Computers in Hospitals

Mr. John Martin arrives at the hospital to see his patients. He will examine the records of their vital signs of life and decide if anyone is well enough to leave the Intensive Care Wards and to return to the normal wards. He will then decide upon his operating list for the day as all neurosurgery operative patients need intensive care post operatively. This is in the day to day running of a busy hospital department.

The hospital being in close proximity to the M4 deals with numerous cases daily. It now boasts a helipad that allows chronically ill patients to be transferred quickly to the A&E department.

Mr. Martin will use all the advantages that ICT can give him in the care of his patients. He will use ICT in numerous different forms as he gather the information needed to help his patient and to ensure that he cares for them in to the best of his ability.

ICT is at the heart of the patient care. It is developing in all exciting and diverse methods in the quest to help care for ill people. Let us look at some of the ways that this occurs.

There are two main areas of computer use in hospitals:

Basic ledger system
Use for patient care

Ledger system.
This deals with the day-to-day purchases that the hospital needs to keep going on a day to day basis. It covers everything that is bought by the hospital and accounts for their purchase and their use by a particular department. All departments have budgets and these are then managed by the computer system.

The finance system also manages the payroll needs of the hospital. This is the basis by which health authority pays the salary of each individual.

Advantages

- Easy to trace the spending of individual areas
- Cheaper sourceing of materials and items when buying bulk
- Budgets are set early on so that they can be adhered to
- Allows overall monetary control to be decentralised

Disadvantages

- Expensive patient care has to be balanced with the budgetary controls
- Epidemics can not be planned for
- New procedures tend to be expensive
- Drug bills are expensive

In Patient use.

The creation and management of lists.

Patient personal records are not kept on computer. There are many issues as to why this is and they will be dealt with later on. At present, patient records are transcripted manually and these records are then held in the Medical Records Department. A computer is used to manage the list of appointments for clinics that go on daily at the busy hospital. Waiting lists are produced for each clinic and the names of the patients on the list are then processed so that their notes are delivered to the correct clinic ready for the day's work. The notes can include a record of previous visits, previous consultations and diagnoses and include also results from tests.

So large is this delivery that a small truck runs around the hospital continually all day long being loaded with notes for the clinics and for the return journey to Medical Records.

A patient is assigned a unique number when they enter a hospital, the keyfield in a database This unique number is only used in that hospital and is not transferable to any other, even those within the same health authority or trust. The computer held patient records does not carry any detail of their complaint or diagnoses but holds only their doctor's name, their GP's name, the date of their appointments and the consultant's name that they are under. (The name of the doctor that is treating them may differ from their consultant's name)

The computer system allows for case note tracking and as an administration tool for the overview of lists and details. When a list appears, the medical records team prepare the appropriate notes and test results for the individual and these are then delivered to the designated ward for admission or to the clinic that they are attending that day

The use of the keyfield allows direct access to the patient record. The patient's records are kept up to date manually and the Medical Records teams type these up. Detailed notes, such as diagrams by the doctor/surgeon are left in records and all printed work is transcribed.

The different areas of the hospital have different uses of IT. The systems developed are unique in their specialism so that they perform the task designated for them. The systems continue to evolve, becoming more sophisticated as they are developed and enhanced. They become more sophisticated in what they do, clever in detecting the tasks prescribed to them. This clearly demonstrates the continual development of ICT

The Haematology Department (Blood)

One computer system is used to administer blood tests and to track blood that is transfused to patients.

Transfusions.

An ill patient is brought into hospital needing an operation. The patient's details are recorded and using this information, a bracelet is produced with the keyfield number printed on by barcode. The use of the barcode is to make the input of information as correct as possible. The scanner used reduces the human involvement and the chance of error there in. The barcode is used to track the transfusions that may be given to the person.

On the unit of blood, there is another unique barcode, which can trace the blood from who gave it. This allows the tracking of the blood as it comes into the system and can trace the individual that gave the blood. This system relates to problems that have arisen over the last few years, especially the CJD (Mad Cow disease) and how that could be spread by transfusion.

When a unit of blood is despatched to a patient, the blood transfusion department scans it and the appropriate barcode is printed out at the department and stuck on to the unit of blood. When it reaches the patient, the scanned barcode on the patient's bracelet and the scanned barcode on the unit of blood have to match before the blood can be administered as a part of a treatment or operation.

Part of the bracelet printed At Morriston Hospital

This system used is called ISBT 128 and is similar to the ISBN system for the cataloguing of books. The system has the following advantages

Advantages

- Blood can be tracked from donor to patient
- Ensuring that the correct blood is given to the correct patient, cutting down the chance of mistake.
- Cutting down the chance of cross contamination

So blood is tacked from the donor to the patient. It can be detected in the system and its bar-coding reduces the human error that may occur in the system.

Other systems in Haematology are aimed towards the computerisation of the tests that take place on the blood of patients. In the Pathology laboratory, the use of ICT enables the diagnosis of blood disorders and biochemical problems. This may be the counting of red blood corpuscles, the analysis of the composition of the blood etc. and all these are carried out automatically. The machines are regularly calibrated and checked to ensure their accuracy by outside bodies. (I think that's a PUN)

Results from these tests are transferred to the ward and the doctor that ordered them via a computer system. This system uses a LAN to communicate the information to the doctor and the correct ward as soon as it is available. This speeds up the return of the appropriate results to the doctor to aid the diagnosis of the patient's problems as quickly as is possible.

The automation of the tests reduces the chance of human error by using a machine to analyse the samples. It reduces the need for highly trained staff as far as possible. There is an issue here with the over-dependence with a particular system. If this system goes down, what would happen to the test that are needed immediately

The only place where this is not possible is in cytology tests where the sample has to be viewed via a microscope. The trained laboratory technician is looking of a change in the cell structure or the presence of wrong type of cell. These may be rogue cells or pointers towards future problems. This has to be done by a trained pathologist and it only a trained person who can be entrusted with this work. No computer program is yet in place to do away with the trained operative in this field.

Hospital Communication – The use of WAN

To communicate information between hospitals for example from Bronglais Hospital in Aberystwyth to Morriston Hospital in Swansea closed network is used. This allows x-rays and scans to be sent by a doctor to a specialist for them to share their opinion. This gives the doctor a second opinion by a specialist in that field. The closed nature of the network ensures the confidentiality of the sent material. All hospitals in Wales are linked together and there is also a gateway to English hospital. It is a system that ensures the correct and best advice for that patient. The message can be sent quickly to its destination and the information can be discussed whilst looking at the image.

Intensive Treatment Unit (ITU)

The area of Intensive Care and Treatment in one with the use of ICT at its core. Patients can be admitted after trauma (e.g. an accident such as car crash or industrial incident) or post operatively where they may have undergone major surgery. Some patients are also referred when an illness or condition escalates in seriousness.

All patients' in ITU are in a one to one situation with a nurse to every patient. Sensors linked to computers and alarms constantly monitor the patient. The readings of the sensors is recorded by computer but legally at the moment, the nurse records the maximum and minimum readings manually. These

records are kept for all patients and are shown top the doctor in charge of the case.

Different sensors can measure a number of different body functions such as

Temperature
Pulse
Blood pressure
Central venous pressure
Heart rate
Blood gases e.g. oxygen in the blood
Gases as a breakdown of breath
Brain monitoring measuring brainwave activity
Continual ECG heart monitoring
Fluid level testing
Inter cranial pressure (pressure in the skull)

With dedicated computers and sensors for these aspects mentioned above, there is the continual monitoring of the patients, 24/7. Alarms are set for extreme readings allowing nurses and doctors react to each condition as necessary.

The data can then be turned into information as it is represented as graphs or when the maximum or minimum readings are read. It allows doctors to spot trends in patient care and to look at the effect of administration of drugs and dosage. This is only truly possible with the computer records where certain times can be examined in greater detail enabling closer examination at definite times in the patients treatment.

Doctors can then act on the input that they are receiving from the equipment. For example, the central venous pressure gives the anaesthetist the information to prescribe more or less fluids to ensure the maintenance of fluid levels.

All this gives the best possible care for the ill patient. It gives the patients the best possible chance for recovery. An area though that cannot be quantified by sensor or probe is the measurement of pain and that is a value judgement that cannot placed on computer record.

Quantifying Measurements for Input to a Computer

Apache

All patients entering ITU are given an APACHE score. This is a raw diagnosis of their illness quantified so that it can be measured The figure is used to see how a patient improves and gets well. The details of all patients in ITU's are sent on to ICNARC (Intensive Care national Audit Research Centre). Here the centre looks for areas of good practice and specialism. If a particular centre is producing good results then the good practice of the centre may be shared with others.

There is has to be the quantifying of the measurements of illness so that it can be put onto a computer database and compared to other centres across the country. Whilst various factors can be easily measured such as temperature and heart rate, others become difficult to quantify such as the measurement of pain.

Diagnostic Tools

The MRI Scanner

The Magnetic Resonance Imaging Scanner is a radiology technique that/ uses magnetism, radio waves and a computer to produce images of the body structure. A huge circular magnet is in the tube that surrounds the patient. When the magnet is switched on, the detection of change in magnet resonance is picked up by radio waves and this change can be modelled by a computer to produce an image. Different tissues change the resonance of the magnetic waves. The image and resolution of the image produced is quite detailed and can detect tiny changes in the body. By changing the reading of the magnetic resonance and by measuring the change, it can

focus the image on different aspects of the patient, producing some quite spectacular results.

The scan is made up of a number of slices through any section of the patient. The distance these slices are apart can be set by the operative to the request of the doctor. It can show up quite clearly any part of the body.

This enables the doctors to investigate problems that could only be looked at previously by surgery. For example, the surgeons can now examine the inside of the heart and how it is functioning. The inner part of the brain can be examined. By changing the resonance of the scan, different tissues and other areas such as blood vessels, tissue, bone or ligament can be seen clearly in the resulting picture. Then neurosurgeons can investigate the integrity of the spinal cord after trauma; brain aneurysms and tumours can be seen clearly. Contrast agents can also be introduced to increase the accuracy of the images.

Accurate pictures can be taken of joints that show up the soft tissue as well as the bones of the body. The heart and aorta can be clearly seen as well as glands and organs, all these without surgery.

Sir Peter Mansfield and Paul C. Lauterbur were the two individuals who developed MRI scanning. The American, Lauterbur discovered the possibility of producing a two-dimensional picture by variations in the magnetic field. Mansfield, from Nottingham, showed how the emissions of the magnetism could be mathematically analysed. He also demonstrated how fast imaging could be achieved though it took more than a decade for his projections to become reality. For their work in developing this scanner, both were awarded the Nobel Prize for medicine in 2003.

Parallel processing and distributed computing

In distributed computing, a number of computers would process its own share of the work independently. This is when the computers that are linked together are all set onto the same task at the same time. An example was in Canada where numerous computers were set a task overnight via the Internet by a university. Their combined computing power allowed them to tackle a problem too large for an individual computer to take on.

Parallel processing is the use of many processors in a single computer. This allows the processors communicate with each other much more quickly. Multiple processors make the writing of programmes much more difficult and this is why they are not widely used.

Some MRI scanners us two 930 Mhz. processors linked together and extremely large hard drives (6 terabytes and larger) to capture the resultant data. The processing power will be used to put the scans together into images, which can be understood by the doctor.

The memory of these machines is backed up every other day, the files being written to optical discs, these then being stored. It allows for a large amount of data to be backed up and catalogued. When a patient returns for check-up, a new scan can be done and the two images, one from before the treatment and one after treatment can be compared. This can also be examined when the patients return after a few years on a matter not connected or otherwise. It gives the doctor a much broader picture of the patient's health and help with an accurate diagnosis and treatment.

All scans are backup on optical disk every three days. The use of an optical disk is to future protect the images.

The Future

The role of Director General of the NHS Programme for ICT is a vital one. There is a need to take healthcare into the digital generation.

There are many avenues that are being investigated and acted upon. One is Electronic Patient Records (EPR). This is the venture to put all patients' records online so that all hospitals have access to them, If you were taken into any hospital anywhere in Britain they could call up your notes and see if you are for example on any medication at the moment. This can only lead to better diagnosis of patient's problems and improve the chances of survival,

This would allow the sharing of information between hospitals, between trusts and health authority, something that does not go on now. It would greatly improve the care a patient receives at an A & E department.

Problems associated with the introduction of such a system would be the compatibility to all. Large projects such as this are notorious for running over-budget and time and the need for the system to be robust, user friendly and future proofed create an immense task. Security of Information is also a major concern as well as the updating of all patient records. Many issues have to be dealt with.

These plans would also make it possible to book appointments with the doctor over the Internet and would be able to look at their own notes also. Patients would also be able to choose where they went for an appointment and to select the practise they attend for a consultation. Your personal notes are locked in a filing cabinet somewhere and at present there are something like 660 million pieces of paper in the NHS system and a vast majority have been typed 2 or 3 times. Streamlining this would cut down on a lot of waste and repetitive work.

The computerising of the patient records would also create a huge database of all the people in Britain. This could also allow an epidemiological investigation to take place. People's records could be compared to see what treatment worked and what other factors there may have been for some complex illness. Trends could be spotted at their early stage and remedial action taken to stop them quickly. This information would be available no matter where the hospital was or what the condition of it is.

A database such as this can also be seen as a step towards a national identity programme where to get treatment one would have to proof of nationality and proof of residence in this country. You would have to exist on the database before one can be dealt with. Immigrants, legal or otherwise would have to prove their adherence to these rules.

There are many problems and a lot of work has to go into their development before they can be achieved. Numerous issues need clarification and many avenues have to be explored before completion. There is though a great improvement that can be made and a huge streamlining of the bureaucracy of the NHS letting managers target the money spent in other directions.