Editorial

The Importance of Biomedical Research

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Biomedical research (BMR) can be defined as systematic investigation aimed to develop or contribute to general knowledge in the health-related sciences.[1] BMR includes studies designed to improve the body of scientific

information on a biological process or disease, as well as those designed to evaluate the safety, effectiveness, or usefulness of a medical product, procedure, or intervention.[2] BMR is based on the scientific method (observation, formulation of a question, construction of a hypothesis, experimentation, data analysis, drawing conclusions and communication of results) and is divided into three main branches: basic research, clinical research and translational research.[2,3]

BMR has resulted in major discoveries that have led to marked progress in the health-related sciences. For example, advances in public health (such as vaccine development, improvement in water quality and drainage, disease prevention programs, and eradication or near-eradication of certain diseases [e.g. smallpox and poliomyelitis]) have increased the worldwide life expectancy from approximately 30 years at the beginning of the 19th century to more than 68 years today.[4,5]

BMR not only impacts the health status of the world's population but also has a positive and significant economic effect. It promotes savings in the public sector, creates jobs, increases and improves the quality of the workforce, stimulates business development and reduces social conflicts by enhancing quality of life.[6] In 1995, the savings attributable to biomedical research in the United States were estimated to be at least 68 billion dollars.[7] In that year, every dollar invested in BMR in the U.S. produced approximately $16 dollars in profits. In Latin America, a cost-benefit analysis of a program to control Chagas disease (designed on the basis of findings from epidemiological studies in 15 countries in Central and South America) found that there is a saving of $17 dollars in health care expenditures and disability for every dollar invested in the prevention of this disease.[8]

Not surprisingly, the World Health Organization has described biomedical research as **an investment and not an expense.**[9] By using the number of lives saved from 1970 to 1990 because of BMR discoveries, and multiplying this number by the "monetary cost of life" (or a "year of life "), a group of economists found that BMR produced ~$2.8 trillion per year (over 100 dollars produced per dollar invested).[10] An additional economic benefit of BMR at the institutional level is that the universities or hospitals in which BMR is conducted attract excellent students and talented professionals, which maintains and/or expands the recognition and leadership of the institution at the local, regional, and international level.

Unfortunately, BMR is not a priority for the governments of most Latin American countries.[11] In 2011, Colombia only invested 0.18% of its gross domestic product (GDP) on research and development, while Argentina invested 0.64%.[12] Brazil, the leader in the region, invested 1.2%. These figures contrast sharply with the United States, which invested 2.84% of its GDP in that area in the same year. Yet even in the latter country (the largest investor globally), BMR expenses are much lower than expected when we take into account the multiple benefits mentioned above.[6,7,13] In 2009, the United States government (through the National Institutes of Health) spent 47 billion dollars in BMR (or 1.9% of 2,472 billion dollars spent in health-related matters).[14] This expense dropped substantially after the economic crisis, falling by nearly 12.5% in 2012.[15] In 2013, with the

onset of drastic cuts in public spending (known as the "budget sequestration"), the total budget of the U.S. National Institutes of Health was reduced by 1.5 billion dollars, which limited further progress in BMR16 In spite of these difficulties, investment in BMR continues to be disproportionately higher in the United States than in Latin America.

Given limited government support in Latin America, health professionals, the general public, and their representatives must be educated about the importance of BMR. This is key to create promoters of this field, as well as long-term policies based strictly on merit and scientific productivity. Such policies (often lacking in a region over-populated by politicians with "short-term goals") should foster and stimulate BMR through substantial and sustained investments in infrastructure, equipment, and human resources (including education, training, and professional development).

In 1937, Albert Szent-Györgyi (who discovered vitamin C) stated that "research consists of four elements: a brain to think with, a pair of eyes to observe, machines to measure, and –lastly– money." Whereas researchers in the United States expect to have protected time and competitive salaries based on the quality and progress of their work (e.g., publications and grants, obtained through competitive applications to foundations and government entities), physicians or health care providers in Latin America are expected to conduct research without payment or with minimal compensation, while also carrying a heavy clinical load. As a result, many talented and ambitious young Latin Americans leave their countries in search of real opportunities to develop and eventually lead high-quality BMR.

To further promote BMR in Latin America would also require changing the current educational models of the vast majority of medical schools in our region, which often encourage memorization and obedience to dogma or existing guidelines, while stalling creative freedom or discordant thought (essential qualities in a researcher). For instance, extremely authoritarian systems frequently discourage bright students to express a divergent opinion, based on recent studies. In our experience, such systems view intellectually curious students as "problematic", which in direct contrast to systems like that of the United States, in which medical students are encouraged to see all angles of a problem and express their opinion based on recently published articles, without fear of retaliation from their teachers or supervisors.

Latin American governments, operating through their ministries of health, should establish priorities in their agenda for BMR, according to the needs of their populations. Such agendas should aim to justly allocate and monitor funds devoted to high-quality studies (and not just those copying or replicating what has been done in developed countries). Educational institutions and medical centers (both public and private) should be essential participants in this process, which should aim to educate, train, and promote the careers of individuals devoted largely or exclusively to BMR. These median and long-term objectives can be achieved with the support of governments, international foundations and organizations, as well as ethically appropriate collaborations with the pharmaceutical industry. Moreover,

we must train and retain talented leaders in BMR (by offering adequate wages, resources, and infrastructure to develop unique research projects), who should expect to be promoted on the basis of merit and no other factors (such as family or political ties). By developing and committing to an appropriately ambitious agenda, BMR can finally be developed in our countries and thus achieve its main objective: to improve the health and quality of life of our populations.

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