Core Content for the Subspecialty of Clinical Informatics

1. **Fundamentals:** The basic knowledge that provides clinical informaticians with a common vocabulary and understanding of the environment in which they function.

    1.1. **Clinical Informatics**
        1.1.1. The discipline of informatics
            1.1.1.1. Definitions of informatics
            1.1.1.2. History of informatics (e.g., evolution of health records)
            1.1.1.3. Domains/subspecialties of informatics
            1.1.1.4. Careers in informatics
            1.1.1.5. Professional organizations
            1.1.1.6. Current and future challenges for informatics
        1.1.2. Key informatics concepts, models, and theories
        1.1.3. Clinical informatics literature
            1.1.3.1. Core literature
            1.1.3.2. Critical analysis of informatics literature
        1.1.4. International clinical informatics practices
        1.1.5. Ethics and professionalism
        1.1.6. Legal and regulatory issues

    1.2. **The Health System**
        1.2.1. Determinants of individual and population health
        1.2.2. Primary domains, organizational structures, cultures, and processes
            1.2.2.1. Health care delivery
            1.2.2.2. Public health
            1.2.2.3. Clinical research
            1.2.2.4. Health professionals education
            1.2.2.5. Personal health
        1.2.3. The flow of data, information, and knowledge within the health system
        1.2.4. Policy & regulatory framework
        1.2.5. Health economics and financing
        1.2.6. Forces shaping health care delivery
        1.2.7. Institute of Medicine quality components
            1.2.7.1. Safety
            1.2.7.2. Effectiveness
            1.2.7.3. Efficiency
            1.2.7.4. Patient-centeredness
            1.2.7.5. Timeliness
            1.2.7.6. Equity

2. **Clinical Decision Making and Care Process Improvement:** The knowledge and skills that enable a clinical informatician to implement effective clinical decision making systems and participate in the development of clinical processes that support effective, efficient, safe, timely, equitable, and patient-centered care.

2.1. **Clinical Decision Support**
- 2.1.1. The nature and cognitive aspects of human decision-making
  - 2.1.1.1. General
  - 2.1.1.2. Medical
- 2.1.2. Decision science
  - 2.1.2.1. Decision analysis
  - 2.1.2.2. Probability theory
  - 2.1.2.3. Utility and preference assessment
  - 2.1.2.4. Cost effectiveness analysis
  - 2.1.2.5. Test characteristics (e.g., sensitivity, specificity, predictive value)
- 2.1.3. Application of clinical decision support
  - 2.1.3.1. Types of decision support (e.g., alerts, reminders, prompts)
  - 2.1.3.2. Users of decision support (including clinicians and patients)
  - 2.1.3.3. Implementing, evaluating, and maintaining decision support tools
- 2.1.4. Transformation of knowledge into clinical decision support tools
  - 2.1.4.1. Knowledge generation
  - 2.1.4.2. Knowledge acquisition
  - 2.1.4.3. Knowledge modeling
  - 2.1.4.4. Knowledge representation
  - 2.1.4.5. Knowledge management and maintenance
- 2.1.5. Legal and regulatory issues
- 2.1.6. Quality and safety issues
- 2.1.7. Supporting decisions for populations of patients

2.2. **Evidence-based Patient Care**
- 2.2.1. Evidence sources
- 2.2.2. Evidence grading
- 2.2.3. Clinical guidelines
- 2.2.4. Implementation of guidelines as clinical algorithms
- 2.2.5. Information retrieval and analysis
  - 2.2.5.1. Search skills
  - 2.2.5.2. Critical analysis of biomedical literature

2.3. **Clinical Workflow Analysis, Process Redesign, and Quality Improvement**
- 2.3.1. Methods of workflow analysis
- 2.3.2. Principles of workflow re-engineering
- 2.3.3. Quality improvement principles and practices

3. **Health Information Systems:** The knowledge and skills that enable a clinical informatician to participate in the development or selection of an information system for clinicians; prepare clinicians prior to implementation and support them during implementation and ongoing operation of a clinical information system; and evaluate the effectiveness of a system in meeting clinical needs.

3.1. **Information Technology Systems**
- 3.1.1. Computer Systems
  - 3.1.1.1. Programming
  - 3.1.1.2. Data structures, control structures
  - 3.1.1.3. Software development methods (e.g., agile, waterfall, spiral, rapid prototyping)
  - 3.1.1.4. System integration
  - 3.1.1.5. Quality
  - 3.1.1.6. Design (e.g., logical schema, normalization/denormalization, process modeling)
- 3.1.2. Architecture
  - 3.1.2.1. Systems (e.g., distributed, centralized, relational, object oriented, warehouses/data marts)
  - 3.1.2.2. Networks
  - 3.1.2.3. Data/database
- 3.1.3. Networks
  - 3.1.3.1. Topologies
  - 3.1.3.2. Telecommunications
- 3.1.4. Security
  - 3.1.4.1. The HIPAA Security Rule and other government regulations
  - 3.1.4.2. Firewalls
  - 3.1.4.3. Virtual private networks
  - 3.1.4.4. Encryption
- 3.1.5. Technical approaches that enable sharing data
  - 3.1.5.1. Integration versus interfacing
  - 3.1.5.2. Dealing with multiple identifiers
  - 3.1.5.3. Anonymization of data
- 3.1.6. Data
  - 3.1.6.1. Integrity
  - 3.1.6.2. Mapping
  - 3.1.6.3. Manipulation (e.g., querying, SQL, reporting)
  - 3.1.6.4. Representation and types
  - 3.1.6.5. Warehousing
  - 3.1.6.6. Data mining and knowledge discovery

3.2. **Human Factors Engineering**
- 3.2.1. Models, theories, and practices of human-computer (machine) interaction (HCI)
- 3.2.2. HCI Evaluation, usability testing, study design and methods
- 3.2.3. Interface design standards and design principles

3.2.4. Usability engineering

3.3. **Health Information Systems and Applications**
- 3.3.1. Types of functions offered by systems
- 3.3.2. Types of settings where systems are used
- 3.3.3. Electronic health/medical records systems as the foundational tool
- 3.3.4. Telemedicine

3.4. **Clinical Data Standards**
- 3.4.1. Standards development history and current process
- 3.4.2. Data standards and data sharing
- 3.4.3. Transaction standards
- 3.4.4. Messaging standards
- 3.4.5. Nomenclatures, vocabularies, and terminologies
- 3.4.6. Ontologies and taxonomies
- 3.4.7. Interoperability standards

3.5. **Information System Lifecycle**
- 3.5.1. Institutional governance of clinical information systems
- 3.5.2. Clinical information needs analysis and system selection
  - 3.5.2.1. Methods for identifying clinician information system needs
  - 3.5.2.2. Assessment of clinical process changes that will be required
  - 3.5.2.3. Elements of a system requirements specification document (e.g., technical specifications, intellectual property, patents, copyright, licensing, contracting, confidentiality, specific organizational needs such as user training and support)
  - 3.5.2.4. Risk analysis and mitigation
  - 3.5.2.5. The costs of health information and communications technologies
- 3.5.3. Clinical information system implementation
  - 3.5.3.1. Elements of a system implementation plan
  - 3.5.3.2. Models of user training and support processes that can meet clinician needs
  - 3.5.3.3. Processes and mechanisms that obtain and respond to clinician feedback
- 3.5.4. Clinical information system testing, before, during and after implementation
- 3.5.5. Clinical information system maintenance
  - 3.5.5.1. Disaster recovery and downtime
  - 3.5.5.2. CIS transitions and decommissioning of systems
- 3.5.6. Clinical information system evaluation
  - 3.5.6.1. Outcomes relevant to the clinical goals and quality measures
  - 3.5.6.2. Qualitative and quantitative methods for evaluating clinical information systems
  - 3.5.6.3. Evaluation plan design

4. **Leading and Managing Change:** The knowledge and skills that enable clinical informaticians to lead and manage changes associated with implementing clinical information systems and promoting adoption by health professionals.

4.1. **Leadership Models, Processes, and Practices**
- 4.1.1. Dimensions of effective leadership
- 4.1.2. Governance (e.g., processes; responsibility versus authority)
- 4.1.3. Negotiation
- 4.1.4. Conflict management
- 4.1.5. Collaboration
- 4.1.6. Motivation
- 4.1.7. Decision-making

4.2. **Effective Multidisciplinary Teams**
- 4.2.1. Human resources management (e.g., hiring, performance reviews and feedback, professional development, termination)
- 4.2.2. Team productivity and effectiveness (e.g., articulating team goals, defining rules of operation, clarifying individual roles)
- 4.2.3. Group management processes (e.g., nominal group, consensus mapping, Delphi method)
- 4.2.4. Managing meetings
- 4.2.5. Managing group deliberations

4.3. **Effective Communications**
- 4.3.1. Effective presentations to groups
- 4.3.2. Effective one-on-one communication
- 4.3.3. Writing effectively for various audiences and goals
- 4.3.4. Developing effective communications program to support system implementation

4.4. **Project Management**
- 4.4.1. Basic principles
- 4.4.2. Identifying resources
- 4.4.3. Resource allocation
- 4.4.4. Project management tools (non-software specific)
- 4.4.5. Informatics project challenges
  - 4.4.5.1. Scope creep
  - 4.4.5.2. Managing expectations
  - 4.4.5.3. Balancing competing priorities

4.5. **Strategic and Financial Planning for Clinical Information Systems**
- 4.5.1. Establishing mission and objectives
- 4.5.2. Environmental scanning
- 4.5.3. Strategy formulation
- 4.5.4. Action planning and strategy implementation
- 4.5.5. Capital and operating budgeting

4.5.6. Principles of managerial accounting
4.5.7. Evaluation of planning process

4.6. **Change Management**
4.6.1. Assessment of organizational culture and behavior.
4.6.2. Change theories (e.g., precede-proceed, social influence theories, complex adaptive systems)
4.6.3. Change management strategies
4.6.4. Strategies for promoting adoption and effective use of clinical information systems