installation is done on the basis of number of simultaneous users, load of patients, number of client terminals to be setup etc. Servers also have sophisticated load sharing, data back-up and recovery mechanisms to facilitate restoration of data in case of failures.

Networking in a HIS installation:
In the most common localised HIS installation, the client computers are setup across the hospital and the servers are setup in a centralised location within the hospital. These are connected together by what is called a network of cables; such a network setup within an institution is called Local Area Network (LAN). Network connections offer various speeds of data transfer. An institution has to plan for network points and connections the same way that the civil architecture of the building is planned when building the hospital. Wide area networks (WANs) are used when multiple hospitals dispersed geographically use a His made available from a single installation.
Newer technologies like wireless interfaces between the client computers and a wireless network setup across the hospital, palm-top interfaces and PDA (personal digital assistant) interfaces are also being introduced by some vendors. These are intended to improve usage and acceptance of the system by the users. The application Service Provider (ASP) model is one in which the vendor himself maintains the application for the client out of his own data centre such that the client can focus on his core competency of rendering healthcare services without bothering about the maintenance of the IT infrastructure for the hospital.

IMPLEMENTATION OF HOSPITAL INFORMATION SYSTEM
(HIS) has always been a challenge. This scenario is not only true for hospitals in India hut also in the West. The implementation challenges in Indian hospitals are multifold and broadly fall in the following categories:
•   Setting up right expectations from the management and users in the hospital .
•   Availability of accurate and exhaustive master data
•   User training
•   Acceptance and appreciation of computerisation by medical, paramedical and other healthcare specialists
•   Quantifying Return on Investment (ROI) and Key performance indicators (KPI)

Implementation of HIS in hospitals is not mere computerisation of the hospital; it is just not about automation of existing paper trail. This approach, if followed will not only lead to failure of the implementation but also transfer the inefficiencies of the manual system to the computerised environment. [3]
Proper business processes, re-engineering and accurate definition of workflows incorporating global best practices will improve the effectiveness and efficiency of the hospital and in turn provide better patient care.
A good HIS product should not only cover the functionality of all the business processes in a typical hospital but more importantly have the flexibility of customisation to the specific needs of the hospital through parameterisation and the ability to configure alternative workflows. There will be resistance from users (for instance, from nurses, phlebotomists other paramedical staff, etc) who may feel that feeding information into the computerised system is additional work and not their primary responsibility or core competence.
Rigorous and continuous training, user friendly screens, hand-held devices for data input and most importantly showing tangible benefits are the answers to overcome this initial resistance. Enough cannot be said

about the extensive preparation required to collect the initial master data. These master data parameters are the ultimate drivers of your system and please remember the old computer adage Garbage in, Garbage out!!!

It is equally important that the right infrastructure in terms of right sizing, the servers and PCs, with good bandwidth network connectivity and clean power supply will go a long way in ensuring smooth and satisfactory implementation.

The return on investment of a HIS implementation can be looked at with both tangible and intangible benefits in mind. A well controlled inventory system can bring in savings of 10 to 15 per cent in the first year itself, thereby justifying the investment for a HIS product in big hospitals. The benefits include improved bed turnover ratio, on line billing to capture all transactions across all departments, drug expiry management, accurate and reliable laboratory test results due to on line interfaces to laboratory equipment, leading to accountability and higher profitability in hospitals.[3]

The third scenario is best suited for the large hospital chains. Business process reengineering and software implementation runs parallel. But it differs in a way from second scenario is that BPR has high impact while starting the project and at last before the final implementation of project BPR should have been finished.

ADVANTAGES/DISADVANTAGES
Advantages of HIS:
Efficient Patient Care is what determines repeat visits bythepatients.

Improves the patient safety using the common information sharing in the different department.

HIS provides better information security and confidentiality to patient's data, which ultimately leads to patient satisfaction and repeat visit of patient.

HISs can improve the efficiency of the hospital in the following ways:

- Maximise the utilisation of hospital resources - HISs can streamline scheduling of active (staff members) and passive (rooms, equipment) resources thereby optimising the use of resources.
- Remove oversight in processing - HISs can do away with oversight in manual systems.
- Remove unnecessary (error probe) manual intervention - In manual systems, laboratory staffs have to pick up the results lists output by the automated instruments, and transcribe them onto paper result reports (which often introduce errors) which are then delivered across the hospitals by attendants. As compared to this, in an automated environment, results given by instruments are directly transferred via an interface to the HIS, thus not requiring manual intervention [4]
- Reduce turnaround time - Considering the above example, in a manual system, the transcription of results onto paper result reports takes a lot of time as also the distribution of reports all across the hospital by attendants. In an automated setting, the results transferred through an interface into the HIS are instantaneously available to all across the hospital thereby significantly reducing turnaround time.
- Swiftly and accurately prepare bills - While this can often take up to several hours in a manual system, a well conceptualised HIS can do this at the click of button.
- Improve quality of patient care, satisfaction - The outcome of a successful HIS implementation is that patients appreciate the healthcare institution as a friendly partner having sleek processed that is reasonably priced and has all important information about the patient at fingertips. This improves quality of patient care and satisfaction significantly.[4]

Possible disadvantages of HISs:
- High initial installation and ongoing maintenance costs: - The initial investment for a HIS is often perceived to be high by healthcare institutions. However, case studies return on investment analysis, and cost benefit analyses for successful implementations of HISs in client sites with a management will to apply information technology in healthcare have shown that such a cost is soon offset by the benefits that can be reaped from a HIS.
- HIS maintenance requires a high technical knowledge for maintaining complex computer network structure.
- It is required to enhance the HIS as per the current technological change and business requirements.
- If HIS is not properly designed it increases the overhead to man-power and effectively end-up high cost to the organisation. [5]

FUTURE OF HOSPITAL INFORMATION SYSTEM
Wireless Applications

Scenario One: Typing on the flat screen display of his wireless workstation, a nurse records his patient's history and vital signs directly into the patient's electronic record. As the patient continues to discuss his family's medical history of heart disease, the nurse's pager rattles and buzzes, displaying an abnormal ECG rhythm and heart rate of a critical patient five rooms away. The nurse excuses himself and attends to the ECG alarm.[6]

Elsewhere in the hospital another nurse administers medication to another patient after using a wireless scanning device to double check that it's the right medication and dosage for that patient. Minutes later, the patient's physician walks in after reviewing the patient's dynamically updated medical record via her wireless digital assistant. After speaking with her patient at some length, she enters her notes and orders additional medication and physical therapy. These orders are instantly checked with the pharmacy and logged in at the physical therapy department.

Driving Force for Wireless Application

Driving this wireless technology phenomenon are the recognizable goals of increasing the efficiency of health care delivery-which usually translates into saving/making money-and improving patient care through enhanced communication of medical information. Champions of the wireless revolution claim this technology-at least some applications- will reduce medical errors, increase accuracy of data, increase efficiency of health care personnel, and overall, improve patient care. They make a convincing case by claiming that caregivers need real-time access to accurate patient data - clinical histories, treatments, medications, tests, lab results, insurance information. With wireless networks and mobile computing solutions, caregivers can tap vital information anywhere in the healthcare network. Timely information is obviously valuable and leads to more efficient, cost-effective care. The cost of medical errors to our health care economy-not to mention the actual lives lost or harmed-may even is reduced using wireless technology that is integrated with a medication management system (more detailed discussion to follow).[6]

Innovative wireless healthcare applications: more than souped up PDAs

A fair number of wireless technologies resemble Palm Pilots TM, and are equipped with some amazing medical software. Beyond hand-held devices, the breadth of wireless applications shows just how vast and innovative this wireless revolution is becoming. Most obviously, wireless technology seems to fit best in settings that would be difficult to install network cabling, such as imaging centers, laboratories, and surgery suites. Yet, wireless solutions could be useful at virtually every point of patient care, and even some places where patients themselves rarely \tread-administrative offices. Medical wireless applications range from clinical monitoring to lab result reporting to medication management to robotic delivery carts to real-time eligibility verification and claim submission. The following illustrations show just a few of the wireless applications cud in health care facilities today. (Where possible, Web sites for vendors have been provided.)

Administration and resource management

Wireless networks and mobile computing devices such as hand-held computers make quick work of healthcare paperwork. Wireless LANs connect hospitals, clinics and I, Hors offices directly to insurance companies so that claims can be submitted as the care is actually delivered. Mobile computers and scanners can also keep medical supplies moving efficiently from the distributor, to the warehouse and to the health care facility. The logging of equipment and management of inventory on wireless units can make the work of resource management much more efficient.

Wireless pre-hospital care

Wireless technologies can be implemented even before the patient enters the hospital with devices installed in ambulances. Critical cases often call for paramedics to call ahead to the emergency department to prepare the waiting medical team.

However, with a wireless based video system, video images, audio, vital signs, and ECG rhythm strips can be captured and sent from a moving ambulance. Images can be automatically captured from a moveable camera in the ceiling of the ambulance, above the patient's head. This information is reviewed in real or near-real time by not only the ED team, but also other tertiary center specialists.

Mobile workstations

Nurses stand to gain in the wireless revolution as well, as a growing number of hospitals are being outfitted with mobile workstations. This will allow health care personnel to collect a wide array of patient information, as well as carry out real-time charting in the patient's electronic medical record, and place orders for

equipment or other therapies. The advantages of a nurse walking from patient to patient collecting and transmitting data on a mobile unit are obvious compared to running back and forth to the nursing station for manual input and retrieval of data. Whether these workstations are installed in patient rooms or fixed to a rolling cart, wireless technologies permit a growing number of functions to take place remotely. Mobile workstations can also be found in surgery suites and during emergency procedures, where wireless technologies keep operating room and emergency room staff in constant communication with each other and with lifesaving patient data. Laptops equipped with wireless PC card adapters stay at the surgeon's side, even in the operating room.

Medication management

Handheld scanning devices, analogous to the bar code scanners found in grocery stores, are now being used by nurses to access Internet-based electronic medication records databases. A nurse scans the bar-coded medication and the patient's bar-coded ID bracelet to confirm that the right medication is given to the patient at the right time and right dosage. Mobile systems like this have the obvious benefits of improved medication management, which potentially can reduce medical errors-a costly by-product in an increasingly complicated and fast-paced health care[6] system. Other wireless handheld devices allow medical personnel to access patient medication profiles, request medication refills, and perform dosage calculations. Still others provide chronically diseased patients with wireless devices to ensure that they not only start their medication regimen, but also continue to alert patients (with alarms) to take their medication on time

Hand-held data assistants

The days when physicians kept a pocket full of paper scraps with patient data, notes, and a tattered mini drug reference guide in their lab coats may soon be over. In its place are wireless hand-held devices that offer the practitioner a multitude of instant references, patient tracking software and a real-time access to the pharmacy for starters.

By the time practitioners master those functions, they'll also be able to tie in distant satellite clinics, access the hospital's patient record system, and connect to insurance Companies or hospital database systems. It all boils down to more efficient access to iii formation that will lead to quicker and possibly more accurate medical decision-making.

Patient monitoring

A wireless network enables hospitals to make any bed a 'monitored bed.' Wireless monitoring of patient beds has many benefits, not the least of which allows continuous Hid non-invasive tracking of patient vital signs without disturbing the patient. Another patient monitoring application includes wireless mini-laptops that give health care practitioners real-time access to patient data. Such devices not only view live patient data, but also look retrospectively to examine trends. Some devices-which resemble pagers-ring if a predetermined vital sign or waveform (ECG) reaches an unacceptable level or form. Atone or vibration will alert the caregiver, displaying the most recent ECG waveform, heart rate, patient's name, room number and alarm message.

Ambulatory/Home patient monitoring

Wireless technologies can also be applied once the patient has left the reaches of the hospital's WLAN. Several wireless units now offer telemetry monitors which track a number of vital signs, such as ECG, heart rate, pulse oximetry, noninvasive blood pressure and send it back to a central nursing workstation. These units are slightly larger than a cordless phone, and can be used tele-metrically as well as a stand-alone monitor. At home, patients can be trained to use these devices to remotely monitor and transmit heir medical data to a host computer. Diabetes care is a popular application where patients can regularly monitor their blood glucose levels and send this data to a central station.[6]

PROBLEM IDENTIFICATION

Being initial phase in the life cycle of Hospital Information System shortcomings are:

- *HIS addressed mainly the administrative functions in the hospital like, patient registration, admission, discharge, transfer, billing, material management and lab investigations.*
- *HIS is expected to support the core clinical consultation of the patients, clinical support functions like automation of lab services, radiology services etc.*
- *Though software implemented is user friendly but require to get updated.*
- *There is no editing provision in many modules if wrong entry has been made by the users. This is responsible for the panic and cyber phobia among the users.*
- *Nursing station, Requires extensive training in informatics*

- *In discharge details, software is not accessing investigation details of the patient, automatically.*
- *During lab request in lab module, while sample management, tagging of sample is tedious job and cause of delay as there is no provision to tag multiple samples of the same patient simultaneously.*
- *There is no provision to track records.*
- *Doctors are lacking access to hospital information system.*
- *Lack of awareness of Information Technology among healthcare professional of the hospital.*
- *Duplication of the work by nursing staff affecting patient's care.*
- *Modules are not provided to the concern department.*
- *Medical record module is only ten percent in use for ICD purposes, no provision for interoperability.*

II. CONCLUSION AND RECOMMENDATIONS:

HIS not only provides an opportunity to the hospital to enhance their patient care but also can increase the profitability of the organisation. The Return on Investment (ROI) coupled with an enhanced image of the hospital act as drivers for health care providers to invest in good systems that will keep their patients satisfied. The new techniques are now rapidly accepted in the healthcare institutions globally. It has already been proven that these techniques enhance the patient safety marginally. These new techniques provide more decision power to doctors for patient's treatment plan via providing vital information about patients on point of care. Hospital will get benefit via more patient satisfaction level which in turn improves the repeat visits by patients.

The result from the study very well reveals that the hospital services is not taking full advantage of the HIS provided by the e-medicare software by Birla-Soft.

The first and the utmost recommendation is to get the entire HIS upgraded.

In the IT master plan, a high-level architecture must be chosen in which the integration of the various subsystems is described. The plan describes the information flows and the integration techniques at a high level. If the choices made exclude specific options then these must be stated.

Unless a monolithic system from one manufacturer is chosen, the management will always have to decide how the system is going to be split into manageable parts that will serve as the building-blocks of the HIS.

The connection between the medical and nursing systems will have to be very efficient because most workflows exceed the limit of these systems from time to time. In such cases it is best to perform the integration at database level, with one system directly interrogating the database of the other (client server) to make sure that data transactions can be handled with a speed that is sufficient not to jeopardize the operational functioning of the participating systems.

The different subsystems are managed decent rally it is best if the routing rules and filters are centrally managed on the central node. Administrator access and passwords for the central node must be protected with special care, as all (medical) information passes via this server.

As far as possible, define the access control rules centrally. We suggest working with unique log-ins on the results server and, where an application server retrieves results with a group log-in, to determine what security measures this server must implement in the area of authentication, authorisation and logging.

All 'server' machines must be protected against the failure of a disk by RAID or mirroring.

Make sure that the discipline required for authentication is included in a document containing the 'code of conduct for computer use' and that all users are bound to this document in a legally enforceable way.

The authentication should preferably be based on that of the underlying management system or be synchronised with it.

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