MEDICC Review
ISSN: 1555-7960
editors@medicc.org
Medical Education Cooperation with Cuba
Estados Unidos

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MEDICC Review, vol. 9, núm. 1, 2007, p. 48
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Oakland, Estados Unidos

Connecting Science to Population Health: The "Closed Loop" Approach

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Vaccination programs have been successful in Cuba, whatever metrics are used to evaluate them: the population is protected against 13 diseases, well beyond WHO goals; illnesses such as polio, diphtheria, whooping cough and others have been eradicated; and even hepatitis B is slated to disappear. How can these results be explained? Certainly strong political will, a society based on justice and solidarity, the concept of health and education as human rights, and a health system accessible to all, are paramount. Without these, no technology would make a difference.

Even with policies in place, however, a full-coverage vaccination program with state-of-the-art vaccines would still be very difficult without a vaccine production capability. And in Cuba's case, underpinning this link between health policy and the biopharmaceutical industry is another: the link between the industry and scientific research.

The biopharmaceutical industry is one of the so-called "knowledge-intensive" sectors, where research is increasingly integrated into the value chain. Reinforcing the link between scientific research and production would be a good thing in and of itself, were it not for the fact that science and technological developments are taking place in a generalized neoliberal framework bent on privatization of nearly everything, including knowledge. In the global biopharmaceutical industry, the increasing protection of intellectual property (patents) and the ever-stricter regulatory environment have built formidable entry barriers, preventing developing countries from accessing cutting-edge technology, concentrating technological and industrial power in fewer hands. The consequences? Constricted vaccine supply, higher vaccine prices, and roadblocks to cost-effective development of domestic capacities.

How can a small, developing country face this challenge? Building scientific capacity and increasing human capital are part of the answer. But they aren't the whole answer, because scientific capacity must be efficiently coupled with economic and public health policies. And while there are certainly barriers to developing high-tech industries, there are also barriers to integrating science with other societal endeavors such as industrial development and public health.

The experience of Cuban biotechnology reveals something about these challenges. While scientific capacities have been developed in Cuba since the 1960s, interactions between the emerging pharmaceutical industry and public health efforts were weak. When the Scientific Pole was founded in the 1980s, this problem was tackled head-on by creating biotech centers which included scientific research, industrial production, and export-oriented commercial activities under the same institutional umbrella.

Each center's responsibility was not limited to generating scientific results, but rather extended to "**closing the loop**" on research — transforming it into new products, developing these products until proven medically useful (registration), building manufacturing processes, covering national needs, and exporting such products to generate a positive, self-sustained cash flow.

This was not an approach followed by just one institution: similar structures are found at the Center for Genetic Engineering and Biotechnology (hepatitis B vaccine and interferon), the Finlay Institute (meningitis vaccines), the Center of Molecular Immunology (monoclonal antibodies and cancer vaccines), the Immunoassays Center (high-tech, high throughput diagnostic systems), and many others among the 24 institutions and 58 manufacturing facilities which currently comprise the Cuban biotech industry. In 2006, this sector was Cuba's second-largest export earner.

In fact, a "double loop" is closed by this approach since return on investment is realized not only economically, but also in improved health status through the use of scientific results in nationwide public health programs. The Finlay Institute was directly involved in the control of the meningitis outbreak in the '80s, the Center for Genetic Engineering is involved in controlling hepatitis B, the Immunoassays Center leads a network of hundreds of laboratories dedicated to perinatal testing, blood safety, and epidemiological surveillance, the Center of Molecular Immunology participates in the National Cancer Program, and so on.

Certainly, the "closed loop" concept was hard to implement. It requires diverse cultures work together; necessitates continual balancing of short- and long-term priorities; and demands constant weighing of high risk-high reward against low risk-low impact projects. This balancing act is neither intuitive nor immune from external pressures. But once the first loops are closed, the process becomes autocatalytic. Scientists' sense of responsibility is reinforced as they embrace the whole start-to-finish process.

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Considering medical and economic impact becomes part of an intellectually rigorous process driving scientists to look at all components (and risks) of "closing the loop." Production becomes more innovative, and research becomes more focused and realistic. Last but not least, scientific research creates its own economic engine, fostering its endurance and growth.

This experience surely has implications beyond the field of vaccines, biotechnology, and even public health. A knowledge-based society has much more than just knowledge. It is essentially the profound association of knowledge production, access, and conscientious use with all aspects of life in building a fair, equitable, and humanistic society. But that's a topic for another article.