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Biomedical Engineering: Issues and Opportunity

Winfred M. Phillips
Vise President for Research and Dean of the Graduate School, University of Florida

ABSTRACT: As defined by the National Institutes of Health (NIH), bioengineering is an interdisciplinary field that applies physical, chemical, and mathematical sciences and engineering principles to the study of biology, medicine, behavior, and health. It advances knowledge from the molecular to the organ systems level, and develops new and novel biologics, materials, processes, implants, devices, and informational approaches for the prevention, diagnosis, and treatment of disease for patient rehabilitation and for improving health.

Bioengineering has made enormous contributions to the advancement of healthcare in the U.S. It has been instrumental in establishing the U.S. as the world leader in healthcare technology, as evidenced by a $4.6 billion trade surplus for this sector in 1993. The field, through basic and applied research and technology assessment, has given us such devices as the pacemaker, orthopedic implants, and noninvasive diagnostic imaging. Bioengineers have developed new processes for manufacturing products in the pharmaceutical and biotechnology industries. An example is the manufacturing of human insulin, the first product based on recombinant DNA technology, where biomedical engineering was critical to the ability to commercialize the product.

Biomedical engineering research has blossomed over the last 30 years due to five significant factors: First, and most important, have been the tremendous gains in scientific knowledge of the genetic, molecular, cellular, tissue, organ, and systems levels — all of which have been advanced by applications of bioengineering. Second, the support of the U.S. Congress in recognizing the need to foster basic and applied biomedical research at NIH, thus creating the largest source of federal support for bioengineering research. Third, the creation in the mid-1970s of The Whitaker Foundation, which today provides the largest nonprofit private source of funding. Fourth, a recognition in our academic institutions of the important role of biomedical engineering in fostering healthcare technology research. Biomedical engineering is now a major research focus in scores of American universities, including full-fledged biomedical engineering departments and programs. The American Institute of Medical and Biological Engineering's Academic Council, as a measure of this growth, has 53 university members. It should be noted

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that biomedical engineering programs at our universities are attracting the very best students in engineering, including higher percentages of women and underrepresented minorities than in other areas of engineering. Fifth, a vibrant and growing healthcare technology industry, which provides vitally needed applied research and product development. While industrial support for bioengineering is at least six to ten times greater than that of the federal government, support for basic research in the industrial sector is small.

This unprecedented growth, focus, and opportunity will be a technical, social, and ethical challenge for the U.S. and the world.