

**BioFlips:**  
**Healthcare for the Future**

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# BioFlips

## Healthcare for the Future

The development of microfluidic biochips (known as “BioFlips”) holds great potential for advances in the diagnosis and treatment of disease and injury. Biological microelectromechanical devices (BioMEMs), like other nanotechnologies, use microscopic chips to study and manipulate materials at an atomic or molecular level. The recent addition of microfluidic properties to these chips now allows researchers to collect, analyze, and control atomic quantities of liquid or gas directly on the microchip.

## Potential Medical Uses

The potential of BioFlips technology lies in the size, functionality, and cost of the chips. These miniature devices are smaller than the width of a human hair and can be implanted in the body, worn as a transdermal patch or wristwatch-like sensor, or swallowed in pill form. BioFlips can collect, interpret, and respond to biochemical changes in the body autonomously. And, with the new-found ability to microfabricate these “smart” chips on a biodegradable plastic surface, BioFlips can be cost-effectively mass-produced—making the technology commercially viable as well.

The biotechnology and biomedical fields are the obvious benefactors of BioFlips technology. BioFlips could revolutionize the pharmaceutical industry with genetic-based drug development and delivery. Similarly, medical care could be drastically improved by BioFlips advancements in microsurgery (robotics), drug delivery (treatment for cancer, diabetes, etc.), medical implants (artificial muscle, bone, and organs as well as stem cells, etc.), and point-of-care diagnostics. And, of course, it’s impossible to ignore the impact BioFlips could have on health insurance providers with the potential to significantly reduce the costs associated with healthcare expenses.

Another, perhaps less obvious, proponent of BioFlips technology is the U.S government. Despite the appeal of improving overall national healthcare, the government’s primary motivation in using BioFlips is national defense—specifically combat casualty/troop monitoring, environmental monitoring, and biochemical warfare agent detection. In fact, U.S. lawmakers recently introduced legislation to increase funding (by \$1.4 billion) for “biological warfare defense” in the wake of the September 11th terrorist attacks.

## Developmental Frontrunners

Currently, the most prominent developers of BioFlips technology are found in research and academic institutions. By far, the biggest player is the Defense Advanced Research Projects Agency (DARPA). The following research programs receive major funding from DARPA:<sup>1</sup>

- Electronics Research Laboratory, University of California at Berkeley
- Microsystems and BioMEMS Laboratory, University of Cincinnati
- Lerner Research Institute, Cleveland Clinic Foundation
- Whitehead Institute, MIT
- Center for Biologic Nanotechnology, University of Michigan
- SciTech and iMEDD, Ohio State University
- Microfluidic Lab, Stanford University

The top corporate/commercial ventures in BioFlips technology include:

- Affymetrix (gene expression arrays)
- Fluidigm Corporation (microfluidic chips)
- Meridian Bioscience, Inc. (plastic biochips)
- MicroCHIPS, Inc. (programmable pill)
- Micronics, Inc. (artificial kidney)

## Overall Benefits

The social benefits of BioFlips are obvious. Diagnosis, monitoring, and treatment of disease/injury will become faster and more accurate. A “smart drug” delivery system will mean a higher quality of life for those suffering from chronic or life-threatening illnesses (such as cancer, diabetes, kidney dysfunction, etc.). The overall effect will be better healthcare.

Money attracts attention. Big money attracts investors. With the fall of dot-coms, investors are looking to markets with proven returns on investment. The economic ramifications of BioFlips technology are enormous. Consider the following:

- The U.S. spends \$30.5 billion annually for pharmaceutical research and development.<sup>2</sup>
- Experts predict U.S. healthcare expenditures for pharmaceuticals will reach \$2 billion in FY2001.<sup>3</sup>
- The biochip market forecasts \$10 billion in annual profits during the next five to ten years.<sup>4</sup>

## Conclusion

As the business sector applies its mass-production expertise to the BioFlips market, the technology will become more readily available and cheaper.<sup>5</sup> Health insurance providers and pharmaceutical companies will capitalize on the reduced costs of doing business. Informed consumers will demand the increased accuracy and control BioFlips offer.

BioFlips technology builds on the discoveries of the 1990s: increasingly smaller, faster, and more sophisticated microchips; computerized identification and mapping of genetic material; and distributed processing of statistical assays in the search for effective drug therapies. Researchers are now applying this knowledge in a nanoscale environment, collecting and analyzing data on the new BioFlips directly, using communications technology to monitor and control the results remotely, and intervening at the cellular level to affect medical (and, ultimately, genetic) outcomes. These advancements, not possible in the previous decade, will change the face of healthcare.

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## Endnote

<sup>1</sup> Defense Technical Information Center. (June 2001). *Department of Defense FY2002 Budget*. Defense Information Systems Agency. <http://www.dtic.mil/descriptivesum/Y2002/DARPA/0603739E.pdf>

<sup>2</sup> Pharmaceutical Research and Manufacturers of America. (2001). *PhRMA Annual Report*. R&D Expenditures Figures. <http://www.phrma.org/publications/publications/profile01/chapter2.phtml>

<sup>3</sup> Pharmaceutical Research and Manufacturers of America. (2001). *IMS Health: Pharmaceutical Pricing Update* <http://www.phrma.org/publications/publications/profile01/chapter4.phtml>

<sup>4</sup> Stikeman, Alexandria. (3/01). BioChips Go Big Time. *Technology Review*. <http://www.techreview.com/magazine/mar01/innovation1.asp>

<sup>5</sup> Curran, Chris. (5/18/01). *BioMEMS Research Produces Mini-Medical Monitor*. University of Cincinnati News. <http://www.uc.edu/news/biomems2.htm>