Introduction
Tata Memorial Hospital embarked on a pioneering path to use Information Technology for its Information System when in 1985 a Norsk Data 500 Supermini computer connected to 40 dumb terminals was installed in the hospital.

In 1997 the Hospital Management decided to review the systems, processes and administration to make use of Information Technology for effective day-to-day decision making. Consequently the IT Infrastructure was upgraded with the commissioning of an AS/400 IBM server on Ethernet backbone with Client Server architecture and PCs acting as intelligent terminals across the Hospital to meet future needs.

Aims and Objectives
• Improve Patient Care
• Integrated, Online Information System
• Effective, Economic, Timely and Manageable Data Processing
• Better tools for Management
• Maximize commonality of Equipment and Systems
• Contain Costs of Operations
• Overall Cost Benefit

Infrastructure
The Hospital currently has 2 iSeries servers (810, 820) and around 500 Pentium PCs connected over a campus wide network based on structured cabling. The Hospital has a VARIS network for Radiotherapy. The recent acquisition of PACS (Picture Archival and Communication System) based on Ultrasparc III Sun V-480 machine has enabled the Digital Network to cover the entire gamut of activities of the Hospital. The Hospital Information System runs on a DB2 Database Server. The front end software is developed in Visual Basic having a Graphic User Interface (GUI). The System has several features namely:
• Modularity
• Scalability
• Online Integrated System
• 24 x 7 operations including data replication and fall back using MIMIX software
• Built in Security and Validation Checks
• Flexibility to take care of unforeseen situations

Customer’s Testimonial
A look at customers’ success and achievements

“Information Technology has had a synergistic effect on treatment facilities to deliver quality healthcare.”

- Dr. (Ms.) K. A. Dinshaw, Director, TMC
Clinical Information System (E.M.R.)

Patient Administration System implemented in 1999 is a pivotal system in the Electronic Medical Record. It takes care of the following patient care activities.

- Registrations, Appointments & Travel Concessions
- Admission Wait-listing, Admissions, Transfers & Discharges

Since its inception there are approximately 300,000 records of patient details available on the system. The system provides key demographic and patient status information to other modules.

Management Control Information such as Trends in Registration, Waitlist, Bed Occupancy, Lead Time Analysis for Treatment, and Readmission Rates are important outputs of this system.

Diagnostic Information System, implemented during the period 2001-03, has enabled the Hospital to put the following diagnostic services on the map of the Electronic Medical Record.

- Radiodiagnosis consisting of Conventional Radiography, Interventional Radiography, CT Scan, MRI Scan, Mammography and Ultrasonography.
- Pathology including Surgical Pathology, Cytology, Biochemistry, Tumour Market and Emergency Laboratory
- Microbiology
- Haemato-Oncology
- Transfusion Medicine including Blood Banking
- Diagnostic Endoscopy
- Cardiology including E.C.G., Echocardiography, Stress Test and Pulmonary Function Tests

In addition to placing the Diagnostic Reports on the Clinician’s Desktop, this module provides for tracking of requisitions and has built-in validation checks for Workflow Management and Business Rules enforcement.

Interfacing of Analytical Equipment like Biochemical Analysers and Cell Counters with the Diagnostic Information System has reduced lead time for reporting and eliminated transcription errors.

The procurement of Picture Archival & Communication System (PACS) (see Figure 1 above) and its integration with the HIS - RIS has enabled coupling of Radiology reports and relevant images for speedy retrieval by the Clinician.

In the first phase, the digital imaging modalities i.e, CT, MR, Ultrasound & Colour Doppler, and DSA units have been networked for interdepartmental transfer and storage of images in digital format. It is also planned to convert conventional radiographs to the digital format.

The long-term objective is to go completely ‘Filmless’ as part of a Cost Containment and Interrelated Technologies Utilization exercise.

Operation Theatre Module, being currently implemented, has the following features:

- Scheduling of Procedures
- Pre-Anaesthesia Evaluation
- Pre-Operative Check Lists
- Surgical Procedure Details
- Anaesthesia Details
- Post-Operative Check Lists

The Surgical Record, Anaesthesia Record, Operation Theatre Register and Clinicians’ Log Book are...
important outputs of this module.

**Radiotherapy Treatment Planning System** uses a VARIS Network VARIS Local Area Network where it is possible to transfer data digitally from CT Scan/MRI and Treatment Planning System (TPS) to the Linear Accelerators. This ensures accurate and quick data transfer for Conformal Radiotherapy, SRS/SRT and IMRT with complete verification.

The following systems are being developed to complete the Electronic Medical Record:
- Radiation Oncology Information System
- Medical Oncology Information System
- ICU information System
- Nursing Information System

The completion of the Electronic Medical Record will aid in Clinical Research and further complement the compilation of the Hospital Based Tumour Registry.

**Cancer Telemedicine Service (CANTELMED)**
The Hospital offers comprehensive, multidisciplinary, Telemedicine Service for cancer care across the country. This service involves networking of all 19 Regional Cancer Centres in the country. Currently Tata Memorial Hospital is linked to B. Baruah Cancer Institute, Guwahati. The remaining centres will be networked in phases by the year 2005. Tata Memorial Hospital is also networked to Walawalkar Hospital, Chiplun and Nargis Dutt Memorial Cancer Hospital, Barshi (Telepathology Project), both in rural Maharashtra, as part of outreach programs.

The service involves exchange of medical data, radiology and pathology images, and online consultations between the networked centres.

Benefits from this service are improved access in previously unserved/under-served areas, reduced costs and improved quality of care.

**The Library Information System** includes Library Cataloguing, Interlibrary loans, Serial control, Bindery management, Circulation, Statistics, Housekeeping and Budgeting, Barcode integration of the systems, and a web-based access to the Library Catalogue.

**Electronic Financial Record (E.F.R.)**
The Electronic Financial Record covers the entire set of commercial activities of the Hospital.

The **Financial Management System** integrates all the financial functions into a complete system for a real time financial analysis of all functions including Patient Billing & Receipting, Purchase and Works Accounting, Financial Accounting, Cost Accounting System and Budgeting and Budgetary Control functions.

The **Payroll System** is an integrated system taking its inputs from the Personnel system, and the Financial Accounting system. The design of the system completely automates the Payroll generation process.

The **HRD and Personnel System** includes all the activities of the department covering pre-employment information, employee information, promotions,
transfers, and all episodes of consequence during the employment, leave accounting and time and attendance systems. The system is a pivotal system in so far as it provides inputs to the other systems and to the HIS Security module.

The Materials Management System covers the Stores, Purchase and Dispensary Operations. The Stores Module covers all activities including indenting, purchase requisitioning, receiving of goods, issue of materials and inventory management. The Purchase Module covers all purchase activities from Purchase Sanction, Rate Contracting, Purchasing of Capital Goods, Consumables and Imported Materials, and Purchase Order Follow up.

The Dispensary Module covers several sales counters across the Hospital from where the goods are sold in cash on credit and to the bedside of inpatients. Separate sales counters also cover free and concessional issue of goods to poor patients and to staff patients. The Dispensary Module cover Sales of Drugs and surgical Consumables and Sales Returns.

The Facilities Management System (see Figure 2) covers Complaint Management, Annual Maintenance Contracts. Work Order and Job order, Job order Preparation System, Electronic Measurement Book Record and other Facilities Management Systems. Other support and allied systems include CSSD, Linen and Laundry, Kitchen and Dietary Services and Information Kiosks for Patient Information.

**Benefits**
- Single point data capture
- Tracking of transactions
- Transparency in transactions
- Single window Clearance
- Reduction in turn-around time for services
- Data, image, and patient flow simplification
- Instantaneous financial record update
- Integrated and interdependent systems
- Intelligent data search for education and research
- Improved work culture and user acceptance of systems
- Comprehensive Management Information System
- Measurable financial benefits to the Institution

**Future Plans**
- Web Enabling of systems
- Implementation of Barcode and Smart Card technology
- Establishment of similar IT Infrastructure at Advanced Centre for Treatment, Research and Education in Cancer (ACTREC)
- Seamless information exchange between Tata Memorial Hospital (TMH) and Advanced Centre for Treatment, Education and Research in Cancer (ACTREC)

For further information on Tata Memorial Hospital, please email to tmhms@vsnl.net

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**MILESTONES**

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<thead>
<tr>
<th>Year</th>
<th>Event</th>
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<tbody>
<tr>
<td>1980</td>
<td>Feasibility Study for Hospital Information System by Tata Consultancy Services</td>
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<tr>
<td>1985</td>
<td>Acquisition of Norsk Data (ND550) Supermini System</td>
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<td>1986-1990</td>
<td>Software Development and Implementation on ND Systems</td>
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<td>1997</td>
<td>Systems Review for Online, Integrated, Hospital Information System based on Client/Server Architecture</td>
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<td>1999-2003</td>
<td>Implementation of the following modules:</td>
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<td>~ Patient Administration</td>
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<td>~ Materials Management</td>
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<td>~ Inpatient Billing</td>
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<td>~ Radiology Information System</td>
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<td>~ Laboratory Information System</td>
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<td></td>
<td>~ Operation Theatre Module</td>
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