to grow at a rapid pace over the coming years. The advantages of biologics are their high affinity for and specificity to their targets, but so far, they are mostly limited to secreted or cell surface targets.

1.1.13 Botanicals

It is likely that humans have used plants as medicine for as long as we have existed. Archeological excavations dated as early as 60,000 years ago have found remains of medicinal plants, such as opium poppies, ephedra, and cannabis. Since the beginning, humans have experimented with plants to learn how they can help us heal. In essence, humans have been involved for thousands of years in a vast "clinical trial" with medicinal plants. The wisdom that resulted from this global experiment is a large part of our history of healing and healthcare. In many early cultures, the knowledge of a plant's curative properties came through the practice of Shamanism, which is a kind of spirit medicine still practiced in many parts of the world. Some Shamans communicate with certain plants ("plant teachers") to access the knowledge about other plants and healing techniques. As the knowledge from Shamanism and other practical experimentation grew, herbalists began to catalog their knowledge of medicinal plants.

One of the oldest written records on medicinal plants, dated 1500 B.C., is the Egyptian Ebers Papyrus. In India, the Charaka Samhita, dated 700 B.C., documented the uses of more than 300 medicinal plants. Throughout much of history, humans believed that the "vital spirit" of the plant contributed to its therapeutic effect. But in the early 1800s, scientists isolated morphine from opium, which led to the belief (in the West at least) that a single, non-living compound in a plant was responsible for its healing properties. This, in turn, helped to create the biomedical model of pharmacotherapy that remains in medicine today. In this model, plants are seen simply as the source of a single chemical that targets a single receptor site or other part of the body and fixes the individual's health problem.

Eventually, most scientists believed that there was no need to use plants in drugs, because chemists could synthesize compounds that were more potent (and often more toxic) than the natural products offered by nature. Now, most pharmaceuticals are synthetic compounds. But note that the structure of the synthetic pharmaceuticals often resembles that of the natural molecules; 11% of the 252 drugs considered essential by the World Health Organization are exclusively derived from flowering plants.

The 1990s witnessed a swing back toward a more holistic perspective in medicine, with less reliance on potent drugs that often have serious side effects. This change contributed to a renewed interest in botanical medicines that generally have fewer risks than pharmaceutical drugs. In 1994, in response to the overwhelming public demand, the federal government passed the Dietary Supplement Health and Education Act (DSHEA). This act allowed botanical medicines to be sold as "dietary supplements" as long as the manufacturers did not make any health claims. (Note that this provision can be somewhat confusing and puts the burden on consumers to research the dietary supplements themselves.) In 2007, the Food and Drug Administration (FDA) announced a final rule establishing current good manufacturing practice requirements for dietary supplements. The final rule requires manufacturers to report all adverse events to the FDA, as well as to evaluate the identity, purity, quality, strength,