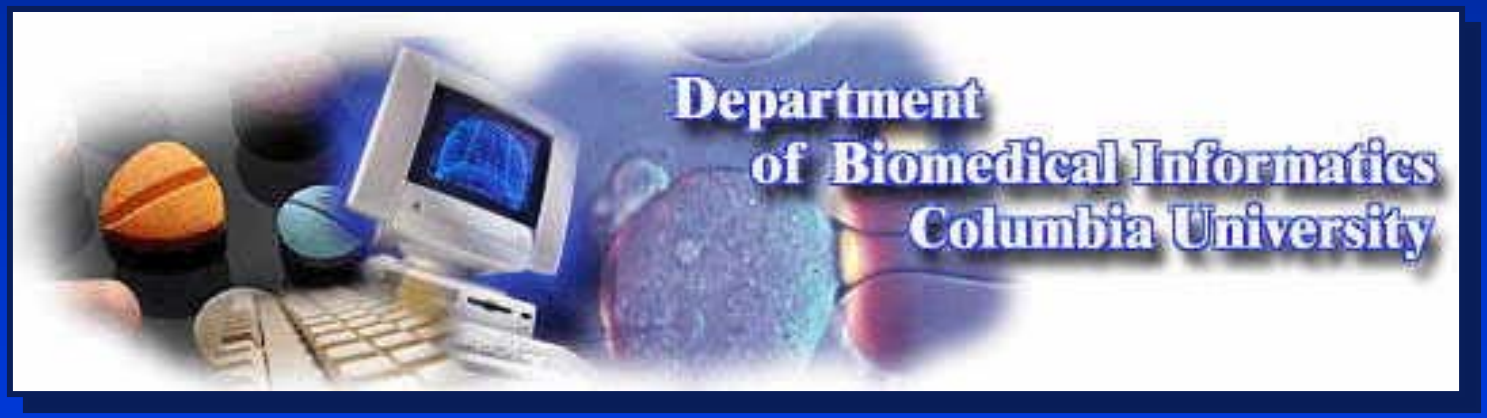
Joint BECON / BISTIC 2004 Symposium

Integrating Biomedical Informatics

Edward H. Shortliffe, MD, PhD
College of Physicians and Surgeons
Columbia University



Clinician Decision Making: Statement of the Problem

Biomedical Informatics for Clinical Decision Support:
A Vision for the 21st Century
NIH Natcher Conference Center, Bethesda, Maryland
June 21, 2004

Some Questions for Discussion

- What is the field of biomedical informatics and how has it evolved from its early roots?
- What are its methods and research emphases that are relevant to clinical decision support?
- What are the opportunities for synergy between the biomedical informatics, the biomedical engineering, and the computational biology communities?
- What are the implications for the future of BECON and BISTIC programs?

Historical Perspective

- Computers in medicine emerged as a young discipline in the 1960s
  - First NIH study section
  - Most applications dealt with clinical issues
- No consistency in naming the field for many years
  - "Computer applications in medicine"
  - "Medical information sciences"
  - "Medical computer science"
- Emergence in the 1980s of a single, consistent name, derived from the European (French) term for computer science: *informatique*
  - Medical Informatics

The Last 20 Years

- NLM-supported medical informatics training programs at several universities (now 18 programs)
  - Application areas broadened in recent years to include biological sciences, imaging, and other biomedical domains
- Creation of professional societies, degree programs, quality scientific meetings, journals, and other indicators of a maturing scientific discipline
- Broadening of applications base, but with a growing tension between the field's service role and its fundamental research goals

What's in a Name?

Medical informatics is the scientific field that deals with the storage, retrieval, sharing, and optimal use of biomedical information, data, and knowledge for problem solving and decision making.

Medical informatics touches on all basic and applied fields in biomedical science and is closely tied to modern information technologies, notably in the areas of computing and communication.

Relationship of Medical Informatics and Bioinformatics

Bioinformatics

Biological and
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Techn es and
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Anticip n of
their Fut e
Clinical
Interdependencies

Medical
Informatics

The Biomedical Information Science and Technology Initiative (BISTI)

- Identified the key role of computers and quantitative methods in the future of biology and biomedical research
- Called for training of a new kind of biologist (and a new kind of computer scientist)
- Called for the creation of centers of excellence in biocomputation
- Led to broad interest in biological applications of computing across NIH and in the biomedical research community
- Led to a tendency to refer to the entire field as “bioinformatics”, with resulting confusion in environments where informatics units had predated this trend

Terminology Issues Abound (after NCRR Advisory Council - 2000)

- Biomedical Computing:
  1. The application and development of computer methods for biomedical research.
- Computational Biology:
  2. A subfield of biomedical computing that is concerned with computer analysis of biological data.
  3. The application and development of computer methods for biological research.
  4. The application and development of mathematical and algorithmic methods for biological research.
- Bioinformatics:
  5. The application and development of computer methods for biological research.
  6. The application and development of computer methods for genomics and molecular biology.
  7. The application and development of database-related computer methods for biological research.

Medical Informatics?

Biomedical Informatics?

Biomedical Informatics

The scientific field that deals with the storage, retrieval, sharing, and optimal use of biomedical information, data, and knowledge for problem solving and decision making.

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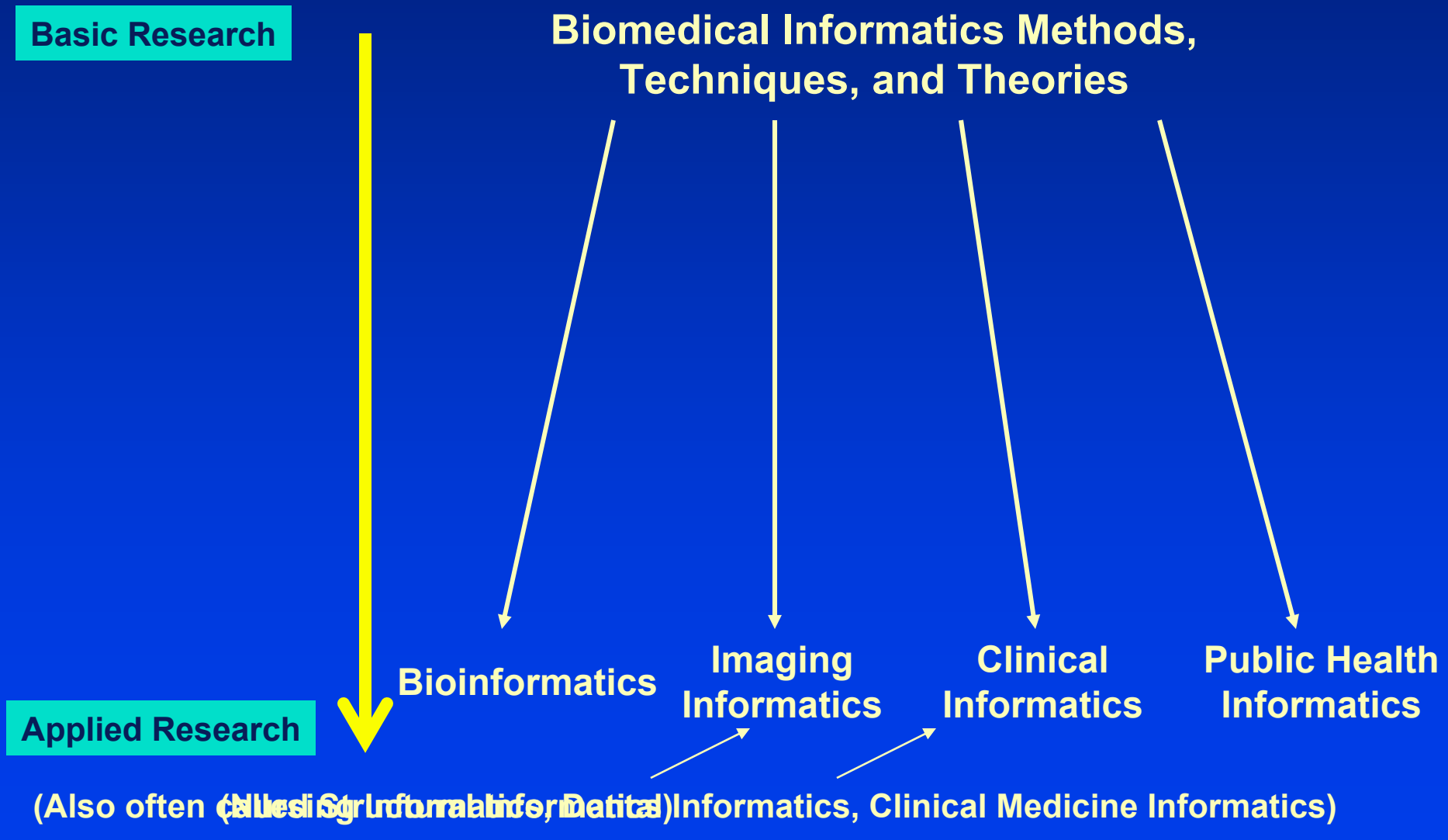
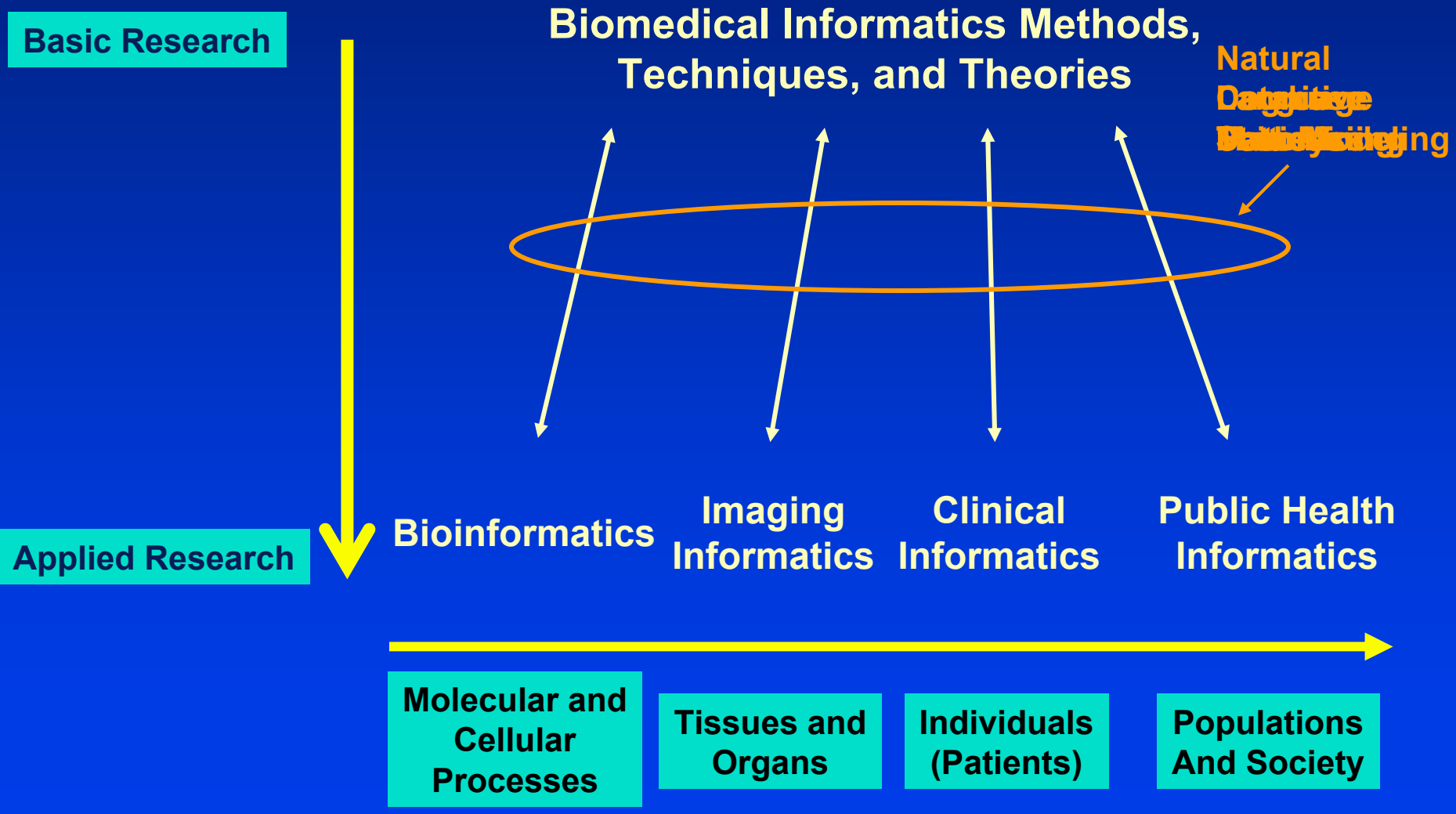
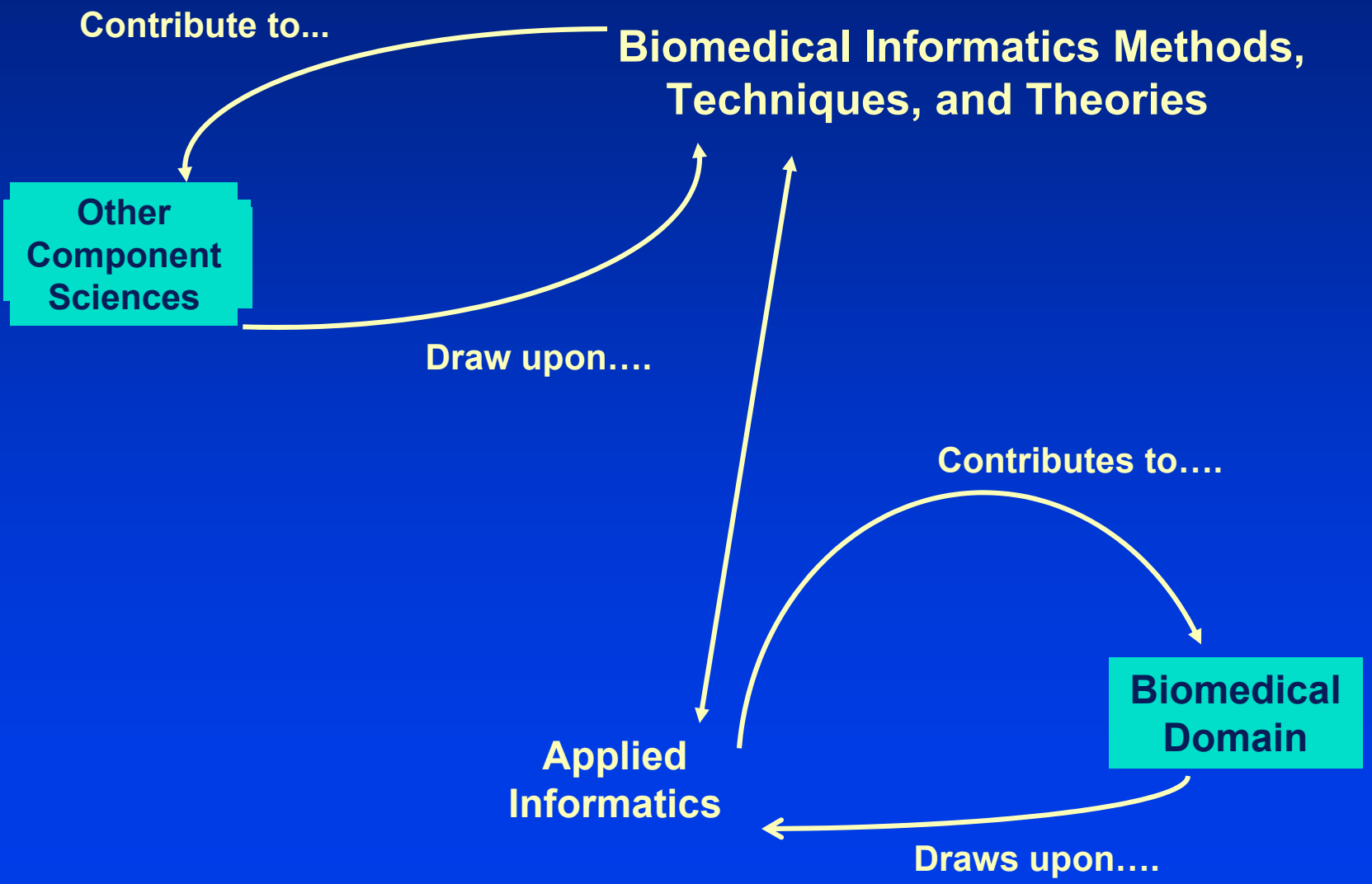
Biomedical Informatics in Perspective



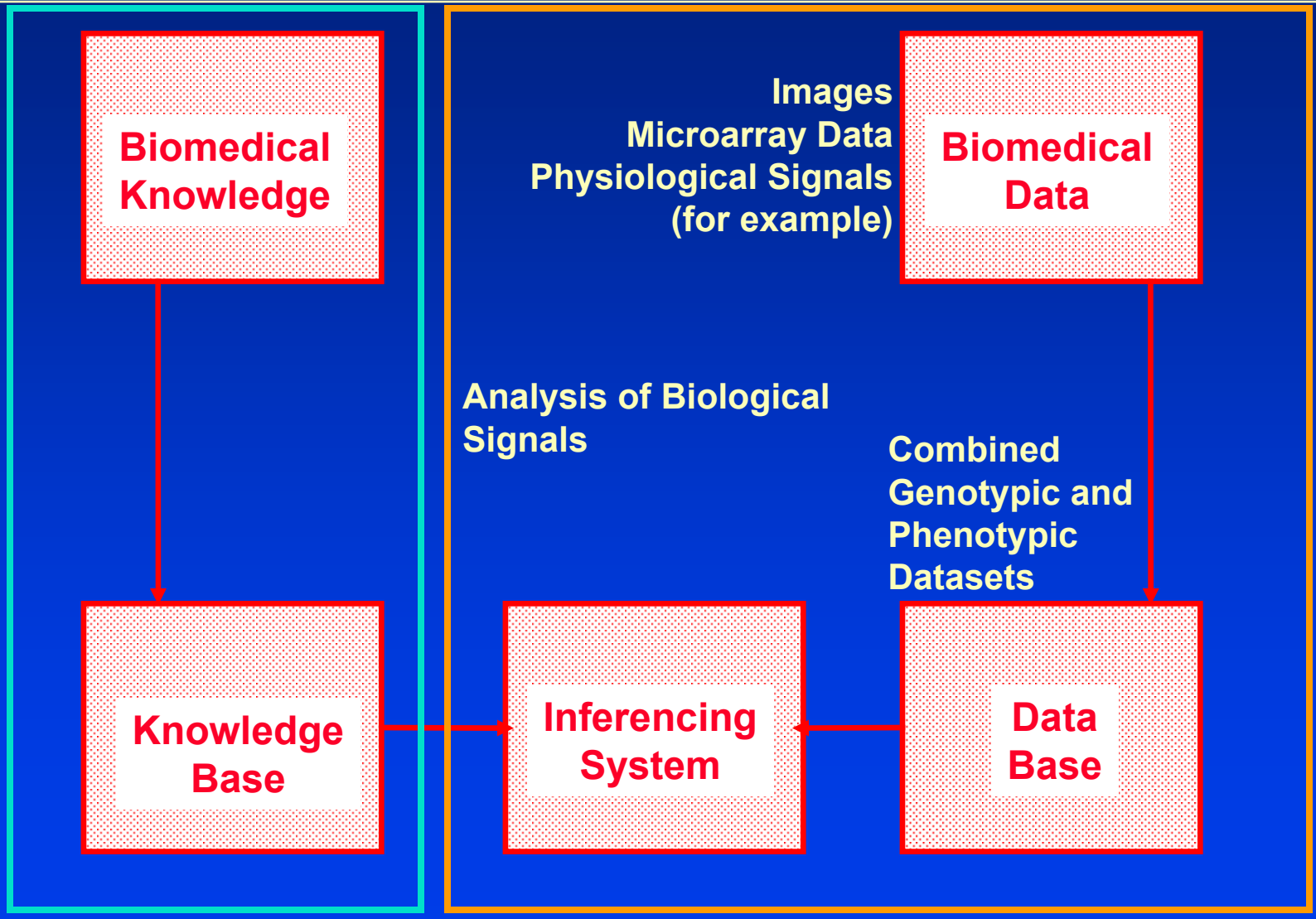
Biomedical Informatics in Perspective



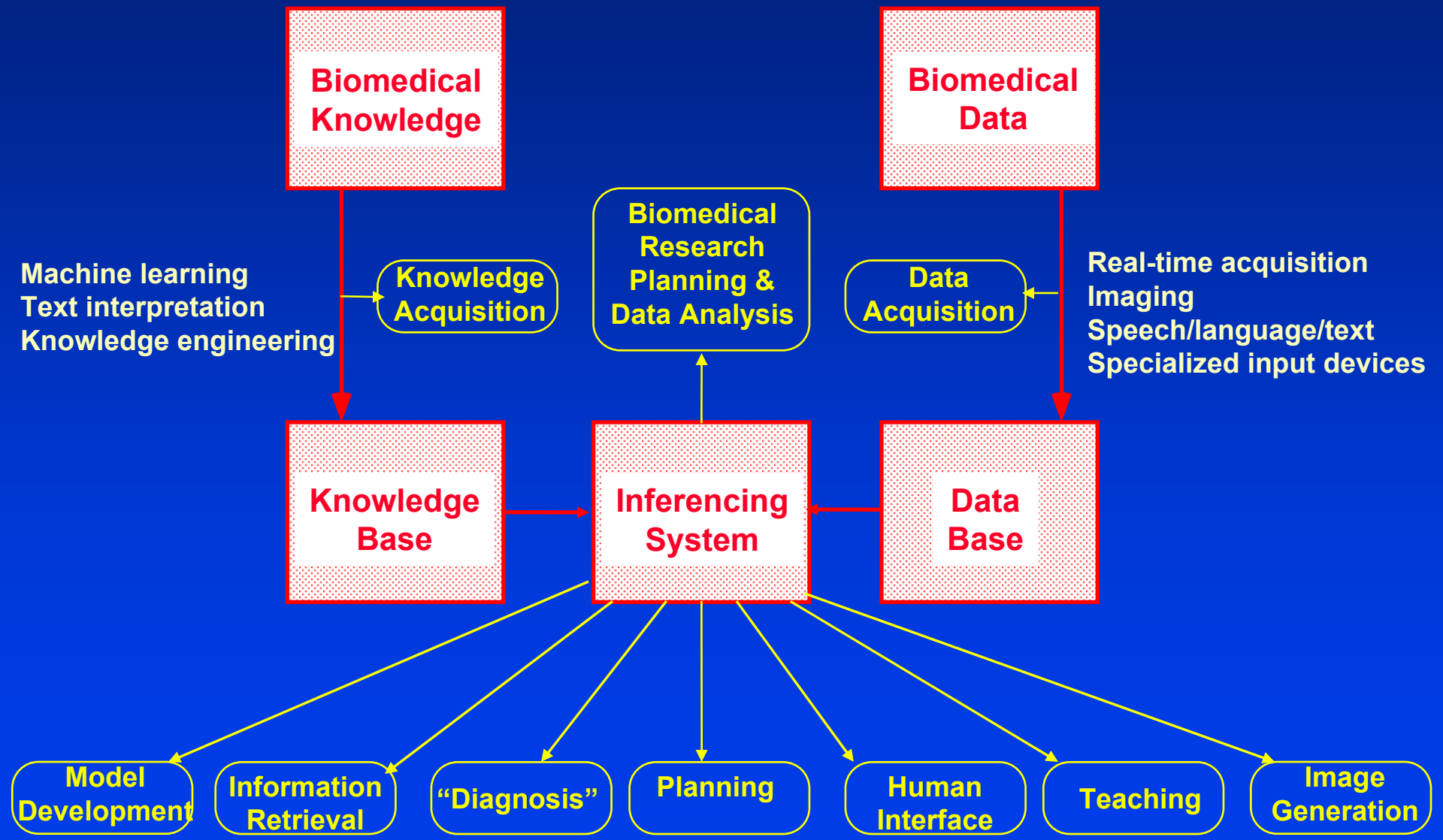
Biomedical Informatics in Perspective



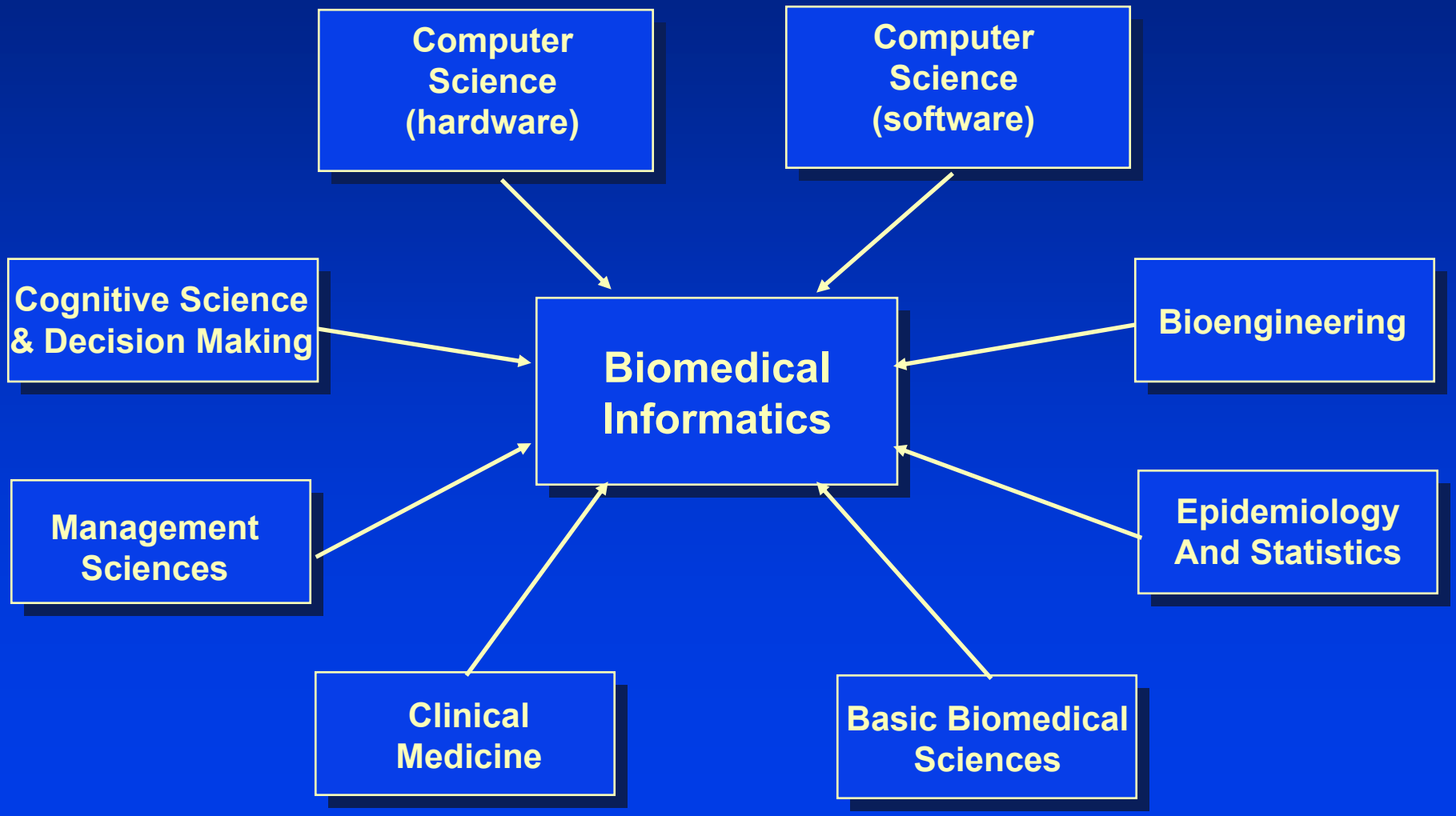
Core of Biomedical Informatics As A Scientificic Discipline



Biomedical Informatics Research Areas



Biomedical Informatics Disciplines



Computer-Assisted Decision Support

Examples of clinical informatics functionalities:

- Generic information access (e.g., Medline / PubMed)
- Patient-specific consultation systems
  - Advice regarding diagnosis
  - Advice regarding optimal workup
  - Advice regarding therapy or patient management
  - Critiques: reactions to users' hypotheses regarding patients and their proper management
- Browsing tools that mix generic and patient-specific elements (e.g., "electronic textbooks of medicine")
- Monitoring tools that generate warnings or advice as needed (advice as a byproduct of patient care)

Computer-Assisted Decision Support

Examples of available methodologies:

- Protocols and algorithms
- Analyses of databanks
- Analyses of signals
- Mathematical models (often physiologic)
- Statistical pattern recognition and neural networks
- Bayesian statistics and Bayesian networks
- Decision analysis
- Artificial intelligence (“expert systems”)
- Syntheses of various techniques

Fundamental Research in Informatics

- Although projects are inspired by biomedical application goals, basic research in biomedical informatics typically:
  - offers methodological innovation, not simply interesting programming artifacts
  - generalizes to other domains, within or outside biomedicine
- Inherently interdisciplinary, biomedical informatics provides bridging expertise and opportunities for collaboration between computer scientists and biomedical researchers and practitioners

Implications for BECON / BISTIC Programs

- Need to stop thinking of the pertinent fields as distinct from one another
  - Interdisciplinary science abhors artificial boundaries
- Need to describe the field and activities in terms that are as inclusive as possible
  - Sensitivities exist and need to be considered
- Need to recognize the substantial synergies between the methods developed in one biomedical domain and their potential applicability in another
  - In the case of decision support, interpretation of data is often an inherently cognitive, knowedge-based process
  - Tools for decision support will often require knowledge-representation and management methods as well as techniques of quantitative analysis

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