CHAPTER 7
RESULTS, DISCUSSIONS & SUGGESTIONS
7.1 Introduction

An EHR refers to a complete patient health record in digital format. Electronic health record systems co-ordinate the storage and retrieval of records with the Personal Computer. The efficiency, productivity and quality of health care institutions can be improved with the help of EHR systems. Electronic health record includes all information contained in a traditional smart card including the patient's health profile and also behavioral and environmental information. By the introduction of EHR system, maintenance of health record documentation can be improved with sufficient information of a patient. In emergency cases, the readily available information of patients is very useful to save their lives. The present development of the EHR system maintains privacy and confidentiality of the health information. The health smart card contains the patient's personal details and health details and these cards can be modified by the specified authorities in a hospital. The EHR system prevents administrative errors and streamlines the payment process and also introduces the paperless environment.

In the EHR health details are modified by the doctors and lab authorities only. It also contains the administration, laboratory, pharmacy details, and Clinical documentation and can be linked with other clinical records of a patient from various settings and time periods to provide a lifelong record of events that may have influenced a patient's health. It also encourages and supports the systematic measurement and recordings of the patient's health status and functional level to promote more precise and routine assessment of the outcomes of patient care.
7.2 Results & Discussions

As discussed in chapter 6, in the development of Integrated Electronic Health Record system, all the health parameters like Blood Pressure, Blood Glucose, Pulseoxy and other clinical parameters are transferred and stored in a Personal Computer. Later on the hospital administrator transfers the information of the Master Health Record on to the smart card through the smart card reader (ACR38). The software package developed in VB will be provided authentication to a particular section to furnish the information concerned, i.e. for example, X-ray division will enter the information regarding the chest preview of the image only. In a similar way the other information corresponding to the concerned sections is entered and this information will come to the main administration of the EHR system provided full authentication to transfer the entire health information concerned to all sections on to the smart card through the card reader in a standard format.

The software package has been developed as per the corporate hospital systems for issuing Master Health Checkup file in terms of e-record instead of paper record. In the present study the package provides 14 pages of EHR record and this may be further expanded with to furnish more information.

The main objective of the present research work is to develop an Integrated Electronic Health Record system (IEHRS) to replace paper record with an e-record. This has been successfully tested and implemented. The implementation of data of EHR system may also be communicated via the internet to any person or place. It is also possible introduce the other health information to EHR system like CTSCAN, MRI, and PETSCAN.. etc., required specially for some patients, in addition other information like admission details and discharge summary with hospital charges if necessary. The quality and improvement of EHR system depends mainly
on the maintenance of security and authentication of information/data with the help of hardware as well as software implementation which provide better information about the patient's health.

The author has developed an indigenous IEHRS integrated medical diagnostic system and Electronic Health Record system. This work is of unique nature and has been worked out through instrumentation technology. In the previous chapters the complete details about design and development of instrumentation and interface with pc for the Electronic Health record system are presented. This is a prototype model for patient monitoring in emergency conditions and also in routine diagnostic and therapeutic systems. The second part of this work is devoted to the development of health recording system based on smart card application. The author has made an effort to build a smart card reading and writing system exclusively for health recording application. As per the literature no innovator has made this kind of work in India.

The details of the software of this system are discussed in chapter 6. The author has developed exclusive software in Visual Basic for the reading and writing of the health information on to electronic health recording system. The electronic recording system consists the following items.

1. Primary patient details
2. Nature of complaints and investigations
3. Diagnostic report
4. Admission/OP details
5. Treatment details
6. Discharge summary with prescription and next appointment details
7. Insurance details
The details mentioned above are recorded in the Health card in 14 pages of standard format. The first page is devoted to the details of the patient viz.. Name of the patient, EPR No, age & sex, address, name of the consulting doctor and name of the family physician. This page is a common access for the entire department for noting down the particulars of the patient. The second part, i.e. medical investigation is followed by nature of complaints mentioned by the patient, for this section 6 pages have been allotted for providing the information about imaging (X-ray, CT, MRI), Ultra Sound Scan, bio-chemical test including blood routine, urine routine and microbial investigations. Based on the physical recommendation, extraordinary investigations like hormonal assay and sensitivity test, etc., may also be included.

After completion of physical and bio chemical investigations, the other is the consolidated report generation based on the investigations for diagnostic purpose mentioned on page 9. Page 10 is devoted to a detailed picture of diagnostic report of the complaints, whether the patient needs OP or in house treatment is also recommended. The next page devoted to recording the details of the treatment process and implement about the treatment according to the report. The next page is devoted to giving the discharge summary and follow-up treatment like prescription, physiotherapy details, next appointment date, SOS treatment... etc., The last page is allotted for recording the insurance details as it is applicable. The sample e-record of the output is presented in the following pages as a hard copy.

Finally, the main aim and objective of the author is to develop and implement a more sophisticated Integrated Electronic Health Record system in Indian Hospital system to contribute to better health care of people.
PERSONAL DETAILS

Name of the Patient : N. Hari Krishna
EPR No : SKIM0002409
Patient Tel : 919440780963
Age : 45 yrs
Sex : Male
Tel / Mobile: 919440780963
Name of Hospital/Nursing : SKU Health Services Centre
Corporate Name/Emp : Dr-2298
Name of Consulting Doctor : Dr.A.Suhasini
Tel no : 919705437345
Name of Family Physician : Dr. T. Obulaiah
Tel no : 919866348976
X-ray chest preview

Cardiac outlines appear normal

Radio-opaque densities noted in the midzone of right lung, suggestive calcified granulomata

Rest of right lung and left lung appear normal

No evidence of mediastinal mass lesion

Both hila appear normal

No evidence of pleural effusion

CP angles appear normal

Bony cage and soft tissues appear normal

Impression: calcified granulomata midzone of right lung suggest clinical correlation

Dr. V. Chalapathi Rao
Consultant Radiologist
Liver is normal in position, size, and shape and shows homogenous echotexture. No focal lesion noted. No evidence of intra or extra hepatic biliary duct dilatation.

CBD and portal vein appear normal.
Gall bladder is well distended. No evidence of calculi. Normal wall thickness.
Pancreas is normal in size and echotexture.

Spleen is normal in size and echotexture.

Both kidneys are normal in position, size, shape and echotexture, cortico medullary differentiation is normal.
Right kidney measures: 8.8 x 4.9 cms
Left kidney measures: 9.4 x 5.6 cms

No evidence of Para-aortic or paracaval lymphadenopathy.


Prostate measures: 4.4 X 3.0 X 4.1 cms
Prostate is normal in size and echotexture
No evidence of free fluid in the peritoneal cavity

Impression: Normal study
Suggest clinical correlation

Dr. K. Pramod Kumar M.D, DM., Pathologist
# SRI KRISHNADEVARAYA UNIVERSITY
# HEALTH SERVICES CENTRE

## ELECTRONIC HEALTH RECORD

**Name of the Patient:** N. Hari Krishna  
**EPR No:** SKIM 0002409  
**Referred By:** Dr. T. Obulaiah  
**Tel No:** 919440780963  
**Age:** 45 Yrs  
**Report Date:** 05/02/09

## BLOOD EXAMINATION REPORT

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>FINDINGS</th>
<th>REFERENCE RANGE (MEN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemoglobin</td>
<td>13.9 gms %</td>
<td>12.0-16.0 gm %</td>
</tr>
<tr>
<td>Rbc</td>
<td>4.50 Mill/cu mm</td>
<td>4.5 – 6.5 Mill/cu mm</td>
</tr>
<tr>
<td>Packed cell volume</td>
<td>42.0%</td>
<td>40.0-54.0%</td>
</tr>
<tr>
<td>Meal corpuscular volume</td>
<td>90 cu microns</td>
<td>76-96 cu microns</td>
</tr>
<tr>
<td>Mean corpuscular Haemoglobin</td>
<td>30.0 pg</td>
<td>27-32 pg</td>
</tr>
<tr>
<td>Mean corpuscular Haemoglobin conc</td>
<td>33.0%</td>
<td>30-35 %</td>
</tr>
<tr>
<td>Total W B C count</td>
<td>7100/cu mm</td>
<td>4000-11000/cu mm</td>
</tr>
</tbody>
</table>

**Differential count**

- **Neutrophils** 65%  
  40-75%

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Dr. P. Pragna Rao M.D.,  
Biochemist

---
# SRI KRISHNADEVARAYA UNIVERSITY HEALTH SERVICES CENTRE

## ELECTRONIC HEALTH RECORD

<table>
<thead>
<tr>
<th>Name of the Patient: N. Hari Krishna</th>
<th>EPR No: SKIM 0002409</th>
</tr>
</thead>
<tbody>
<tr>
<td>Referred By: Dr. T. Obulaiah</td>
<td></td>
</tr>
<tr>
<td>Tel No: 919440780963</td>
<td>Age: 45 Yrs</td>
</tr>
<tr>
<td>Report Date: 05/02/09</td>
<td></td>
</tr>
</tbody>
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<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Lymphocytes</td>
<td>28%</td>
<td>20-45%</td>
</tr>
<tr>
<td>Eosinophils</td>
<td>3%</td>
<td>1-6%</td>
</tr>
<tr>
<td>Monocytes</td>
<td>4%</td>
<td>2-10%</td>
</tr>
<tr>
<td>Basophils</td>
<td>0%</td>
<td>upto to 1%</td>
</tr>
</tbody>
</table>

**Peripheral smear**

- Normocyclic/normochromic
- Platelets adequate

**ESR weatengern method**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1st hr.</td>
<td>10 mm</td>
</tr>
<tr>
<td>2nd hr.</td>
<td>12 mm</td>
</tr>
</tbody>
</table>

**INVESTIGATIONS**

- **Plasma glucose fasting**
  - Corresponding urine sugar: nil
  - FINDINGS: 101 mg/dl
  - Reference Range: 70-110 mg/dl

- **Plasma glucose post lunch**
  - Corresponding urine sugar: nil
  - FINDINGS: 121 mg/dl
  - Reference Range: 70-150 mg/dl

Dr. PRAGNA RAO M.D.
Biochemist
**SRI KRISHNADEVARAYA UNIVERSITY  
HEALTH SERVICES CENTRE**

**ELECTRONIC HEALTH RECORD**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value (Normal Range)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Name of the Patient:</strong> N. Hari Krishna</td>
<td></td>
</tr>
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<td></td>
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<tr>
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<tr>
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<td></td>
</tr>
<tr>
<td><strong>Age:</strong> 45 Yrs</td>
<td></td>
</tr>
<tr>
<td><strong>Report Date:</strong> 05/02/09</td>
<td></td>
</tr>
<tr>
<td>Blood urea</td>
<td>24 mg/dl (15-45 mg/dl)</td>
</tr>
<tr>
<td>Serum creatinine</td>
<td>1.4 mg/dl (0.8-1.5 mg/dl)</td>
</tr>
<tr>
<td>Serum uricacid</td>
<td>6.0 mg/dl (3.5-7.0 mg/dl)</td>
</tr>
<tr>
<td>Serum bilirubin-total</td>
<td>0.90 mg/dl (0.1-1.0 mg/dl)</td>
</tr>
<tr>
<td>-direct</td>
<td>0.20 mg/dl</td>
</tr>
<tr>
<td>-indirect</td>
<td>0.70 mg/dl</td>
</tr>
<tr>
<td>GPT</td>
<td>50 iu/l (upto 49 iu/l)</td>
</tr>
<tr>
<td>ALP</td>
<td>228 iu/l (110-310 iu/l)</td>
</tr>
<tr>
<td>Total proteins</td>
<td>6.9 gms % (6.0-8.0 gms %)</td>
</tr>
<tr>
<td>albumin</td>
<td>4.2 gms % (3.8-5.2 gms %)</td>
</tr>
<tr>
<td>globulin</td>
<td>2.7 gms % (2.3-3.6 gms %)</td>
</tr>
<tr>
<td>A/G ratio</td>
<td>1.5 : 1 (1.2 – 2.5 : 1)</td>
</tr>
<tr>
<td>Total cholestrol</td>
<td>229 mg/dl (140-250 mg/dl)</td>
</tr>
<tr>
<td>Hdl cholesterol</td>
<td>51 mg/dl (35-55 mg/dl)</td>
</tr>
<tr>
<td>Ldl cholesterol</td>
<td>141 mg/dl (70-180 mg/dl)</td>
</tr>
<tr>
<td>Ldl</td>
<td>37 mg/dl (5-40 mg/dl)</td>
</tr>
</tbody>
</table>

Dr. PRAGNA RAO M.D.  
Biochemist

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**SRI KRISHNADEVARAYA UNIVERSITY HEALTH SERVICES**
Name of the Patient: N. Hari Krishna  
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Referred By: Dr. T. Obulaiah 
Tel No: 919440780963  
Age: 45 Yrs  
Report Date: 05/02/09

<table>
<thead>
<tr>
<th>TEST</th>
<th>VALUE</th>
<th>NORMAL RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serum triglycerides</td>
<td>186 mg/dl</td>
<td>15-185 mg/dl</td>
</tr>
<tr>
<td>Raio tot.chol /hdl.chol</td>
<td>4.4 mg/dl</td>
<td>less than 4.5</td>
</tr>
<tr>
<td>Gamma gt</td>
<td>36 iu/l</td>
<td>Male : 10-52 iu/l</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Female: 06-32 iu/l</td>
</tr>
<tr>
<td>Potassium</td>
<td>3.0 mtq/l</td>
<td></td>
</tr>
<tr>
<td>Normal range</td>
<td>3.5-5.2 mtq/l</td>
<td></td>
</tr>
</tbody>
</table>

Dr. RADHA SAGAR  
Pathologist

SRI KRISHNADEVARAYA UNIVERSITY HEALTH SERVICES CENTRE
ELECTRONIC HEALTH RECORD
SRI KRISHNADEVARAYA UNIVERSITY HEALTH SERVICES CENTRE

ELECTRONIC HEALTH RECORD

Name of the Patient: N. Hari Krishna
Tel No: 919440780963
EPR No: SKIM 0002409
Age: 45 Yrs
Referred By: Dr. T. Obulaiah
Report Date: 05/02/09

PRESENT COMPLAINTS

History of presenting complaints:
cold

Duration of Presenting Complaints:
One year

Relevant Clinical Findings
Sinus

Relevant Past history and Treatment:
Taking coldact

Provisional / Differential diagnosis:

Dr. K. Promod Kumar
Consultant Cardiologist
**HEALTH PARAMETERS AND DETAILS**

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Yes/No</th>
<th>Since When</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension</td>
<td>Y</td>
<td>12/10/2003</td>
</tr>
<tr>
<td>IHD</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>Osteoarthritis</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>COPD/Bronchial Asthma</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>Any other Chrronical disorder</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>Diabeter</td>
<td>Y</td>
<td>2/4/2002</td>
</tr>
<tr>
<td>Heart Diseases</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>Cancer</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>Alcohol/Drug abuse</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>Maternity cases</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>Drug sensitivity</td>
<td>n</td>
<td></td>
</tr>
</tbody>
</table>

Dr. K. Promod Kumar  
Consultant Cardiologist
Name of the Patient: N. Hari Krishna

EPR No: SKIM 0002409

Referred By: Dr. T. Obulaiah

Tel No: 919440780963

Age: 45 Yrs

Report Date: 05/02/09

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data of Admission</td>
<td>6/1/2009</td>
</tr>
<tr>
<td>Approximate Expenses</td>
<td>5000</td>
</tr>
<tr>
<td>Room Rent</td>
<td>500</td>
</tr>
<tr>
<td>Investigation charges</td>
<td>2750</td>
</tr>
<tr>
<td>Cost of Implant</td>
<td>----</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approximate duration of stay</td>
<td>10days</td>
</tr>
<tr>
<td>Doctor/Surgeon fees</td>
<td>2500</td>
</tr>
<tr>
<td>OT</td>
<td>15000</td>
</tr>
<tr>
<td>Package Rate</td>
<td>50000</td>
</tr>
<tr>
<td>Total Amount</td>
<td>67500</td>
</tr>
</tbody>
</table>

Dr. K. Mohan Rao
Chief Administrator
PART B - TO BE FILLED BY THE HOSPITAL AUTHORITIES

Sri Krishnadevarya University Health Service Centre will not be held liable for the payment in the event of any discrepancy between the facts presented at the time of admission & in final documents submission.

Signature & Stamp of Treating Doctor: ________________________________

Rubber Stamp of Hospital & Signature: ________________________________

Dr. K. Mohan Rao
Chief Administrator
PART C - INSURANCE DETAILS

I have 'No Objection' to Sri krishnadevaraya University health service centre obtaining data is of my treatment / collecting documents and also hereby authorize PHS to pay the hospital bill and reimburse itself /receive the amount from my claim receivable from my insurance company. If my claim is rejected, I/we (the patient) will pay for the hospital &related expenses should this authorization become null & void due to wrong and / or misleading and / or incorrect information regarding the duration of ailments and /or other historical information regarding my (patients) health status/.I acknowledge and agree that information provided by me are true and up to the best of my knowledge.

Insurance company : LIC
Policy details-Policy No : 10011001
Policy Type : Jeevana Jyothi
Date : 5/16/2006
Amount : Rs: 3, 00,000/-

Contact Information

Address : SV Puram
City : Anantapur
State : AP
Country : India

Dr. K. Mohan Rao
Chief Administrator
SRI KRISHNADEVARAYA UNIVERSITY HEALTH SERVICES CENTRE

ELECTRONIC HEALTH RECORD

Name of the Patient: N. Hari Krishna
EPR No: SKIM 0002409
Referred By: Dr. T. Obulaiah
Tel No: 919440780963
Age: 45 Yrs
Report Date: 05/02/09

DISCHARGE SUMMARY

Diagnosis:
PROLAPSE OF INTER VERTEBRAL DISC C6-7

C/o:
Pain in the neck x 1 year
Tingling sensation in left hand x 1 year

Clinical Presentation:
H/o pain in the neck x 1 Year. pain is of shooting type radiating to left arm
No h/o weakness of left arm/trauma

Past history:
K/C/O diabetes Mellitus x 1 Year
Hypertension x 6 months

O/E:
Middle aged man moderately built and nourished
Conscious & oriented
No pallor/laterus/cyanosis/Clubbing/Lymphadenopathy/Edema
Afebrile
PR-78/min  BP-140/90 mm Hg, RR-18/min
CVS-S1 S2 +
RS- AEIBE, NVBS
PA- soft ,BS +
CNS-HMF normal

GCS- 15/15.  BERL - pupils
 UL    LL
Power Rt 5/5  5/5
Lt 5/5  5/5

Tone- Normal
Cranial nerves- Normal
Name of the Patient: N. Hari Krishna
EPR No: SKIM 0002409
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Laboratory Investigations: HB-16.3 gm/dl, TC-8030, DC-62/28/4/6, PLT-2.83L, BUN-8.6 mg/dl, Sr. Creat-1.1 mg/dl, PT Test/Control-13.3 sec, INR-1.04, APPT Test-26.4 sec

Summary of Imagining:
MRI spine—prolapse of intervertebral disc C6-C7

Pre-operative diagnosis: prolapse of intervertebral disc C6-C7
Operation procedure executed: anterior cervical C6-7 Micro discectomy.

Course in the hospital: Patient admitted with afore mentioned complaints on 5-2-09. Relevant investigations were done and was operated on 6-03-07. Post operative recovery was uneventful.

Condition at discharge: Conscious, oriented and co-operative, vitals- stable

Advise at discharge:
1. Tab, Gramocef-O 200mg 1-0-1 x 5 days
2. Tab, zolfresg-O 10mg 0-0-1 x 1 week
3. Cap. Beneficiale 1-0-0 x 15 days
4. Tab, Stamlo-O 2.5mg 1-0-0 x until further orders
5. Tab, Storva-O 10mg 0-0-1 x until further orders
6. Liq. Cre, affom 2 tsp 0-0-1 x 5 days
7. Tab, Amaryl 1mg 1-0-0 (before food) until further orders
8. Tab, Glycomet 500mg 0-0-1 (after food) until further orders
9. Bed rest for 2 months
10. Review in neurosurgery opd after 2 week
11. Review in endocrinology opd with Dr. Geetha Bhat after 2 weeks with prior appointment tel. no. 2218 3022

Dr. Ravi Gopal Varma.
Consultant neurosurgeon
7.4 Suggestions

1. In health organizations, highly sensitive data and information must be protected with access control systems. These control systems allow defining and controlling which users are authorized to access specific data but prohibit the access of unauthorized users.

2. EHR’s at the national level begins to impose expectations that any new technology must be compatible with data-driven medical enterprises. New data, communication and visual technologies (eg; “endo cams,” digital camera vies of the intensive uploaded to a hip mounted data collection device.

By this more systems will be designed to allow data collective to become a by product of the process administration of a medication to a patient could be integrated billing, inventory and MAR systems. This improvement will come as the systems mature and as the clinical users become more involved in the design of systems and associated process changes.

3. Implementation of standards and vocabulary adoption

Once standards are widely used, clinical trials data can be imported from EHR’s in a standard form establishing comparability across studies and sites. This improvement will free data administrators from the need to validate data types and content and enable them to focus on other activities such as data security.

4. the pay for performance movement

The reimbursement for hospital and physician services is tied at least in part to measures of quality improvement and this suggestion led to the pay for performance movement. It moves towards the goal of recognizing and rewarding quality of health care in hospitals.
5. Healthcare systems in the home will exchange information with other systems in a manner similar to home automation technology.

6. Telemedicine.

Health care is moving closer to the patient and host of technologies allow patients to play a greater role in their own care. In order to maximize the health benefit to the patient, these telehealth systems must be smarter.