



# **INFORMATION TECHNOLOGY AND COMPUTING TOPICS AND THEIR RELEVANCE TO MEDICAL UNDERGRADUATE AND GRADUATE PROGRAM CURRICULA AT RIT**

**A DISCUSSION OF INTEGRATING COMPUTING TOPICS INTO CLINICAL DEGREE PROGRAMS**

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# COMPUTING HAS CHANGED EVERYTHING

A VERY BRIEF TIMELINE USING IMAGING AS AN EXAMPLE

- PRIOR TO 1965 ALMOST NO MEDICAL/CLINICAL EXPOSURE TO COMPUTING RESOURCES EXISTED
- EARLY 1970 SAW THE INITIAL RESEARCH IN NON-INVASIVE IMAGING
- ADVANCES IN APPLICATION SOFTWARE AND COMPUTER HARDWARE SINCE THEN HAVE MADE IMAGING METHODS COMMONPLACE THROUGHOUT MEDICINE TODAY
- CLEARLY, WITHOUT COMPUTING, THERE WOULD BE NONE OF THIS TECHNOLOGY IN USE, NOR IT'S TREMENDOUS BENEFIT TO MANKIND EXPERIENCED
- AND, ALL THAT COMPUTING HAS ENABLED SINCE THEN CHANGED OUR VIEW OF MEDICINE AS WE KNEW IT

# UNDERGRADUATE DEGREE IN DIAGNOSTIC ULTRASOUND

- ULTRASOUND CLINICIANS RELY 100% ON COMPUTING FOR THEIR LIVELIHOOD
- THIS AUTHOR TEACHES THE ONLY COMPUTING-CENTRIC COURSE IN THE DEGREE PROGRAM
- IT BECOMES VITAL THAT THESE STUDENTS HAVE A BASIC UNDERSTANDING OF COMPUTING HARDWARE, SOFTWARE AND ITS INTEGRATION WITH THAT HARDWARE, AND THE SPECIALIZED HARDWARE THAT IMPLEMENTS IMAGING
- IN ADDITION, IT'S ALSO VITAL TO REVIEW ALL THE WAYS IN WHICH COMPUTING AUGMENTS THE ENTIRE HEALTHCARE ECOSYSTEM, WITHOUT WHICH TODAY'S PRACTICE OF MEDICINE COULD SIMPLY NOT FUNCTION

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# THE “COMPUTERS IN MEDICINE” COURSE

- A REQUIRED FRESHMAN-LEVEL INTRODUCTORY COURSE IN COMPUTING TECHNOLOGY AND ITS APPLICATION IN THE PRACTICE OF MEDICINE
- FOUR MAJOR TOPIC GROUPS
  - COMPUTER HARDWARE AND SOFTWARE
  - THE ELECTRONIC HEALTH RECORD (EHR)
  - HOW COMPUTING IMPACTS ALL FACETS OF HEALTHCARE
  - INFORMATION PRIVACY AND ITS IMPLICATIONS FOR CLINICIANS

# THE “COMPUTERS IN MEDICINE” COURSE

## COMPUTER HARDWARE AND SOFTWARE

- HARDWARE PLATFORMS (PC, MAINFRAME, SUPERCOMPUTER, PORTABLE DEVICE) AND THEIR TOPOLOGIES AND USES
- CLINICAL PERIPHERALS
  - BASICS OF MRI, CAT SCAN, AND ULTRASOUND IMAGING TECHNOLOGY
  - PATIENT ROOM TECHNOLOGY (NO MORE CLIPBOARD “CHARTS”!)
  - LAPTOP PCS ON TRANSPORTABLE CARTS THAT ACCESSES PATIENT HEALTH RECORD
  - VITAL SIGNS SENSORS (AUTOMATIC SPHYGMOMANOMETER, PULSE OXIMETER, PORTABLE IV INFUSION PUMP, AND OTHERS)
  - BARCODING SCANNERS
- AND, OF COURSE, ALL THE APPLICATION SOFTWARE THAT INTEGRATES THESE DEVICES WITH THE HEALTHCARE IT SYSTEM

# THE “COMPUTERS IN MEDICINE” COURSE

## COMPUTER HARDWARE AND SOFTWARE

- COMPUTING HARDWARE AND SOFTWARE TOPICS
  - THE INSIDE COMPONENTS OF A TYPICAL PERSONAL COMPUTER
  - COMMON COMPUTING PERIPHERALS (MOUSE, KEYBOARD, DISPLAY, ETC.)
  - HARDWARE/SOFTWARE INTERACTION
    - OPERATING SYSTEM SOFTWARE
    - APPLICATION SOFTWARE
  - NETWORKS AND DATA COMMUNICATIONS



# THE “COMPUTERS IN MEDICINE” COURSE

## THE ELECTRONIC HEALTH RECORD

- THE HISTORY, REGULATING ORGANIZATIONS, PROS AND CONS OF THE EHR
  - ELIMINATION OF HANDWRITTEN RECORDS
  - METHODOLOGIES TO UNIVERSALLY SHARE PATIENT INFORMATION (DATABASES, ETC.)
  - CONCERNS AND PITFALLS IN IMPLEMENTATION
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# THE “COMPUTERS IN MEDICINE” COURSE

HOW COMPUTING IMPACTS ALL FACETS OF HEALTHCARE

- HEALTHCARE DOMAINS (MOST ARE AUGMENTED BY ROBOTICS)
  - SURGERY
  - PHARMACY
  - REMOTE MEDICINE
  - PSYCHIATRY
  - HOME HEALTHCARE
  - AND OTHERS...
- RESEARCH IN OTHER DOMAINS
  - NASA, UNDERSEA LABORATORIES

# THE “COMPUTERS IN MEDICINE” COURSE

## INFORMATION PRIVACY AND ITS IMPLICATION FOR CLINICIANS

- REGULATIONS AND REGULATORY ORGANIZATIONS (HIPAA, GLB, ONCHIT, OTHERS)
- BENEFITS AND DANGERS OF INFORMATION SHARING
- BASIC INFORMATION SECURITY CONCEPTS
  - PHYSICAL SECURITY
  - LOGON SECURITY (PASSWORDS, ETC.)
  - MALWARE
- NEW PARADIGMS (5G, IOT, ANYPLACE/ANYTIME)
- MAINFRAME ADVANTAGES TO SYSTEM DESIGN WITH RESPECT TO INFORMATION SHARING AND SECURITY

# THE MS IN HEALTH INFORMATICS PROGRAM

- THIS AUTHOR IS THE PROGRAM COORDINATOR
- CREATED IN 2016 IN A JOINT VENTURE BETWEEN THE GCCIS AND CHST COLLEGES AT RIT
- SERVES TWO PRIMARY POPULATIONS OF INCOMING STUDENTS
  - CURRENT CLINICIANS WITH LITTLE OR NO COMPUTING EXPERIENCE
  - CURRENT IT PROFESSIONALS WITH LITTLE OR NO CLINICAL EXPERIENCE
- INTENDED AS A PROFESSIONAL DEGREE
  - TWO JOB QUALIFICATIONS UPON GRADUATION
    - ADVANCED USERS OF THE EHR AND EHR/CLINICAL OFFICE MANAGEMENT APPLICATION SOFTWARE PRODUCTS
    - DEVELOPERS OF NEW EHR AND EHR/CLINICAL OFFICE MANAGEMENT APPLICATION SOFTWARE PRODUCTS

# THE MS IN HEALTH INFORMATICS PROGRAM

- COMMON SET OF CORE COURSES
- CHOICE OF TWO ADVANCED TRACKS
- FULL ONLINE DELIVERY
  - TWO 7-WEEK COURSES PER SEMESTER (ONLY ONE COURSE AT A TIME)
  - ONE WEEK RESIDENCY REQUIREMENT NEEDED FOR THE “PRACTICE OF HEALTHCARE” COURSE
- 30 SEMESTER CREDIT HOUR PROGRAM
  - COMPLETE IN TWO YEARS
  - CAPSTONE COURSE (NO THESIS)

# THE MS IN HEALTH INFORMATICS PROGRAM

COMMON SET OF CORE COURSES OFFERED BY:  
GOLISANO COLLEGE OF COMPUTING AND INFORMATION TECHNOLOGIES (GCCIS)-  
INFORMATION AND SCIENCES DEPARTMENT (IST)  
COLLEGE OF HEALTH SCIENCES AND TECHNOLOGY (CHST)

- MEDI-701 INTRO TO HEALTH INFORMATICS (CHST) YR1-SEM1A
- MEDI-705 MEDICAL KNOWLEDGE STRUCTURES (CHST) YR1-SEM1B
- HCIN-610 FOUNDATIONS OF HUMAN-COMPUTER INTERACTION (GCCIS-IST) YR1-SEM2A
- MEDI-735 CLINICAL INFORMATION SYSTEMS (GCCIS-IST) YR1-SEM2B
- MEDI-704 PRACTICE OF HEALTHCARE (CHST & GCCIS-IST) YR1-SUMMER
  - REQUIRES ONE WEEK OF ON-SITE PARTICIPATION IN HOSPITAL PHYSICIAN SHADOWING
  - RIT PROVIDES HOUSING FOR THIS EXPERIENCE
- ISTE-764 PROJECT MANAGEMENT (GCCIS-IST) YR2-SEM1A
- MEDI-788 CAPSTONE IN MEDICAL INFORMATICS (CHST AND GCCIS-IST) YR2-SUMMER OR AFTER ALL COURSEWORK COMPLETED

# THE MS IN HEALTH INFORMATICS PROGRAM

## CHOICE OF TWO TRACK SEQUENCES (TAKEN IN YR2-SEM1 B AND YR2-SEM2A/B)

- **TRACK 1- CLINICIAN (USER) NO PREREQUISITES FOR THIS TRACK**
  - ISTE-608 INTRO TO DATABASE
  - MEDI-610 SCRIPTING FUNDAMENTALS
  - MEDI-731 SYSTEM INTEGRATION CONCEPTS
- **TRACK 2 – ANALYST (DEVELOPER)**
  - ISTE-782 VISUAL ANALYTICS PREREQ - GRADUATE STATISTICS
  - MEDI-730 MEDICAL APPLICATION INTEGRATION PREREQS - MEDI-701, ISTE608, 1 YR JAVA PROGRAMMING (IT IS ASSUMED THAT CANDIDATES IN THE DEVELOPER TRACK WOULD HAVE INTRO TO DATABASE ISTE608 AND JAVA SKILLS UPON ENTRY INTO THE PROGRAM)
  - MEDI-766 BUILDING THE ELECTRONIC HEALTH RECORD PREREQS – HCIN610, MEDI705

# THE MS IN HEALTH INFORMATICS PROGRAM

## COURSE DESCRIPTIONS

### MEDI 701 INTRODUCTION TO HEALTH INFORMATICS

THIS COURSE PROVIDES A RIGOROUS INTRODUCTION TO THE PRINCIPLES OF HEALTH INFORMATICS. THE FOCUS IS ON THE STUDY OF THE NATURE OF HEALTH INFORMATION AND ITS USE IN CLINICAL PRACTICE, CLINICAL QUALITY, AND CLINICAL EFFICIENCY IMPROVEMENTS. KEY TOPICS INCLUDE: THE ELECTRONIC HEALTH RECORD (EHR) AND ITS IMPACT ON HEALTH CARE DELIVERY, THE INTERNET AND MOBILE COMPUTING AS SOURCES OF MEDICAL INFORMATION, HEALTHCARE INFORMATION SYSTEMS, THE SOFTWARE DEVELOPMENT LIFECYCLE, THE IMPORTANCE OF THE INFORMATICS SPECIALISTS IN MEDICINE AND THE VARIOUS ROLES THEY CAN PLAY, AND GOVERNMENT ECONOMIC INCENTIVES AND POLICY ISSUES IN HEALTHCARE SUCH AS PRIVACY, CONFIDENTIALITY, INCLUDING HEALTH CARE REGULATORY AND ACCREDITATION ISSUES AND THE HEALTH INSURANCE PORTABILITY AND ACCOUNTABILITY ACT (HIPAA). STUDENTS WILL PARTICIPATE IN ONLINE DISCUSSION OF HEALTH INFORMATICS. THEY WILL ALSO INVESTIGATE SEVERAL TOPICS OF INTEREST IN THE FIELD AND PROVIDE PRESENTATIONS.




# THE MS IN HEALTH INFORMATICS PROGRAM

## COURSE DESCRIPTIONS

### MEDI 705 MEDICAL KNOWLEDGE STRUCTURES

THIS COURSE PRESENTS CONCEPTS RELATED TO ORGANIZATION AND RETRIEVAL OF KNOWLEDGE-BASED INFORMATION IN THE HEALTH SCIENCES. IT INCLUDES A STUDY OF CLASSIFICATION SCHEMES, CONTROLLED VOCABULARIES AND THESAURI, METADATA, AND ONTOLOGIES. MAJOR SCHEMES AND SYSTEMS EXAMINED, FOR EXAMPLE, INCLUDE MESH, UMLS, AND PUBMED. ALSO COVERED ARE THE TOPICS OF KNOWLEDGE RETRIEVAL AT THE POINT OF CARE, AND KNOWLEDGE DISCOVERY.





# THE MS IN HEALTH INFORMATICS PROGRAM

## COURSE DESCRIPTIONS

### MEDI 704 PRACTICE OF HEALTHCARE

THIS TEN-WEEK COURSE IS AN INTRODUCTION TO CLINICAL PRACTICE FOR GRADUATE STUDENTS IN MEDICAL INFORMATICS THAT REQUIRES A ONE-WEEK RESIDENCY IN ROCHESTER, NY. IT CONSISTS OF THE STUDY OF SIX MEDICAL SPECIALTIES INCLUDING SHADOWING OF CLINICIANS IN THESE AREAS. STUDENTS IN THIS COURSE WILL BE PART OF A TEAM OF HEALTH CARE PROFESSIONALS IN THE SELECTED SPECIALTIES. THEY WILL ROUND WITH PROVIDERS, ASSIST WITH INFORMATION GATHERING AND DISSEMINATION, AND OBSERVE SPECIALTY SPECIFIC DISEASE PROCESS, DIAGNOSIS AND TREATMENT. THEY WILL OBSERVE AND NOTE CLINICAL WORKFLOW AND TECHNOLOGY USAGE. THEY WILL INTERACT WITH TEAM MEMBERS AND ASSIST WITH THE ACQUISITION OF REFERENCE KNOWLEDGE AS APPROPRIATE. THEY WILL KEEP A LOG OF CASES DURING THE ROTATION AND USE THIS AS THE BASIS FOR THEIR RESEARCH PROJECT AND CASE PRESENTATION.

# THE MS IN HEALTH INFORMATICS PROGRAM

## COURSE DESCRIPTIONS

### MEDI 610 SCRIPTING FUNDAMENTALS

THIS COURSE IS AN INTRODUCTORY SCRIPTING COURSE. STUDENTS WILL LEARN TO DESIGN SOFTWARE SOLUTIONS USING THE PROCEDURAL APPROACH, TO IMPLEMENT SOFTWARE SOLUTIONS USING A CONTEMPORARY PROGRAMMING LANGUAGE, AND TO TEST THESE SOFTWARE SOLUTIONS. TOPICS INCLUDE PROBLEM DEFINITIONS, DESIGNING SOLUTIONS, IMPLEMENTING SOLUTIONS USING CONTEMPORARY PROGRAMMING LANGUAGE, IMPLEMENTING A CONTEMPORARY LIBRARY/Framework, AND TESTING SOFTWARE SOLUTIONS. PROGRAMMING PROJECTS WILL BE REQUIRED

# THE MS IN HEALTH INFORMATICS PROGRAM

## COURSE DESCRIPTIONS

### ISTE 782 VISUAL ANALYTICS

THIS COURSE INTRODUCES STUDENTS TO VISUAL ANALYTICS, OR THE SCIENCE OF ANALYTICAL REASONING FACILITATED BY INTERACTIVE VISUAL INTERFACES. COURSE LECTURES, READING ASSIGNMENTS, AND PRACTICAL LAB EXPERIENCES WILL COVER A MIX OF THEORETICAL AND TECHNICAL VISUAL ANALYTICS TOPICS. TOPICS INCLUDE ANALYTICAL REASONING, HUMAN COGNITION AND PERCEPTION OF VISUAL INFORMATION, VISUAL REPRESENTATION AND INTERACTION TECHNOLOGIES, DATA REPRESENTATION AND TRANSFORMATION, PRODUCTION, PRESENTATION, AND DISSEMINATION OF ANALYTIC PROCESS RESULTS, AND VISUAL ANALYTIC CASE STUDIES AND APPLICATIONS. FURTHERMORE, STUDENTS WILL LEARN RELEVANT VISUAL ANALYTICS RESEARCH TRENDS SUCH AS SPACE, TIME, AND MULTIVARIATE ANALYTICS AND EXTREME SCALE VISUAL ANALYTICS




# THE MS IN HEALTH INFORMATICS PROGRAM

## COURSE DESCRIPTIONS

### ISTE 764 PROJECT MANAGEMENT

INFORMATION TECHNOLOGY PROJECTS REQUIRE THE APPLICATION OF SOUND PROJECT MANAGEMENT PRINCIPLES IN ORDER TO BE DEVELOPED ON TIME, ON BUDGET, AND ON SPECIFICATION. THIS COURSE TAKES STUDENTS THROUGH THE NINE KNOWLEDGE AREAS OF MODERN PROJECT MANAGEMENT AND THE UTILIZATION OF PROJECT MANAGEMENT PRINCIPLES IN BOTH TRADITIONAL AND AGILE ENVIRONMENTS.



# THE MS IN HEALTH INFORMATICS PROGRAM

## COURSE DESCRIPTIONS

### MEDI 730 MEDICAL APPLICATION INTEGRATION

A TYPICAL HOSPITAL INFORMATION SYSTEM ARCHITECTURE CONTAINS A VARIETY OF BEST OF BREED APPLICATIONS RUNNING ON DIFFERENT HARDWARE AND SOFTWARE PLATFORMS. EXCHANGE OF INFORMATION BETWEEN THESE APPLICATIONS CAN BE A SIGNIFICANT PROBLEM. IN THIS COURSE, STUDENTS WILL LEARN HOW TO LEVERAGE THE LOOSE COUPLING OF SERVICE-ORIENTED ARCHITECTURES AND MESSAGE ORIENTED MIDDLEWARE TO ADDRESS THE ISSUES OF DATA INTEGRATION BETWEEN THESE TYPES OF COMPUTER PROGRAMS WHEN EXECUTING ACROSS DOMAINS. PROGRAMMING PROJECTS WILL BE REQUIRED.

# THE MS IN HEALTH INFORMATICS PROGRAM

## COURSE DESCRIPTIONS

### HCIN 610 FOUNDATIONS OF HUMAN COMPUTER INTERACTIONS

HUMAN-COMPUTER INTERACTION (HCI) IS A FIELD OF STUDY CONCERNED WITH THE DESIGN, EVALUATION AND IMPLEMENTATION OF INTERACTIVE COMPUTING SYSTEMS FOR HUMAN USE AND WITH THE STUDY OF MAJOR PHENOMENA SURROUNDING THEM. THIS COURSE SURVEYS THE SCOPE OF ISSUES AND FOUNDATIONS OF THE HCI FIELD: COGNITIVE PSYCHOLOGY, HUMAN FACTORS, INTERACTION STYLES, USER ANALYSIS, TASK ANALYSIS, INTERACTION DESIGN METHODS AND TECHNIQUES, AND EVALUATION. THIS COURSE WILL FOCUS ON THE USERS AND THEIR TASKS.

# THE MS IN HEALTH INFORMATICS PROGRAM

## COURSE DESCRIPTIONS

### ISTE 608 DATABASE DESIGN AND IMPLEMENTATION

AN INTRODUCTION TO THE THEORY AND PRACTICE OF DESIGNING AND IMPLEMENTING DATABASE SYSTEMS. CURRENT SOFTWARE ENVIRONMENTS ARE USED TO EXPLORE EFFECTIVE DATABASE DESIGN AND IMPLEMENTATION CONCEPTS AND STRATEGIES. TOPICS INCLUDE CONCEPTUAL DATA MODELING, METHODOLOGIES, LOGICAL/PHYSICAL DATABASE DESIGN, NORMALIZATION, RELATIONAL ALGEBRA, SCHEMA CREATION AND DATA MANIPULATION, AND TRANSACTION DESIGN. DATABASE DESIGN AND IMPLEMENTATION PROJECTS ARE REQUIRED.

# THE MS IN HEALTH INFORMATICS PROGRAM

## COURSE DESCRIPTIONS

### MEDI 735 HEALTHCARE SYSTEMS

A STUDY OF THE COMPONENT APPROACH TO CLINICAL INFORMATION SYSTEMS. STUDENTS WILL LEARN ABOUT THE EVOLUTION OF HEALTH INFORMATION SYSTEMS, AND THE VARIETY OF SYSTEMS OFFERED BY VENDORS AT THE PRESENT TIME. THE IMPORTANCE OF THE ELECTRONIC HEALTH RECORD (EHR), THE COMPUTERIZED PHYSICIAN ORDER ENTRY (CPOE) AND CLINICAL DECISION SUPPORT WILL BE STRESSED AS THEY BECOME THE FOCAL POINTS IN CLINICAL INFORMATION SYSTEMS. THE FOLLOWING COMPONENTS WILL BE STUDIED IN DETAIL: PATIENT, ACTIVITY, HEALTH RECORD, KNOWLEDGE, AND SECURITY COMPONENTS. THE ROLE OF IMAGING MANAGEMENT AND INTEGRATION WILL ALSO BE REVIEWED.



# THE MS IN HEALTH INFORMATICS PROGRAM

## COURSE DESCRIPTIONS

### MEDI 766 BUILDING THE ELECTRONIC HEALTH RECORD

THIS COURSE EXPLORES THE ACQUISITION, STORAGE, AND USE OF INFORMATION IN THE ELECTRONIC HEALTH RECORD (EHR) THROUGH HANDS-ON DEVELOPMENT AND PROGRAMMING. STUDENTS WILL LEARN ABOUT THE TYPES OF INFORMATION USED IN CLINICAL CARE: TEXT, STRUCTURED DATA, IMAGES, AND SOUNDS. OTHER TOPICS COVERED INCLUDE: CLINICAL VOCABULARIES (EXISTING SCHEMES AND THEIR LIMITATIONS); HOW CLINICAL INFORMATION IS GENERATED AND UTILIZED; METHODS OF INFORMATION STORAGE AND RETRIEVAL; DEPARTMENTAL SYSTEMS (LABORATORY, RADIOLOGY, AND HOSPITAL INFORMATION SYSTEMS); ORGANIZATIONAL SYSTEMS (INCLUDING SCHEDULING, REGISTRATION AND FINANCIAL SYSTEMS); AND THE LEGAL, SOCIAL AND REGULATORY PROBLEMS OF EHRs INCLUDING SECURITY AND CONFIDENTIALITY.




# THE MS IN HEALTH INFORMATICS PROGRAM

## COURSE DESCRIPTIONS

### MEDI 788 CAPSTONE IN HEALTH INFORMATICS

THIS TEAM-BASED COURSE PROVIDES STUDENTS WITH THE OPPORTUNITY TO APPLY THE KNOWLEDGE AND SKILLS LEARNED IN COURSEWORK TO DESIGN, DEVELOP, AND IMPLEMENT A SOLUTION TO A REAL PROBLEM IN THE MEDICAL INFORMATICS DOMAIN. PROJECT TEAMS ALSO WILL BE RESPONSIBLE FOR SUBMITTING A FINAL PROJECT REPORT, AND FOR MAKING A FINAL PRESENTATION TO PROJECT STAKEHOLDERS.



# THE MS IN HEALTH INFORMATICS PROGRAM

## COURSE DESCRIPTIONS

### MEDI 731 SYSTEM INTEGRATION CONCEPTS

THIS COURSE WILL PROVIDE STUDENTS WITH AN UNDERSTANDING OF APPLICATION INTEGRATION CONCEPTS IN HEALTHCARE. STUDENTS WILL ALSO LEARN MEDICAL BUSINESS PROCESSES AND HOW THEY IMPACT DATA INTEGRATION WITHIN A HEALTHCARE SETTING. MIDDLEWARE MESSAGE BROKERS WILL BE EXAMINED ALONG WITH THE USE OF THE HL7 MESSAGING STANDARD. WEB SERVICES AND OTHER FORMS OF DATA INTEGRATION WILL BE STUDIED. STUDENTS WILL DEVELOP INTEGRATION SOLUTIONS TO SUPPORT HEALTHCARE INFORMATION SYSTEMS EXCHANGE AND VALIDATION PROCEDURES AND SOLUTIONS TO ENSURE THE QUALITY OF INFORMATION EXCHANGED BETWEEN HEALTHCARE SYSTEMS.