Chapter 10
Medical Informatics and Bioinformatics

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ABSTRACT

In the last 50 years, computational applications have been developed to aid clinicians and researchers alike in the broad field of Biomedicine. Adopted early in the evolution of the field, the term medical informatics has been applied to the various sub-disciplines of computer applications and methods of organizing and using information principles and techniques in both clinical care and biomedical research. This chapter provides a broad survey of the complex discipline of Biomedical Informatics with special emphasis on the key emerging sub-disciplines such as translational informatics, clinical research informatics, consumer health informatics, and the informatics of the "omics" sciences, systems biology, and nanotechnology.

1. CHAPTER OBJECTIVES

Biomedical Informatics is a diverse field that covers applications and theory from two broad disciplines: information and computer sciences and the whole of biomedicine, which spans the spectrum from molecular biology through clinical care to public health. In this chapter, a general review of the field is given with a special focus and added depth in areas that are interesting and illustrative.

In this chapter, the reader should achieve the following four objectives:

- Acquire an understanding of the basic tenets of medical informatics (also called *clinical informatics*), and gain an appreciation for both the challenges facing its

practitioners and for the promise that it holds for healthcare, which differs from other sectors of the economy in many ways that also manifest themselves in medical informatics. The provided historical background is to orient the reader to the evolution of informatics in healthcare, and includes references to assist self study.

- Gain an understanding of the basic tenets and organizing principles of bioinformatics well enough to permit a casual reading of the general scientific literature that relies on this technology, and know where to turn to investigate a specific topic in more depth. Although there is no clear boundary between bioinformatics and medical informatics, a useful rule of thumb is that bioinformatics addresses the application of informatics from nanoparticles to molecules to sub-cellular organelles to cells, tissues, and organs to systems biology, while medical informatics addresses the application of computing to the health of people and populations.

- Gain an understanding of how informatics evolved in biomedicine, and insights into why healthcare in particular has been a slow adopter of computing technology when compared with other sectors of the economy. The evolution of medical informatics and bioinformatics involves much more than the evolution of technology; a fact which is illustrated in the background and literature recommendations.

- Gain an understanding of emerging trends that will either wither or lay the groundwork for further evolution of this dynamic and diverse field into the state-of-the-art. Finally, in the professional societies and organizations section, resources that will enable readers to both catch up with the old and keep up with the new are presented.

2. INTRODUCTION

The history of biomedical informatics extends back at least 60 years. Since it derives from both biomedical and the computer and information sciences, the terminology is often confusing. The authors adopted the following conventions in this chapter, but the reader may find different usages in the literature.

- **Biomedical informatics:** covers medical informatics and bioinformatics. (Synonym: sometimes shortened to just *informatics*).
- **Medical informatics:** focuses on applications of computer and information science to healthcare. (Synonyms: *clinical informatics, healthcare informatics*).
- **Translational informatics, clinical research informatics**, **and public health informatics:** are sub-disciplines of biomedical informatics that are grouped here under medical informatics, and are defined in detail, along with consumer health informatics, in section 5.3.
- **Bioinformatics:** covers the methods used to organize, analyze, and model biological processes from the molecular level to the macroscopic level.
- **An electronic medical record:** is an integrated collection of computer applications designed to collect and process data for patients. (Synonym: *electronic health record, or EHR*).

3. DEFINITION OF MEDICAL INFORMATICS AND BIOINFORMATICS

In their classic informatics textbook, Shortliffe and Cimino define biomedical informatics, the parent of medical and bio- informatics, as "*the scientific field that deals with biomedical information, data, and knowledge—their storage, retrieval,*

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