Chapter 1: The role of Time in Medicine[1]

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Science or Art?
Temporal Information Systems in Medicine
Research on Time, Medicine, and Information Systems
Organization of the Book

Outline

① Science or Art? From Knowledge-Intensive to Data-Intensive Applications

② Temporal Information Systems in Medicine

③ Research on Time, Medicine, and Information Systems

④ Organization of the Book

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Science or Art?

Medical tasks, such as diagnosis and therapy, are by nature complex and not easily amenable to formal approaches.

The philosophical question "Is medicine science or art?" is frequently posed to show that expert clinicians often reach correct decisions on the basis of intuition and hindsight rather than scientific facts.

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From Knowledge-Intensive to Data-Intensive Applications

- Medical knowledge is inherently uncertain and incomplete.
- Patient data are often ridden with uncertainty and imprecision, showing serious gaps.
- In addition, they could be too voluminous and at a level of detail that would prevent direct reasoning by a human mind.

The technology of expert systems is largely founded on attempts to automate medical expert diagnostic reasoning.

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From Knowledge-Intensive to Data-Intensive Applications

Care providers are required to perform various tasks such as diagnose the cause of a problem, predict its development, prescribe treatment, monitor the progress of a patient and overall manage a patient.
The work of all care providers can benefit substantially from computer-based support.

The biggest challenge was the modeling of knowledge for the purpose of supporting tasks such as diagnosis, therapy, and monitoring.

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From Knowledge-Intensive to Data-Intensive Applications

The information explosion has brought a drastic change in focus from **knowledge-intensive** to **data-intensive** applications and from **systems that advise** to **systems that inform**.

The major challenge is no longer the deployment of knowledge for diagnostic or other purposes but the intelligent exploitation of data.

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Temporal Information Systems in Medicine

Time plays a major role in medical information systems: indeed, it is an important and pervasive concept of the real world and needs to be managed in several different ways:

- events occur at some time points,
- certain facts hold during a time period,
- temporal relationships exist between facts and/or events.

In the medical-informatics field, temporal data modeling, temporal maintenance, and temporal reasoning have been investigated, to support both electronic medical records and medical decision-support systems.

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Perspectives for Temporal Information Systems in Medicine

Definition

Temporal information systems in medicine are information systems able to store, manage, query, and support different inference tasks on time-oriented clinical data.

They can be observed from different perspectives.

- *technical tasks*
- *medical tasks*
- *clinical areas*

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Technical Tasks

- Management of time-oriented data stored in medical records of ambulatory or hospitalized patients
- Prediction of future values of clinical data, given past trends
- Abstraction of time-oriented clinical data
- Time-oriented knowledge-based decision support, such as for systems supporting diagnosis, monitoring, or therapy planning

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Medical Tasks

- Diagnosis
- Therapy administration and monitoring
- Protocol- and guideline-based therapy
- Patient management

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Clinical Areas (examples)

- cardiology
- oncology
- psychiatry
- internal medicine
- intensive care
- cardiac surgery
- orthopaedics
- urology
- infectious diseases
- anaesthesiology
- paediatrics
- endocrinology

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Research on Time, Medicine, and Information Systems

Representing, maintaining, querying, and reasoning about time-oriented clinical data is a major theoretical and practical research area.

Three research directions:

- **Temporal data maintenance**
- **Temporal data abstraction and reasoning**
- **Design of temporal medical systems**

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Research on Time, Medicine, and Information Systems

- Temporal information systems require a *multidisciplinary combination of research in the areas of database systems, artificial intelligence, and medical informatics.*

  - These systems provide an excellent motivation for research on multiple theoretical and methodological aspects of dealing with the management of and reasoning about complex time-oriented data

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Parts and chapters of the Book

- Fundamentals
  - temporal modeling and temporal reasoning
  - temporal databases

- Temporal Reasoning and Maintenance in Medicine
  - clinical temporal databases
  - abstraction of time-oriented clinical data

- Time in Clinical Tasks
  - time in clinical diagnosis
  - automated support to clinical guidelines and care plans

- The Display of Time-Oriented Clinical Information
  - displaying of time-oriented clinical data and knowledge