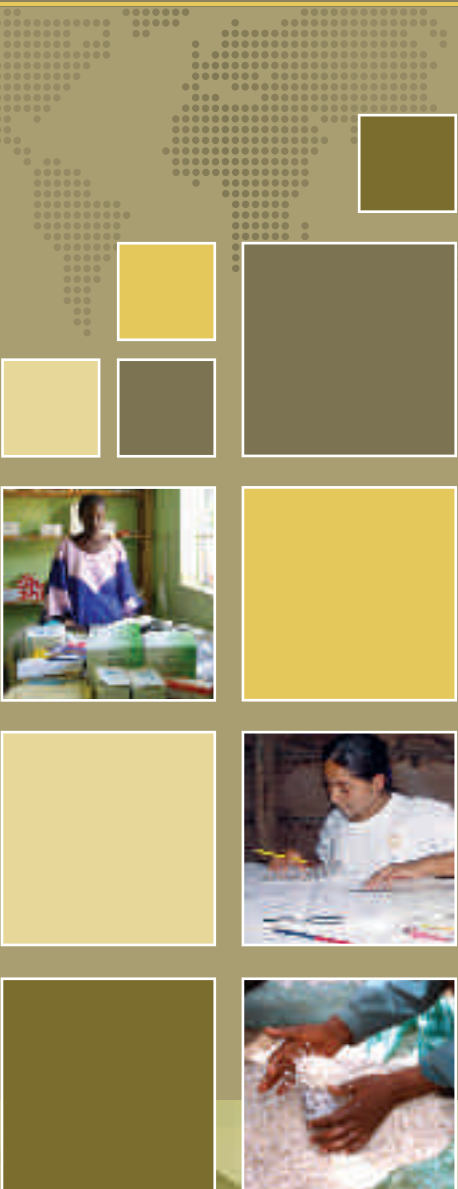


Monitoring Financial Flows for Health Research 2009

Behind the global numbers



Monitoring Financial Flows for Health Research 2009 Behind the global numbers

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Published by the Global Forum for Health Research, October 2009

ISBN 978-2-940401-23-9

Suggested citation: Erik Landriault and Stephen A Matlin (eds.), Global Forum for Health Research, Monitoring Financial Flows for Health Research 2009.

Keywords:

1. Research and development (R&D) 2. Investments 3. Financial flows 4. Report Card
5. Health 6. Equity 7. Low- and middle-income countries 8. Developing countries
9. Global Forum for Health Research

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The Global Forum for Health Research is an independent international organization based in Geneva, Switzerland. It is supported by the Rockefeller Foundation, the World Bank, the World Health Organization and the governments of Canada, Ireland, Mexico, Norway and Switzerland

Editing by Inis – www.inis.ie

Printed in France by an FSC-certified printer.

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Edited by
Erik Landriault
and Stephen A Matlin

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Foreword

One of the key messages heard as part of the 2008 Global Ministerial Forum on Research for Health in Bamako, was that not only do low- and middle-income countries need to develop capacity to conduct research, but there needs to be a greater sense of accountability for health research systems globally. Part of this accountability comes from greater transparency surrounding how these investments are dispersed and utilized. With adequate monitoring systems, this information could:

1. Inform investments in health research.
2. Draw attention to the inequitable distribution of investments.
3. Foster cooperation with donors, governments, industry and organizations.

In this issue of *Monitoring Financial Flows*, we examine the importance of monitoring financial flows to health research, with a special focus on public investments in health research in selected Latin American countries. Throughout the studies, it should be evident that health research systems are organized so as to link the creation of knowledge with imperatives of improving health and equity.

Chapter 1 discusses the many shortcomings of the current global health research system, namely, that until recently there has been a lack of incentives to undertake research and provide access to interventions for the poor. The failure to prevent and treat disease is devastating to communities, economies, individuals and nations. Particularly in a time of a

global economic crisis, it is important to remember that **health research is not a luxury**.

Subsequently, *Chapter 2*, the central comparative study of this year's *Monitoring Financial Flows*, coordinated by Daniel Maceira with Fernando Aramayo Carrasco (Bolivia), Guillermo Paraje (Chile), Sergio Duarte Masi (Paraguay), and Delia Sánchez (Uruguay) examines how various countries established priorities for health research using a common methodological approach for the years 2002–2006. The authors make the case that with limited resources, governments benefit from better alignment of national health research priorities with the populations' health profile. Individual country studies (*Chapters 3–7*) highlight the health profiles and the government health research strategy in Argentina, Bolivia, Chile, Paraguay and Uruguay.

Having supported research on tracking resource flows to health research in Brazil in 2006, the Global Forum for Health Research approached the Ministry of Health to contribute a chapter for the publication. *Chapter 8* by Vianna et al. highlights investments in health research by public, private and international organizations in Brazil for the years 2003–2005. By institutionalizing this practice, the Ministry of Health in Brazil, has facilitated more concerted investments in health research and informed policy-making for its health and innovation systems.

Moreover, in light of the upcoming Forum 2009 in Cuba, the Cuban Ministry of Health kindly agreed to undertake a study about resources for health research. In *Chapter 9*, Adolfo Alvarez Blanco and Niviola Cabrera Cruz highlight Cuba's technical assistance, investments in scientific research and innovation, and training of researchers.

Lastly, in its advocacy role, the Global Forum for Health Research has been working since 1998 to help increase accountability for the development of drugs, diagnostics and vaccines for diseases mainly found in low- and middle-income countries; to support research on how to deliver these interventions and provide access to them; and to encourage research to support the development of effective and equitable health services that benefit poor and marginalized populations. As part of this effort, the Global Forum, has instituted a Report Card (*Chapter 10*) to be published in

the Monitoring Financial Flows series, which measures progress against agreed targets. One of the greatest difficulties in this monitoring of health research is that its activities are expensive, but there are no validated methods for measuring its impact. Moreover, measurement challenges of incomplete data, lack of integrated databases and historic data, double counting, inconsistency of published information and numerous accounting standards pose significant challenges in measuring investments.

Despite these hurdles, there are a number of international efforts to track investments by region, disease category and funders. In undertaking the most recent issue of the Report Card, the Global Forum found that although policy-makers set ambitious targets to ramp up research and development for health, the majority of countries are ill-equipped to monitor these investments.

Chapter 1

Ignorance is fatal

Stephen A Matlin¹

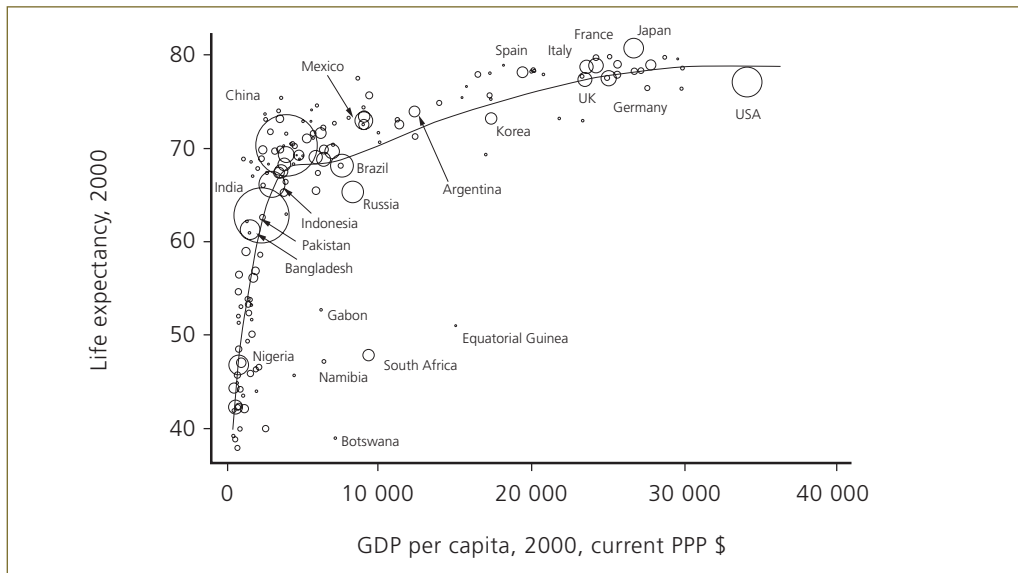
1 Why research for health?

1.1 Ignorance is fatal

Enormous gains in average life expectancy were achieved during the 20th century, with many countries seeing longevity improvements of 20–30 years during this period. However, these gains were not evenly distributed around the world. In particular, as illustrated by the

Millennium Preston curve (Figure 1), in any one period the poorest countries had average life expectancies substantially shorter than wealthier ones and as gains have been made over the course of time the disparities between richer and poorer countries have grown wider (Dye, 2008; Deaton 2004).

Figure 1 Preston curve: Life expectancy versus gross domestic product (GDP) per capita, 2006



PPP = Purchasing power parity.
Source: Deaton, 2004

The relationship between average life expectancy and poverty is not a straightforward one, as demonstrated by the flattening of the Preston curve: Beyond a certain point additional wealth does not translate into additional longevity, but the same amount of real income (in constant US\$) is associated with more longevity in a later time period (Dye, 2008).

An extremely important factor is technical progress – defining this broadly as the sum of scientific advances in fields such as medicine and public health, the diffusion of these technologies to different countries and the capacities of countries to undertake, apply or adapt the technologies for local use. Easterlin (1999) has shown that 20th century mortality decline had its origin

in technical progress. Much of the variation in country outcomes results from very substantial cross-country variation in the rate of technical progress: e.g. technical progress explains 66% of intercountry variation in the decline in infant mortality from 1962 to 1987, whereas change in income explains 9% (Jamison et al., 2004; Jamison, 2006).

A key conclusion is that ignorance is fatal – the poor die young and a large part of this excess mortality is attributable not directly to poverty but to failure to apply the knowledge, processes and products that are the fruits of research. The Millennium Preston curve (Figure 1), shows that relatively poor countries such as Brazil and China can achieve a health status comparable to the richest countries (Deaton, 2004).

1.2 Low- and middle-income countries face a wide range of challenges to health

Much health research is potentially of immediate general benefit to people everywhere – for example, the creation of drugs, vaccines and diagnostics for common diseases found in all countries; the acquisition of knowledge about how to prevent diseases through public health measures such as clean water and sanitation; and development of understanding of the relationships between noncommunicable diseases and factors such as diet, physical activity and tobacco use. But there is also a great deal of research that needs to be focused on regional, national or local factors – such as research on diseases found predominantly or exclusively in tropical countries; the

organization, efficiency and effectiveness of services for disease prevention and health promotion; and the impact of variations in local cultural, behavioural, environmental and social conditions.

In their report, the Commission on Health Research for Development (1990) drew attention to the fact that too little research was being undertaken to address the health needs of low- and middle-income countries² (LMICs). They estimated that, for 1986, out of a global total of about US\$ 30 billion spent on all health research and development (R&D), only roughly US\$ 1.6 billion was devoted to the specific health needs of LMICs, while over 90% of the world's preventable mortality was occurring in these countries.

The high rates of mortality faced by LMICs in the 1980s were considered to be largely due to infectious tropical diseases and maternal, perinatal and nutritional conditions. The importance of this group of problems, together with the growing impact of the newly emerged disease HIV and the re-emerged disease tuberculosis, was given prominence in the Millennium Development Goals (MDGs)³, with targets being set for the substantial reduction of these threats to health by 2015.

In 2008, the mid-point to 2015, several major assessments of progress towards achieving the MDGs were published. From these, a mixed picture emerged:

- According to the MDG Africa Steering Group (2008), “At the mid-point (2008) in the global effort to achieve the MDGs by 2015, progress in many African countries is not on track. Nevertheless, a number of recent successes demonstrate that

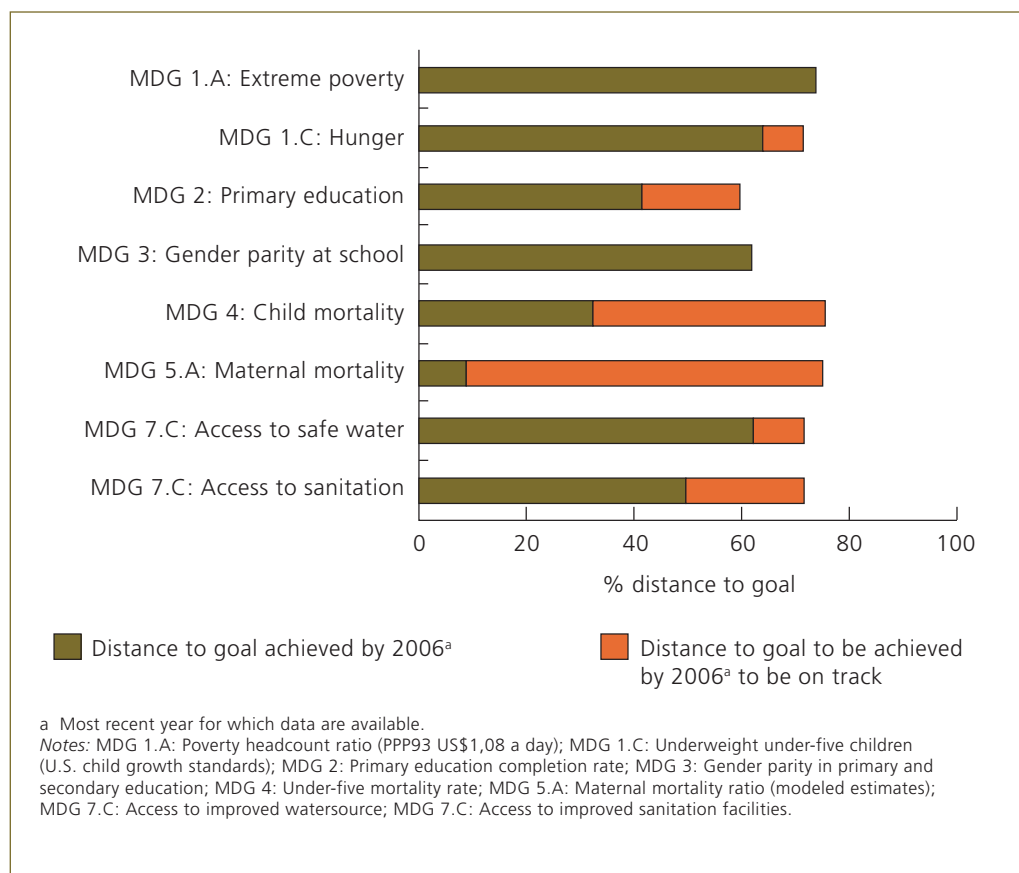
rapid progress is possible across Africa when sound national programmes are matched with adequate development assistance and full technical support from the international system.”

- Health MDGs 4 and 5 are particularly far off-track (Figure 2), especially in sub-Saharan Africa (World Bank, 2008).
- Other MDGs, which are all important determinants of health, are also off-track. For example, about 2.8 billion people (>40% of the world’s population) live with some form of

water scarcity (UN, 2008). Less than 50% of the population has access to improved drinking water in a number of countries in sub-Saharan Africa (WHO, 2008a).

While the MDGs have been a major driving force for development efforts during the last decade, they focus narrowly on a handful of conditions. Some widening has subsequently been achieved – most notably with the agreement in 2008 to add a target for

Figure 2 Global progress and prospects on the MDGs



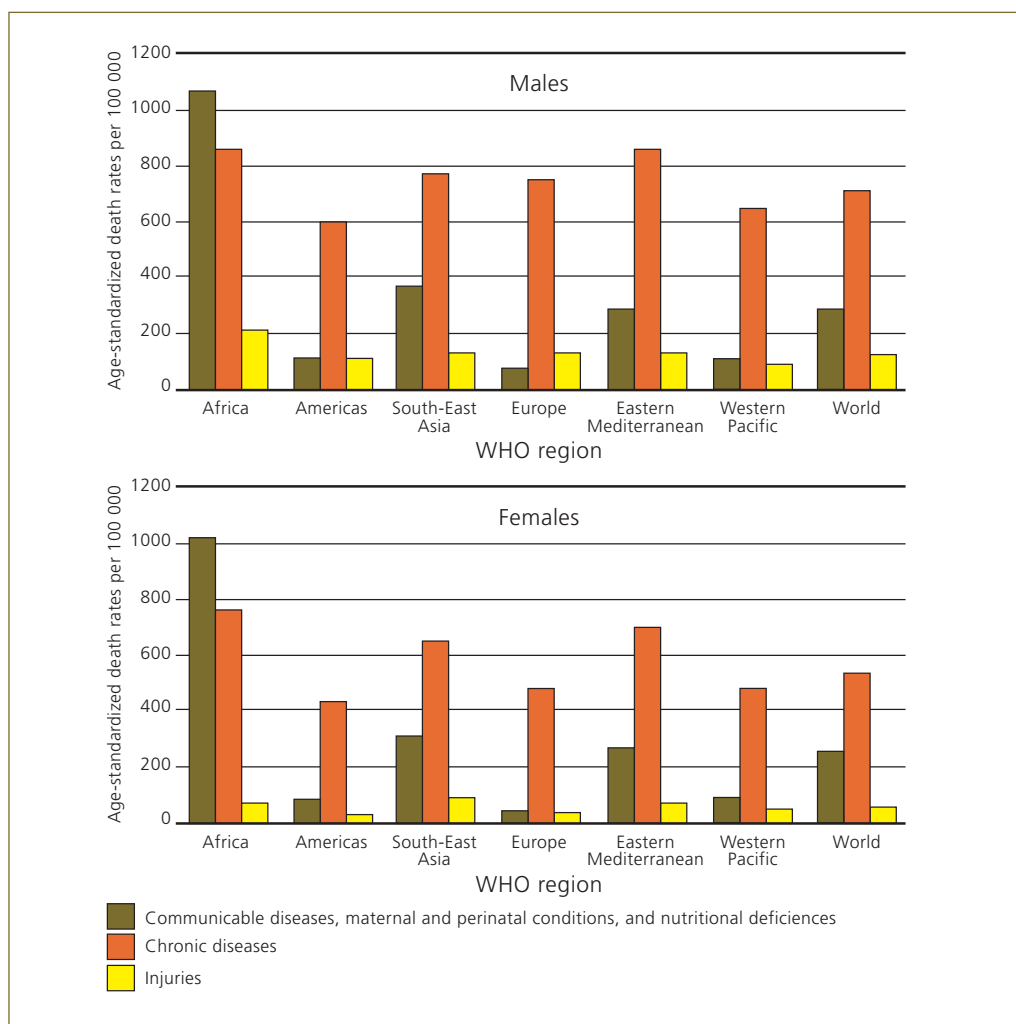
Source: World Bank, 2008.

achieving universal access to reproductive health⁴ – but other important factors are still missing, such as the construction of effective, efficient, affordable and equitable health systems as an essential underpinning of health improvement. As long as 150 million people annually suffer catastrophic financial shocks due to uninsured health-care expenditures (Xu et al., 2007), the overarching MDG

of poverty reduction is likely to remain elusive.

Moreover, during the past two decades a dramatic epidemiological transition has taken place in many LMICs, with the emergence of a ‘new epidemic’ of noncommunicable diseases (NCDs) – in particular, cancer, chronic respiratory conditions, diabetes, heart disease,

Figure 3 Death rates by region



Note: Chronic diseases: cardiovascular disease, chronic respiratory disease, diabetes.

Source: WHO, 2005.

stroke and mental and neurological disorders. NCDs are now the leading causes of morbidity and mortality in every region except sub-Saharan Africa – where they are also very prominent but still overshadowed by the continuing high rates of mortality due to the persisting group of communicable, maternal, perinatal and nutritional conditions (Figure 3) (WHO, 2005).

A further development adding to the complexity of the picture is the growing awareness of the importance

of determinants of health beyond biological factors and health systems, such as economic, environmental, political and social determinants. The 2008 report of the WHO Commission on Social Determinants of Health provides a rich source of evidence on the impact of socioeconomic factors, which can lead to massive health disparities between populations, between and within countries, including high-income countries (HICs) as illustrated in Table 1 (CSDH, 2008).

Table 1 Male life expectancy

Place	Life expectancy at birth
United Kingdom	77
Glasgow (Lenzie N)	82
Glasgow (Calton)	54
United States of America	75
Montgomery County	80
Washington DC	63

Source: CSDH, 2008

1.3 Research for health

Alongside this growing complexity of problems associated with health in LMICs has come an understanding of the need to widen the domains of research that must be developed to address them. Since the ground-breaking work of the Commission on Health Research for Development (1990), the domain of ‘health research’ has increasingly been recognized to include a spectrum ranging from biomedical research that provides understanding of the biological nature of diseases and creates products to prevent or treat disease states, to health policy and systems research, social science, behavioural and operational

research that leads to knowledge of how to test, scale-up and follow through the introduction of health interventions and optimize their benefits. In recent years, the Global Forum for Health Research has highlighted the need for a shift of attention from ‘health research’ to ‘**research for health**’,⁵ which is research undertaken in any discipline or combination of disciplines that seeks to:

- understand the impact on health of policies, programmes, processes, actions or events originating in any sector – including, but not limited to, the health sector itself and encompassing biological, economic, environmental, political, social and other determinants of health;

- assist in developing interventions that will help prevent or mitigate any adverse impact;
 - contribute to the achievement of health equity and better health for all.
- This ‘research for health’ approach is gaining traction and emphasizes that a broad, intersectoral agenda of research is needed, addressing a wide range of determinants of health and requiring both technological and social innovation.

2 Research for health in a time of global economic crisis

The financial crisis that began in 2008 has led to a global economic downturn on a scale not seen since the 1930s (IMF, 2009a). There have been widespread concerns that poverty will increase,⁶ that development assistance may diminish (IRIN, 2008) and that progress towards the MDGs would be even slower (Box 1) (UN, 2008).

Box 1 Towards the Millennium Development Goals

- The economic slowdown will diminish the incomes of the poor; the food crisis will raise the number of hungry people in the world and push millions more into poverty; climate change will have a disproportionate impact on the poor.
- The need to address these concerns, pressing as they are, must not be allowed to detract from our long-term efforts to achieve the MDGs.

Ban Ki-Moon, UN Secretary-General (Foreword to UN, 2008)

The justification for such concerns is well founded, in the light of previous experience in times of banking crises in donor countries that are members of the Organisation for Economic Co-operation and Development (OECD) Development Assistance Committee (DAC), when official development assistance (ODA) fell steeply (UNCTAD, 2009). Estimates show that official development assistance may be as much as 24% lower, even four years after the financial crisis.

The health sector, in particular, could be one of the most severely affected by a global recession. At the July 2009 meeting of the UN Economic and Social Council (ECOSOC), the high-level segment addressed current global and national trends and their impact on social development, including health. It adopted a Ministerial Declaration on implementing the internationally agreed goals and commitments regarding global public health (UN, 2009). The Global Forum has added its voice to others in high-level gatherings – making the case

not only for the need to protect health investments but also for **the essential roles that research must play in times of scarce resources** (Box 2) (Global Forum for Health Research, 2009). In the face of challenges to health of the current scale and magnitude, research to find solutions is even more critical – research that directly addresses the heavy burdens of ill-health and health inequities experienced

by the poorest and most disadvantaged populations. The Global Forum presses for the setting and implementing of priority research agendas that attack these problems – and their root causes – and is intensifying its efforts to ensure that these priorities are communicated to policy-makers, that the resources for the research are found and the research results are incorporated into effective programmes.

Box 2 The vital role of research for health at a time of financial crisis

Research is not a luxury that is affordable only in times of plenty but is a continuing necessity – and never more so than in hard times.

For all countries, research is vital as a source of evidence about the causes, prevention and treatment of ill-health and to ensure that health resources are being used effectively and efficiently. Most importantly, research is vital for poor countries. In hard times, when health is under pressure, the greatest threat is that health inequities will increase. Research for the health of the poor is essential to prevent this and to ensure that the impacts of the financial crisis on health and health equity are predicted and mitigated.

Research for health is precisely aimed at achieving this – to understand the causes of the causes of ill-health and the impacts on health of factors originating in many different sectors and to help mitigate any adverse impacts of these factors.

As we argue the case for protecting and promoting health in this period of financial crisis and as we look for innovative ways of financing this, we must explicitly include research for health as an essential component of that agenda, in order to ensure that we keep the reduction of health inequities at the centre of attention.

Extract from intervention by the Global Forum for Health Research at the High-level Consultation on the Financial Crisis and Global Health, WHO, Geneva, 19 January 2009.
Source: Global Forum for Health Research, 2009.

Fears for serious impacts of the economic crisis on development have especially focused on Africa. In a World Economic Outlook Update in Jan 2009 (IMF, 2009b), the International

Monetary Fund (IMF) forecasted a GDP growth rate for Africa of 3.5% – i.e. 1.9% below the 2008 growth rate. The growth forecast for primary commodity exporters was even lower:

Angola, for instance, was projected to have a nominal GDP in 2009, only 5/6 of that in 2008.

However, it has been pointed out (te Velde, 2008) that the relationship between the OECD's GDP and Africa's GDP has weakened as a result of the emergence of countries such as China, as well as structural changes in African economies. According to the IMF World Economic Outlook report in April 2008, a decline in world growth of 1% would lead to a 0.5% drop in Africa's GDP, so the effects of global turmoil on Africa (via trade, foreign direct investment and aid) would be quite high. The correlation between African GDP and world GDP since 1980 was 0.5, but between 2000 and 2007, it was only 0.2. As there have been significant structural changes (and a move into services that were able to withstand competition much better) as well as the rise of China, African growth has at least temporarily decoupled from OECD GDP.

In fact, this decoupling may continue to be important as the economies of a number of emerging economies continue to grow in relation to those of OECD countries. The total GDP of LMICs, measured in purchasing power parity (PPP), is predicted to overtake advanced economies in 2013 (Euromonitor, 2008).

Within the field of health R&D, investment by the pharmaceutical industry is of particular importance, since this sector is responsible for half the global total. Although there are no global or national targets, it is therefore of interest to track how this sector is performing, particularly in the current global economic conditions.

Total global private for-profit sector spending on health R&D in 2005 was US\$ 81.2 billion. Of this, US\$ 79.7 billion (98%) was spent by the private for-profit sector in HICs – US\$ 38.2 billion (47%) in the USA alone. Together, the G7 countries accounted for 79% of privately funded health R&D.

Important trends were seen in the pharmaceutical industry in 2009, with some large-scale mergers and acquisitions: Pfizer buying Wyeth for US\$ 68 billion in January 2009; Merck buying Schering-Plough for US\$ 41 billion in March 2009; and Roche buying Genentech for US\$ 47 billion in March 2009.

Building on the commitments outlined in February 2009 by GlaxoSmithKline (GSK) Chief Executive Officer, Andrew Witty, GSK published its 2008 Corporate Responsibility Report (GSK, 2009) and announced a major initiative involving:

- A more flexible approach to intellectual property rights to stimulate research into medicines for neglected tropical diseases. GSK will place over 500 granted patents and over 300 pending applications (relating to approximately 80 patent families) in a pool to help others to develop potential medicines for neglected diseases.
- Reducing prices for patented medicines in the least developed countries (LDCs) so they are no higher than 25% of the developed world price, as long as this covers cost of goods (to ensure this policy is sustainable). GSK will make price reductions on 110 products and formulations across LDCs with an average price reduction of 45%. This will come into effect from 1 April 2009.

- Reinvesting 20% of profits made from sales of medicines in the LDCs to support strengthening of health-care infrastructure. GSK will identify the first projects to invest in over the coming months.

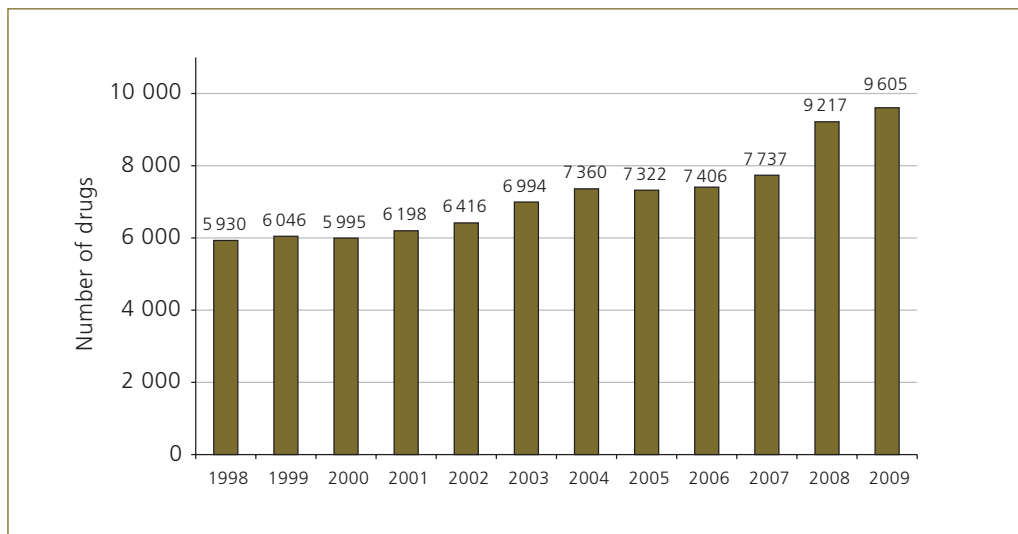
With the mergers and consolidations that have been seen in the pharmaceutical industry globally in recent years have come worries about falling levels of productivity and innovation. The latest annual survey from Citeline Drug Intelligence (2009) shows a mixed picture for the drug pipeline. The global economic downturn had yet to impact on pharmaceutical R&D by May 2009, which recorded a 4.3% growth of the global drug pipeline. This is one of the bigger jumps seen this decade and takes the total number of drugs in active development to 9,605 (Figure 4). There was an increase in the number of ‘new active substances’ (i.e. new chemical

or biological entities, as opposed to reformulations of existing drugs) reaching the market for the first time in 2008 relative to 2007, with 32 market entrants during the course of 2008, a considerable improvement on the disappointing 25 seen the previous year, and above the average seen through this decade. However, this is still well below the figures seen during the 1990s, when there were frequently more than 40 introductions per year.

There were several worrying findings:

- 28% growth in new active substances reaching the marketplace, but no obvious potential blockbuster launches.
- No anti-cancer drugs launched, despite nearly one third of the development pipeline being in oncology.
- Virtually all pipeline growth was accounted for by a rise in pre-clinical stages, with other phases flat or declining.

Figure 4 Total number of R&D projects reported in Citeline Drug Intelligence each year, 1998–2009



Source: Citeline Drug Intelligence, 2009.

Other findings from the annual review include:

- The USA remained the pre-eminent market with 15 of the 32 new launches occurring there.
- GSK remained the largest pharmaceutical company in R&D terms but Johnson and Johnson recorded the most first launches.
- 66% growth of single or dual drug portfolio companies contrasts with the consolidation of large pharmaceutical companies from mergers and acquisitions.

Notes

- 1 Stephen A. Matlin is the Executive Director of the Global Forum for Health Research. Educated as an organic chemist (Imperial College, London) he spent 20 years in academia before joining the Commonwealth Secretariat as a Director responsible for health and education sectors. Prior to joining the Global Forum, he worked as a Senior Research Fellow at Oxford University.
- 2 The World Bank Country Classification for 2008 lists 43 countries as low income (Gross national income per capita US\$ 975 or less), 55 lower middle income (US\$ 976–3855), and 46 upper middle income (US\$ 3856 –11 905). (<http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS/0,,contentMDK:20420458~menuPK:64133156~pagePK:64133150~piPK:64133175~theSitePK:239419,00.html>, accessed 19 August 2009).
- 3 UN Millennium Development Goals (www.un.org/millenniumgoals, accessed 10 August 2009)
- 4 MDG target for achieving universal access to reproductive health. (www.un.org/millenniumgoals/maternal.shtml, accessed 19 August 2009).
- 5 Global Forum for Health Research, definition of 'research for health'. (www.globalforumhealth.org/Glossary, accessed 19 August 2009).
- 6 DFID prediction: By December 2010 the number of people living on less than US\$1.25 a day will be about 90 million higher because of the far-reaching impacts of the financial crisis. Department for International Development, UK, 26 March 2009.

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Chapter 2

Comparative study

Daniel Maceira¹

1 Introduction and theoretical framework

1.1 Introduction

Health research was defined by the 43rd World Health Assembly as “a process for systematically obtaining knowledge and technologies which can be used to improve the health of individuals and groups. Such research work provides basic information on the population’s health and diseases, on how to develop prevention, healing and alleviation of the effects of diseases, and helps to better plan approaches to individual and community health services” (WHO, 1990).

A broader outlook is needed to analyse funding of the health systems and the determining factors of research in this discipline, taking into account the social nature of the goods and services involved in maintaining or restoring health within a public policy framework. There are no doubts about the social nature of the goods and services needed to restore and maintain health, nor about the status of health as a right reflected in several documents of national and supranational institutions.² Despite the above, the discussion on health and economics is complex, since it involves decisions on investment and the setting of priorities related to peoples’ quality of life. In this regard, the challenge for economics as a tool to analyse health systems is to find a way of effectively implementing access to the right to health (Maceira & Peralta Alcat, 2008b).

A similar challenge arises at the moment of strengthening health research, in order to align the investment in health

with population needs, helping to improve welfare, in particular for the poorest and least advantaged people. For research to fulfil this potential, it is essential that it be adequately resourced, within the broader context of financing for health and development (Burke & Matlin, 2008).

From an economic standpoint, the importance of goods and services supplied and demanded by health systems requires an institutional framework to control operations and to favour common interests. In the same way, a public strategy is needed for health research, in order to prioritize investment in research in those areas that can benefit the health of populations with fewer resources. All such standards aim at having a socially acceptable allocation in terms of efficiency (best results with a minimum amount of resources) and equity (socially responsible equality and justice and appreciation of each individual).

From this point of view, **innovation in health and research priorities should promote a bridging of the gap between the needs and services offered and support democratic knowledge-dissemination mechanisms, facilitating access to all.** This brings about an additional requirement as to the state’s responsibilities within the health system.

1.2 Health systems and innovation systems

All systems related to health maintenance or restoration, as well as those linked

to innovation, reveal tensions between creation and socially desirable provision. Both sectors are characterized by three elements: uncertainty and asymmetrical information on demand, lack of competition and externalities.

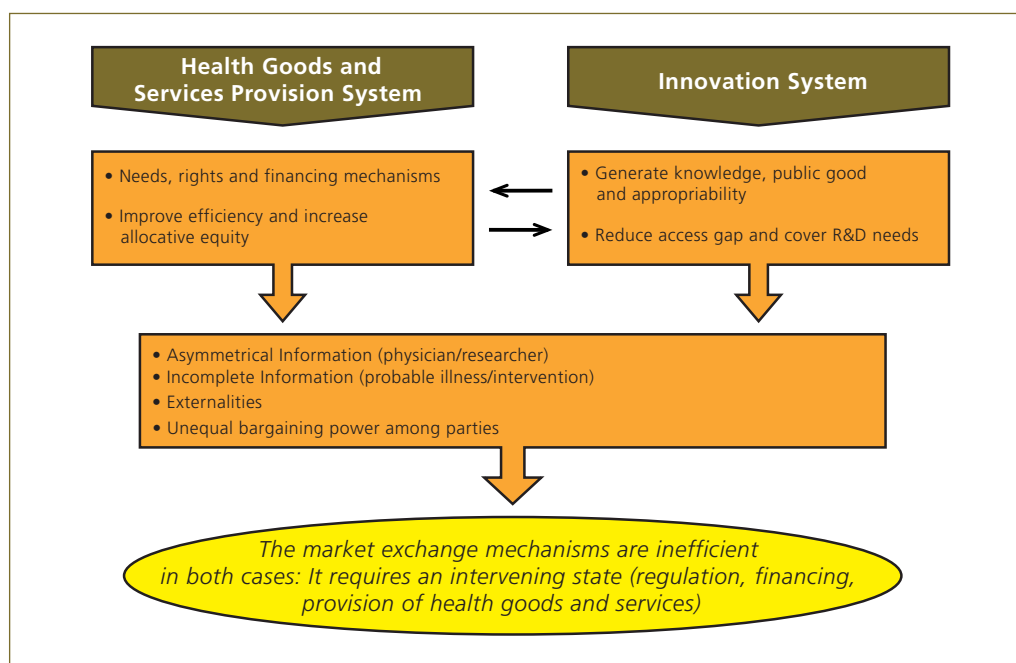
However, the rationale of activities related to research and development (R&D) and the innovation process also includes operating under idiosyncratic circumstances in which information is incomplete and asymmetrical, increasing the challenge at policy level.

At the same time, the systemic nature of all innovation processes entails that an organization does not innovate independently from others. For instance, a company that has embarked on a search for innovation is influenced by

other firms, competitors, public actors and other organizations. The behaviour of all actors is, in turn, framed within the institutions that must regulate the innovation process (laws, regulations, routines, etc.). These organizations and institutions are components of a system of knowledge creation and trading. Innovations thus arise as an outcome of the “innovation system” (Edquist, 2000).

Likewise, the generation of health-related goods and services and of knowledge allows strong spillover effects that are not captured by the price system and are therefore underprovided by the market. Lack of coverage for low-income sectors and research deficiencies as regards certain poverty-related treatments and diseases are just some of the examples illustrating this problem.

Figure 1 Parallels between health and innovation systems



Source: Maceira & Peralta Alcat (2008a).

Health research has features inherent in both systems, in the generation of health-related goods and services and in innovation, thus becoming a challenge for policy-makers in a field where there is strong interaction among policy-makers, researchers and companies. According to certain guidelines of economic literature, the existence of market failures calls for the state's participation to define an intervention structure that allows a reduction of the negative effects as far as effectiveness and equity are concerned. Such interventions can take place in different ways, through different mechanisms of public-private cooperation and with a greater involvement of the state. The selection of each course of action depends on the government's skill in identifying social needs, on its regulatory or financial capability and on its political preferences.

Intimately related to this problem are the priorities established by public authorities. These give rise to criteria that direct public funds for research and the cooperation and complementariness structures between government agencies and with private companies, research institutes, patients' associations, etc.

A political economy approach attempts to understand the motivations of each of the sector's leading players (e.g. the political power, the ministry of health, decentralized public institutions, health workers' trade unions, associations of physicians, patients and pharmaceutical companies), their effects on the systems and sector-based reforms, and the system's capability to meet the population's needs. In the specific case

of health research, it consists basically of analysing the interests, players and ideas that determine the research agenda.

According to the definition proposed by the Organisation for Economic Co-operation and Development (OECD) and the United Nations Educational, Scientific and Cultural Organization (UNESCO) and taken from the Global Forum (2001), R&D in health entails creative work based on a systematic process, with the purpose of increasing the stock of knowledge, which includes knowledge on humankind, culture and society and its use for new applications. It therefore involves a process of knowledge generation and testing of hypotheses within the medical and natural sciences, as well as social sciences, which encompasses economics and behaviour.

Investment in health research has been the origin of great progress in the field of health worldwide, providing new means of prevention, diagnosis and therapy to meet health needs. It is therefore a key tool for improving the population's health conditions, meeting the challenges that still exist in this field.

R&D in the field of health is thus a source of knowledge and an input to innovation processes that allow improvement of the living conditions of the population, with important economic and social effects. However, important scientific advances in health have had a limited impact on developing countries. Although a part of this phenomenon results from poverty and deficiencies in the health systems of these nations, the problem is much more complex. For instance, of the 1233 new drugs approved between 1975 and 1999,

only 13 were meant to be used in tropical diseases (Jamison et al., 2006). This is an example of what is meant by the “10/90 gap”, which shows the lack of correlation between resources targeted to health research and the population’s health needs.

This imbalance is connected with limitations inherent in the operation of scientific research and innovation systems,³ which limits the alignment of social interests with those of innovators. It is thus necessary to develop supplementary mechanisms between the private innovative sector and public authorities, so as to identify socially desirable instruments for innovation and dissemination.

Innovation is the creation, development and implementation of a new product, process or service, with the aim of improving efficiency, effectiveness or competitive advantage. Innovation may apply to products, services, manufacturing processes, managerial processes or the design of an organization (Global Forum, 2009).

1.3 National innovation systems

The expression “national innovation system” (NIS) was used for the first time in publication by Freeman (1987). He defined it as “the network of institutions of the public and private sector whose activities and interactions initiate, import and disseminate new technologies”. Despite the holistic vision and the interdisciplinary perspective of the notion, some authors voice difficulties as to the definition, application and ground rules that govern a NIS (e.g. Lundvall, 1992; Nelson & Rosenberg, 1993).

Edquist (2000) proposes a set of activities as NIS components, for instance:

- provision of R&D;
- creation of human capital, production and reproduction of skills to be used in R&D activities;
- generation of new market products;
- creation of institutions that have an influence on innovative organizations and innovation processes, providing incentives or eliminating obstacles;
- funding of innovative processes and other activities that can facilitate trade and knowledge for their adoption.

Within this framework, the main components of an NIS are organizations and institutions. Within the former are the formal structures created for specific purposes: companies, universities, public agencies responsible for innovation and competition policies, etc. On the other hand, institutions are a set of standards, habits, routines, established practices and laws that regulate relations and interactions among individuals, groups and organizations – that is, the ground rules for organization interaction – for instance, patent laws, rules and standards that have an impact on the relationship between universities and firms. Institutional differences between countries give rise to different coordination modalities in the relationship between organizations and different mechanisms for setting priorities, to the extent that they have an impact on the existence and ways of relating to other organizations.

Therefore, the capacity of a health innovation system in a country to bridge the gap to access knowledge and treat

certain diseases or topics depends partly on the prioritization mechanisms of the state that created the institutions. The state, interacting with other players of the innovation system, sets its limits and the effectiveness of the resulting strategy.⁴

The health innovation system is defined as a set of organizations, institutions and activities whose main objective is to generate high-quality knowledge that can be used to promote, re-establish or maintain the population's health status (Pang et al., 2003). The definition includes all players involved in knowledge generation and use of the outcomes in both the public and private sectors. From this point of view, the health innovation system of a country is the intersection between the innovation system and the health system.

From this standpoint, an effective NIS in the field of health must manage, finance, create and maintain resources, and produce and use scientific knowledge. In this context, this document presents an analysis of the national health innovation systems in five Latin American countries – Argentina, Bolivia, Chile,

Paraguay and Uruguay – based on the use of a common analysis methodology, focusing on the national government investments in research for health in each country. The purpose is to get to know the national innovation system in the field of health (NISH) structure in light of the population's needs in each country. The implementation of this working agenda focuses on answering the following questions on research:

- Which are the institutional arrangements established in each country to promote, develop and support their NISH?
- Is there a prioritization mechanism in health research within the framework of an NISH?
- Is there coordination among public financing institutions?
- Has there been an increase throughout the time of funding of research on priority topics, given the country's epidemiological profile?
- Are there idiosyncratic biases in research topics – that is, is it possible to underscore any relationship between countries and also between regions in a country and the prioritized research topics?

2 Methodology⁵

Given an analysis framework on health research and the role of the state in coordinating an NISH, the purpose of this research was to analyse the national health innovation systems in five Latin American countries – Argentina, Bolivia, Chile, Paraguay and Uruguay. The study analysed the flow of financial resources for health research for the years 2002–2006, focusing on the

national government investments using a common methodology.

In each case, the institutional arrangements established in each country to promote, develop and support their NISH are considered. In the same way, the institutional arrangements made to invest resources in the sector, and the characteristics of each of them and the

origin of allocations (direct ministerial contributions or open competition for research funds), are identified. When allocations are not concentrated in a single institution, an attempt is made to establish whether there are specific coordination mechanisms or competencies for each participating agency.

In addition, given the NIS framework, the document endeavours to identify the prioritization mechanisms in health research in these countries. This paper particularly attempts to establish the relative share of each research topic, with the purpose of carrying out an analysis of the determining factors of investment in health research. In relation to this, the paper also intends to identify the existence of idiosyncratic biases in research topics. The idea is to find the existence of any relationship between regions and the prioritized research topics in that country.

In order to identify comparable analysis mechanisms among nations on the flow of research funds, it was necessary to select a term for the study (in this case, the five-year period 2002–2006) and also to agree on a fund annualization mechanism to facilitate follow-up of fund evolution. This was necessary because frequently resources are allocated biannually or triannually to project implementation, thus requiring homogeneous mechanisms for studying resource allocation during the different periods. These agreements allowed analysis within each country, and then comparison among countries, of the evolution of funds and also collating institutions and particularly research topics throughout time.

Finally, from the above it is possible to point out that the purpose of this study is to determine what resource allocation mechanisms are used to assign public sector research funds within the framework of an NISH, either explicitly or implicitly defined.

According to this approach, a categorization of research projects is proposed to classify them along two lines: (i) the objective of the study and (ii) the nature of the research methodology. Within the first group, related to research lines on basic conditions are the papers addressing the social, economic and cultural determining factors of health problems, which can be broken down into four groups linked to traditional profiles: communicable diseases, noncommunicable diseases, addictions and violence, and nutrition- and environment-related illnesses.

The last bloc of the project analyses health actions or interventions. Therein, four alternative lines were classified. First are those related to research in health programmes, systems and services, normally linked to management issues. Second, there are the technological research and development projects targeted to the production of health-related equipment or techniques and software. A third kind of project aims at basic research carried out essentially in laboratories. The fourth line of research with the “health action” group includes those projects that prioritize traditional and alternative medicine topics.⁶

These nine thematic research blocs, classified by purpose of the study, were crossed with the research methodologies

Figure 2 Matrix of health research projects

			Research methodology		
			Biomedical	Clinical	Public health
Objective	Context	<i>Social, economic and cultural</i>			
	Topics	<i>Communicable diseases</i>			
		<i>Noncommunicable diseases</i>			
		<i>Nutrition and environment</i>			
		<i>Violence and accidents</i>			
	Actions	<i>Health policies, systems and services</i>			
		<i>Technological R&D</i>			
		<i>Basic science</i>			
		<i>Traditional medicine</i>			

Source: Based on information obtained from the Centro de estudios de estado y sociedad workshop, September 2008.

used, which were structured into three groups: basic research, clinical research and public health research.

The outcome is a matrix of 27 categories, which were used to classify research projects financed by government authorities in the five countries included in the study. Hereafter, these definitions are used to identify each of the research objectives and methodologies present in the countries under consideration. Such definitions were deemed to be the basis to differentiate between topics in the five national studies and to classify each of the projects financed by the national government innovation system, by financing institution and project. When a research project includes more than one analysis object, the more specific objects were weighted.

2.1 Research methodologies

Biomedical research, as defined by OECD (2005), covers the study of

diseases and specific conditions (mental or physical), including detection, cause, prophylaxis, treatment and rehabilitation of patients; the design of methods, drugs and devices used to diagnose, support and maintain an individual during and after treatment of a specific disease or condition; and scientific research required to understand vital underlying processes that affect the disease and human well-being, including areas such as cellular and molecular pathology of the disease, genetics and immunology. The complete list of activities includes clinical trials and research in laboratories, the study of exposure to environmental agents and behavioural risks.

According to the Declaration of Helsinki, **clinical research** combines research and professional care. The UK Medical Research Council defines it as “an investigation in human subjects, designed to answer questions on health and disease. Besides a direct examination

of individual patients and populations, it also includes the testing of biological samples and personal data of individual participants. And furthermore, research among volunteers or among groups of apparently healthy individuals when these tests are related to the investigated disease”.⁷

Public health research has the essential purpose of looking into, analysing and explaining the distribution of health conditions among the population, their determining factors, and the communal solutions to collective health problems. Therefore, its purpose is to generate the necessary knowledge to understand the causes and factors that influence the population’s health conditions, and to evaluate and explain the effects on those conditions of the different policies, interventions and mechanisms of system organization and health service provision (de los Ríos, 1999).

2.2 Research objectives

Research in health-related socio-economic and cultural aspects is defined as the spaces in which interactions related to health, disease and their context take place, the mechanisms of influence and feedback. According to the World Health Organization (WHO), most health problems can be attributed to people’s socioeconomic conditions. In health policies, there has, however, been a prevalence of solutions centred on the treatment of diseases, without appropriately incorporating interventions on the “causes of causes”, such as actions on the social environment. Consequently, health problems are still in place, health and health-care inequalities have

increased, and the results obtained with health interventions focused on healing have been insufficient and do not allow compliance with the Millennium Development Goals. Among the topics included within the “social determining factors of health”, WHO lists living conditions during early childhood development, health systems as social determining factors, working and employment conditions, effects on health of some globalization processes, design and organization of programmes to control priority diseases for public health, extreme housing conditions, social exclusion, and necessary methodologies to be used for assessing interventions and policies on social determining factors in the field of health.

Communicable or transmissible diseases are defined as any diseases caused by an infectious agent or specific parasite, or by their toxic products or the toxic products of other biological agents. They happen because of the transmission of that agent or its products from an infected individual or animal or from a reservoir to a susceptible host. They can be transmitted directly or indirectly by means of an intermediate host of plant or animal origin, or by a vector or the environment (Ministry of Health, Chile, 2000).

Noncommunicable chronic diseases are a group of heterogeneous diseases that contribute to mortality through a small number of outcomes (e.g. diabetes, heart disease, stroke). Deaths are the result of a process that started years ago. The natural evolution of diabetes or heart disease can be modified with actions that change the clinical course of conditions determining

their incidence. Among them, it is worth mentioning excessive bodyweight and obesity, abnormal concentrations of blood lipids, hypertension, smoking, a lack of exercise, an inappropriate diet, and metabolic syndrome. The above characteristic provides opportunities for prevention, development of forecasting tools and the creation of pharmacological-economic models. For instance, if the modifications to the national prevalence of these anomalies are known, then it is possible to forecast the damage of noncommunicable chronic diseases and assess the effects of preventive actions (Córdova-Villalobos et al., 2008).

Nutrition and the environment refers to those topics of health research stemming from the analysis of specific determining factors related to food intake and the environmental context (water, sanitation, pollution and so on) and behaviour linked thereto, beyond the organization and operation of the health system. According to the WHO Food Security Programme (2005), diseases related to the above topic have an infectious or toxic origin caused by agents that enter the body through food intake, metals and persistent organic pollutants.

Violence and accidents refers to the deliberate use of physical force or power, either effectively or menacingly, against oneself, another person, a group or community, which causes or has the possibility of causing injuries, death, psychological damage, development alterations or deprivation (WHO, 2005a). This includes the following categories within the international classification of diseases: injuries, suicide, homicide, injuries produced by

firearms, and all other injuries caused by weapons. This category also includes accidents and behaviour that is risky for people's health, outside the patterns included in the previous groups.

Health policy and systems research (HPSR), according to the Alliance for Health Policy and Systems Research of the WHO (2005b), has been defined as the production and application of knowledge to improve how societies organize themselves in order to achieve health goals. It encompasses how societies plan, manage and finance health services and research on the role and interests of different actors in the health system. HPSR is a topic area, not a discipline, and draws upon a variety of contributing disciplines, including economics, sociology, anthropology, political science and epidemiology.

Technological research and development is related to the creation of technological innovations applied to the development of inputs for their use or implementation in the health system (e.g. equipment, hardware, software). Technological R&D has the purpose of supporting an improvement in quality and a cost reduction in products and services in the industrial and other sectors, in agriculture, and health etc. Technological R&D projects are usually implemented by groups of researchers from different disciplines and their related problems are interdisciplinary (Lara Rosano et al., 1998).

Basic research refers to pure study and research in sciences for increasing our scientific knowledge base. According to the *Frascati Manual* (OECD, 2002), basic

research is theoretical or experimental research carried out primarily to acquire new knowledge on the underlying grounds of an observable phenomenon or event, with no specific application or use. According to OECD (1993), pure basic research is that carried out to improve knowledge, with no specific quest for social or economic recognition in the long term, with no effective efforts to apply such results to practical problems or to transfer such results to sectors responsible for their application.

Traditional, alternative and supplementary medicine, according to WHO

(2003), are health practices, knowledge and beliefs that include medication based on plants, animals and minerals, spiritual therapies, manual techniques and exercises, applied individually or in a combined manner, to treat, diagnose and prevent diseases or maintain well-being. According to this source, countries in Africa, Asia and Latin America use traditional medicine to cover some of their primary health care needs. In Africa up to 80% of the population uses the above techniques, while in industrialized countries adaptations of traditional medicine are known as “supplementary” or “alternative”.⁸

3 The public financing of research in health: a comparative study of Latin American cases⁹

3.1 Introduction

The objective of this chapter is to put forward a comparative study of the financing mechanisms in health research, informed by the results of the five country analyses (Argentina, Bolivia, Chile, Paraguay and Uruguay), while discussing the priorities of the region. The chapter examines:

- institutional criteria that characterize the allocation of resources;
- social-sanitary profiles and related research priorities;
- comparative analysis of research projects and their evolution from 2002 to 2006;
- identification of research methodologies receiving public resources, their priority status, and subsequent dissemination.

3.2 Institutional framework

There is a lack of homogenous criteria to describe how public resources in health research in Latin America are directed. In Argentina and Chile, most funding is allocated through research grants, fellowships, or the selection and continued financing of individual researchers with institutionally defined career paths. In contrast, Bolivia lacks an institution charged with the responsibility to evaluate and select among competing research projects. Consequently, the discretionary exercise of such prerogatives falls on the Ministry of Health and Sports. Intermediate cases include Uruguay and more recently Paraguay, which are moving forward to implement systematic mechanisms for the competitive allocation of research funds.

In Paraguay and Uruguay, public universities finance and host most research projects. In Paraguay more than 80% of the research in clinical and public health issues is developed by the public university (National University of Asunción), while in Uruguay 62% of research on health is pursued through the Scientific Research Sectoral Commission, which belongs to the National University.

In Argentina and Chile public universities receive research funds, but they are not their main source of income. In the case of Chile, although the National Commission for Scientific and Technological Research (CONICYT) is the institution that finances all the projects on health research, the National Fund for Scientific and Technological Development (FONDECYT) awarded the majority of resources during the period under study (85% of the projects). In Argentina most research projects until 2005 were funded by the National Council for Scientific and Technical Research (CONICET), and for the past year the Scientific and Technological Research Fund (FONCyT) was the main source of funds. In terms of number of annual projects, CONICET still represents the greatest contribution during the study period (70.9%), followed by Salud Investiga (14.3%) and FONCyT (11.3%).

The criteria for the allocation and use of research funds determine a country's capacity to create a national system of innovation organized into networks, where public financing is shared among private and public institutions. Lower

levels of development, in turn, are associated with wider discretion by the ministry of health, which is guided by strategic or emerging health guidelines. Through the comparative study of the five cases, it is possible to observe that the absence of a systematic norm to allocate resources results in the concentration of financing mechanisms in the public sector, as in Bolivia, in all likelihood overestimating the capacity that the public sector has to finance a national health system.

In Argentina and Chile, it is likely that resources allocated by the ministries of health were underestimated, because of the focus on systematic and formal mechanisms used to competitively assign grants. Moreover, the complexity of these countries' health ministries makes it more difficult to analyse the resource-allocation process. Within these ministries, there are departments specializing in research and departments with research as a component of other, more general activities. In the case of the latter, it is difficult to discriminate the sources of funding directed towards research from those of health spending.

Moreover, in Argentina, decentralizing the health system resulted in each province's health ministry using local resources to finance health benefits, reducing the amount available for research. These resources were not considered in this study, relatively undervaluing the role of health ministries in the financing of health research in countries such as Argentina, Chile and, to a lesser extent, Paraguay and Uruguay, compared with Bolivia.

Table 1 Demographic and socioeconomic indicators

	Argentina	Bolivia	Chile	Paraguay	Uruguay
1 Population (millions) (2007)	40	10	17	6	3
2 Urban population (% of total population) (2005)	90.1	64.2	87.6	58.5	92.0
3 Human development index (HDI)/country position (2006)	0.860 (46)	0.723 (111)	0.874 (40)	0.752 (98)	0.859 (47)
4 Population living under the poverty line (% living on < 1,25 US\$ per day) (2000-2006)	4.5	19.6	<2.0	9.3	<2.0
5 Adult literacy rate (% aged 15 years and over) (2006)	97.6	89.8	96.4	93.6	97.8
6 Access to improved drinking water sources (%) (2006)	96	86	95	77	100
7 Gross national income (GNI) US\$ PPP billions (2007)	513.0	39.4	209.0	26.8	36.6
8 Gross national income (GNI) US\$ PPP per capita (2007)	12.99	4.14	12.59	4.38	11.04
9 Per capita government expenditure on health (US\$ PPP) (2006)	1665	204	697.00	342	989

Sources/Notes:

World Bank, World Development Report 2009 (1, 2, 7, 8)

United Nations, United Nations Development Indices 2008 (3, 4, 5, 6)

World Health Organization, World Health Statistics 2009 (9)

PPP - Purchasing Power Parity

3.3 Demographic, socioeconomic and epidemiological profiles

The allocation of resources to finance health research should be ensured by a transparent decision-making process with clear links with the medical needs of the population. Consequently, in this section we summarize some of the usual health indicators for each country in order to describe the differences in the socio-sanitary profiles of the five nations.

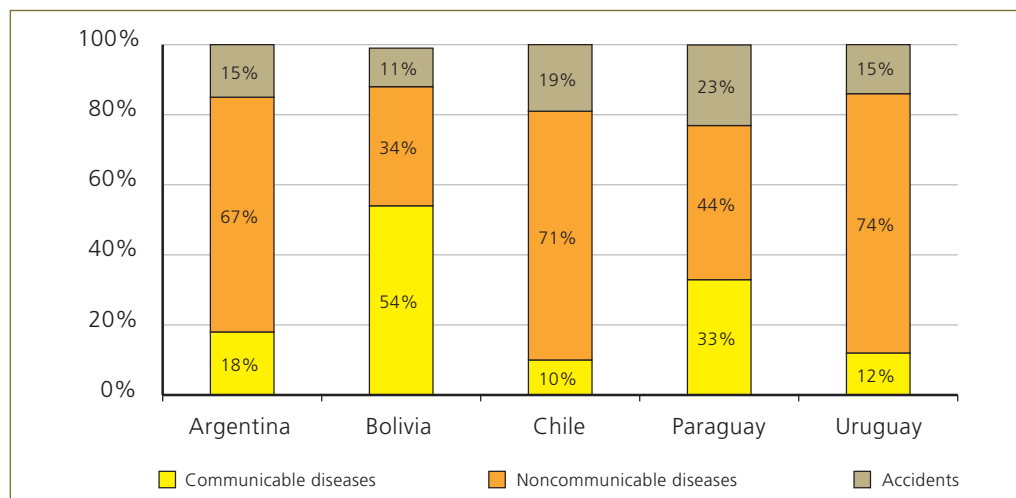
The analysis in this section explains the main demographic, social, economic and sanitary indicators of morbidity and

mortality in the five countries. We analyse in further detail the years of potential life lost (YPLL) and describe the usual indicators of morbidity and mortality.

3.3.1 Main causes of death

Figure 3 shows the 2004 distribution of YPLL for each country by three broad causes: communicable diseases, noncommunicable diseases and accidents. Although differences in the total population by country affect the YPLL count, the relative importance of each category as a percentage of total cases allows us to draw country-specific conclusions.

Figure 3 Years of life lost by broader causes, 2004¹⁰



Source: World Health Organization (2009).

With the exception of Bolivia, noncommunicable diseases are the main source of morbidity and mortality in the countries. However, there are noticeable differences: in Argentina, Chile and Uruguay, the percentage of noncommunicable diseases exceeds 67%, at 67%, 71% and 74%, respectively. By contrast, Bolivia displays more YPLL by communicable than non-communicable diseases (54% and 34%, respectively), placing Bolivia in the epidemiological transition. Paraguay is in an intermediate stage, with 44% for noncommunicable diseases, while the incidence of communicable diseases (33%) remains significant.

In the case of accident-related YPLL values, the average of the five countries represents more than 16%, with a maximum of 23% in Paraguay and a minimum of 11% in Bolivia.

3.4 Comparative analysis of the financing of public research in health

In this section, we analyse the behaviour of resources invested by each country in the period 2002–2006 to generate knowledge in the area of health. To this end, we seek to explain performance as the function of the size of the population, the country and the choice of research methodologies.

Argentina is the country with the largest number of research projects (1457), followed by Chile (344), Uruguay (62), Paraguay (42) and Bolivia (23). This rank ordering remains the same when adjusting by population, with Argentina scoring a maximum of 0.37 research projects per 10 000 inhabitants and Bolivia a minimum of 0.02.

Table 2 Morbid-Mortality Indicators

Indicators	Argentina	Bolivia	Chile	Paraguay	Uruguay
Life expectancy at birth (years) (2007)	75	66	78	74	75
Infant mortality rate (per 1 000 live births) (2007)	14	48	8	24	12
Mortality rate < 5 years (per 1 000 live births)	16	57	9	29	14
Maternal mortality ratio per 100 000 live births (2005)	77	290	16	150	20

However, the total amounts in millions of US dollars adjusted for purchasing power parity (US\$ PPP) provide a complementary interpretation. Argentina is still ranked highest, with more than US\$ PPP 55 million, followed by Chile, with 26 US\$ PPP million. Uruguay

and Bolivia both invested US\$ PPP 1.5 million, while Paraguay invested US\$ PPP 0.5 million in 2006. Moreover, on a per capita basis, Chile is ranked highest, with more than US\$ PPP 15 000 per 10 000 inhabitants, followed by Argentina, at 14 000 US\$ PPP.

Table 3 Quantity and cost of health research projects, 2006

Country	Total Projects	Projects per 10 000 inhabitants	US\$ PPP	US\$ PPP per 10 000 inhabitants
Argentina	1457	0	55 424 294.80	14 221.93
Bolivia	23	0	1 557 979.74	1 618.34
Chile	344	0.20	26 269 001.30	15 982.60
Paraguay	42	0.06	492150	819.02
Uruguay	62	0.18	1 571 287	4 727.10

Source: Developed by authors, based on data submitted to the project team.

The Argentine and Chilean series display the largest amounts of public financing in health research during this period. In the first case, Argentina, financing for research projects increased from approximately US\$ PPP 30 million in 2002 to more than US\$ PPP 55 million in 2006. While in Argentina the annual growth rate in publicly financed research was approximately 16%, annual increases in Chile were 6%.

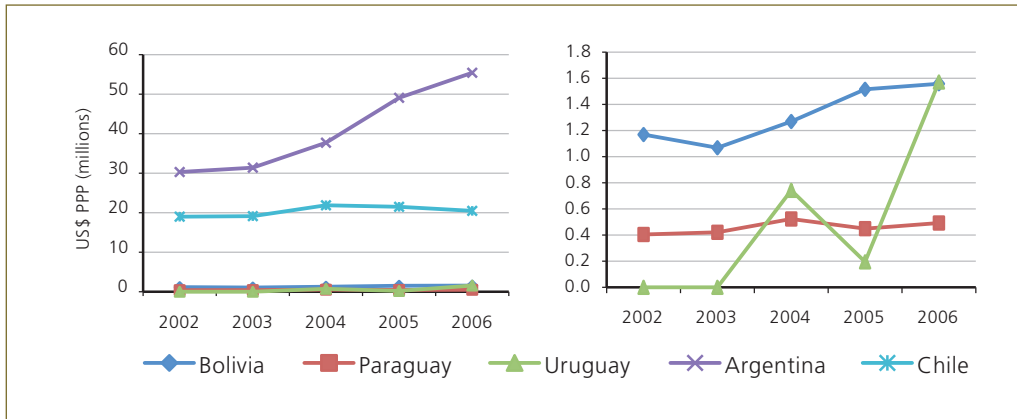
Similarly, while financing in Paraguay remained relatively constant under half a million a year, Bolivia increased its

investment in health research from US\$ PPP 1.2 million in 2002 to almost US\$ PPP 1.6 million in 2006. The annual growth rate in Bolivia and Paraguay averaged 8% and 6%, respectively. In contrast, investment in Uruguay decreased during the period 2004–2005, with a strong upward trend in 2000.

3.4.1 Amounts and participation by research methodology

In addition to examining the time series, we felt that it was important to examine the composition of research

Figure 4 Evolution of investment in health research (US\$ PPP millions), 2002–2006



funds by project, due to varying allocation practices by objective. To this end, we present in Figure 5 the amounts (expressed in US\$ PPP millions) that each country allocated to research projects related to three methodologies: biomedical, clinical and public health.

Biomedical research received the greatest financing, by a substantial amount, in every country; however, important differences remain in the total amount of resources invested by country. In particular, Argentina allocated a little more than US\$ PPP 46 million to biomedical

research, whereas Chile invested slightly less than US\$ PPP 17 million. By contrast, Paraguay and Uruguay invested around US\$ PPP 0.5 million each. Meanwhile, Bolivia allocated no resources to financing projects in the field of clinical research and yet invested US\$ PPP 1 million in biomedical projects.

Chile, with approximately US\$ PPP 7 million, was the leader in clinical research investment, followed by Argentina (US\$ PPP 3 million), Uruguay (US\$ PPP 400 000) and Paraguay (US\$ PPP 100 000).

Figure 5 Financing by research methodology (US\$ PPP millions), 2006

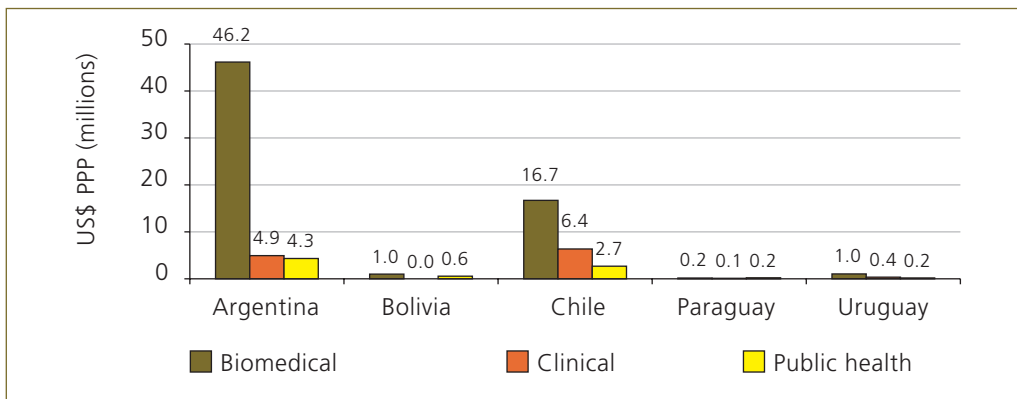
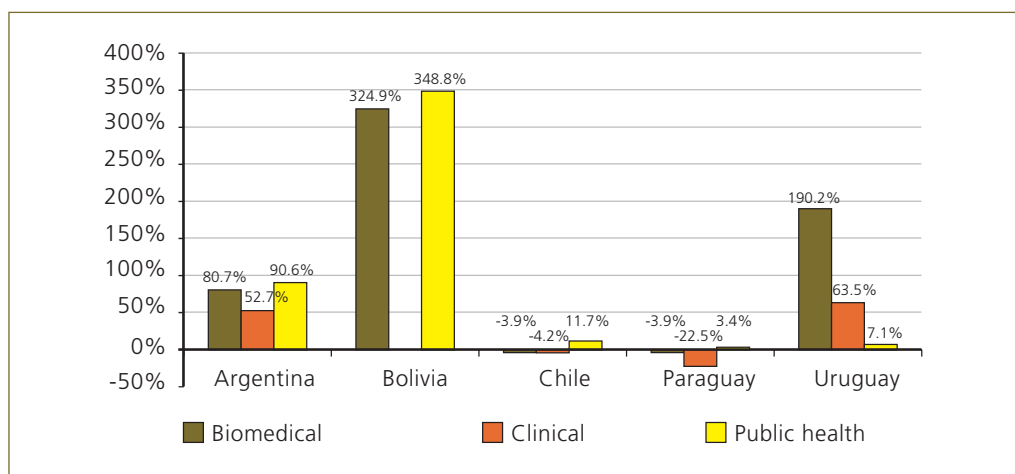


Figure 6 Variation in financing by research methodology, 2004–2006



3.5 Publications

In this section, we analyse the diffusion of innovation in health research, through a research study published by researchers from all five countries. We focus on two data sets generally used to report data on total publications per 10 000 inhabitants between 2002 and 2007 (see Tables 4 and 5).

As reported in Table 4, data from Lilacs publications shows that Chile ranked first in total publications per 10 000 people, with a maximum value of 1.15 and a minimum value of 0.69. In the Scielo database results reported in Table 5, Chile again ranked first, with a maximum of almost 1 publication per 10 000 people in 2006. Taken together, the years 2002 and 2005 show the greatest total number of publications per 10 000 people (2.8 and 0.94, respectively) if all countries were considered together.

These bibliometric indicators, however, depend critically on the reference

database used. Chile joined Scielo before Argentina and had more national journals indexed. This fact produces a relative underestimation of Argentina's production. In addition, Scielo and Lilacs are databases that journals join voluntarily; therefore, they are not necessarily representative of Latin American journals. In addition, adjusting bibliometric indicators by population needs to consider that small countries tend to have larger per capita rates.

In any case, the results highlight **very low levels of dissemination of scientific knowledge by all five countries** in the past six years.

3.6 Mechanisms for setting priorities

From comparative cost–benefit studies to the analysis of social-sanitary profiles, there is little consensus on how to settle on clear, common rules for the allocation of resources in the general area of public health, particularly in health research.

Table 4 Evolution of publications per 10 000 inhabitants from the Lilacs database, 2002–2007

Country	2002	2003	2004	2005	2006	2007
Argentina	0.43	0.44	0.50	0.45	0.40	0.20
Bolivia	0.68	0.46	0.30	0.08	0.00	0.05
Chile	1.15	1.08	1.15	0.99	1.03	0.69
Paraguay	0.24	0.18	0.11	0.10	0.03	0.00
Uruguay	0.30	0.54	0.38	0.51	0.37	0.21

Table 5 Evolution of publications per 10 000 inhabitants from the Scielo database, 2002–2007

Country	2002	2003	2004	2005	2006	2007
Argentina	0.09	0.15	0.21	0.28	0.30	0.18
Bolivia	0.02	0.02	0.01	0.02	0.02	0.02
Chile	0.70	0.74	0.79	0.84	0.99	0.91
Paraguay	0.00	0.01	0.01	0.01	0.01	0.01
Uruguay	0.13	0.12	0.14	0.24	0.29	0.23

In the first place, and **according to the social, economic and epidemiological profile of the countries**, through the analysis of the YPLL data presented in Figure 3, for example, it is possible to consider that country-specific illnesses should weigh more heavily on the funding priorities of each nation. Consequently, the fact that over 65% of YPLLs in Argentina, Chile and Uruguay are attributed to noncommunicable diseases should lead to investment policies concentrated more heavily in such fields. Similarly, Bolivia and Paraguay should probably allocate a larger share of their resources to research projects in the subjects that relate to communicable diseases.

However, using the same information, it is understandable that a rational use of scarce resources should result in the financing of research lines to eliminate inequities in the access to services, facilitating a greater homogeneity in

the country's sanitary profile. From this perspective, a second funding strategy would concentrate investment in research topics related to communicable diseases in Argentina, Chile and Uruguay, in order to reduce the equity gap, assuring the epidemiological transition.

Additionally, there are other mechanisms for setting research priorities that are not necessarily linked to social-sanitary profile indicators. One example could come from the need to improve the use of existing resources in the provision of health, which would lead to public health and social research being prioritized in detriment of clinical and biomedical research. This would help to improve mechanisms for assuring health coverage and managing existing resources, especially in countries with strong institutional barriers related to segmented systems.

Furthermore, prioritization of research topics might be related to certain issues

whose research may be considered strategic in the future, even if their social, economic and sanitary profiles or the health system's current needs do not merit it.

Any of the aforementioned criteria – in addition to others that we may add – show that the mechanisms for setting priorities are complex and that it is not a simple task to compare how sums were allocated in each of these countries. **These modes were shaped not only by technical aspects but also by political decision-making.**

3.7 Results and learning

Based on this information, Table 6 illustrates the relative participation in 2006 of all five countries in terms of total percentage of funds for each objective and according to the matrix of methodologies and research issues used in the study.

The selected cells reflect the country with the maximum relative percentage in each category. According to these, and first considering research programmes based on biomedical methodology, Argentina has the greatest share in six of nine categories, with percentages higher than 60% in each of them. Only in social, economic and cultural objectives does Bolivia have the highest share, while Chile takes the lead in projects based on biomedical methodologies and focused on nutrition and the environment (100% and 62.3%, respectively).

These models change radically when considering projects associated with clinical methodology. In this case, Argentina leads in research on objectives in health policy, systems and services, in

social, economic and cultural issues, and in technological R&D. Chile presents maximum values in all five other financed objective categories, with its highest percentage in nutrition and the environment (76.7%).

In the case of studies in public health methodology, Argentina leads in social, economic and cultural objectives, research on health policy, systems and services, violence and accidents, technological research and development, and basic science (52.4%, 61.2%, 65.2%, 100% and 100%, respectively). Finally, Chile has the greatest values in studies in communicable diseases, noncommunicable diseases, and nutrition and the environment, with shares of 55.6%, 59.9% and 50.5%, respectively).

Table 6 also shows that Paraguay and Uruguay target funding to the main sources of illnesses, despite limited investments. Even with small participation in the group, Paraguay concentrates its funding on communicable diseases, for each methodological group (biomedical, clinical and public health). Uruguay, on the other hand, devotes its resources towards research in communicable diseases mainly, for each methodological approach, with nutrition and environment as the second research group. Bolivia organizes its research agenda giving priority to nutrition and environment, as well as social, economic and cultural issues related to biomedical research, also investing in communicable diseases and violence and accidents.

Although the five countries show similar percentages in YPLL related to violence, their shares vary widely. Argentina

Table 6 Prioritization and relative share of investment (US\$ PPP) by country and methodology

Objectives	Total US\$ PPP	Research methodology				
		Biomedical				
		Argentina %	Bolivia %	Chile %	Paraguay %	Uruguay %
Social, economic and cultural	47 674.2		100.0%			
Communicable diseases	9 015 558.59	61.7%	6.7%	28.6%	1.2%	1.8%
Noncommunicable diseases	24 483 598.9	72.5%		24.4%	0.1%	3.0%
Nutrition and environment	1 794 038.98	16.5%	19.1%	62.3%		2.0%
Violence and accidents	17 000	100.0%				
Health policies, systems and services research						
Technological R&D	4 968 394.53	67.3%		31.0%	0.6%	1.1%
Traditional medicine	231 412.00	100.0%				
Basic science	24 490 570.70	77.4%		22.5%		0.1%

Objectives	Total US\$ PPP	Research methodology				
		Clinical				
		Argentina %	Bolivia %	Chile %	Paraguay %	Uruguay %
Social, economic and cultural	124 020	100.0%				
Communicable diseases	2 206 432.66	41.9%		56.1%	1.9%	
Noncommunicable diseases	5 912 092.56	36.2%		57.4%	1.0%	5.4%
Nutrition and environment	1 485 360.4	21.3%		76.7%		1.9%
Violence and accidents	76 000.1	44.7%		55.3%		
Health policies, systems and services research	367 802	100.0%				
Technological R&D	1 476 638.48	67.7%		31.8%	0.5%	
Traditional medicine						
Basic science	113 286.40	27.5%		56.5%		16.0%

Objectives	Total US\$ PPP	Research methodology				
		Public health				
		Argentina %	Bolivia %	Chile %	Paraguay %	Uruguay %
Social, economic and cultural	325 200.94	52.4%	2.9%	26.8%	0.0%	17.9%
Communicable diseases	1 091 902.3	12.7%	19.3%	55.7%	10.3%	2.0%
Noncommunicable diseases	826 966.27	29.3%	1.1%	50.9%	7.1%	11.5%
Nutrition and environment	1 591 877.04	44.3%	4.7%	50.5%	0.5%	
Violence and accidents	24 503.64	61.2%	38.8%			
Health policies, systems and services research	3 033 610.9	65.2%	8.1%	25.1%	1.3%	0.2%
Technological R&D	1 072 603.45	100.0%				
Traditional medicine						
Basic science	1 980	100.0%				

Note: Numbers in red represent the countries with the highest values by objective.

finances the total number of projects related to the objective of violence and accidents connected to biomedical methodologies and is responsible for 44.7% and 61.2% of clinical research and public health in that category, although these are low figures for a national investment in public health research.

Table 7 Prioritization and relative share of investment (US\$ PPP) by methodology, 2006

Objectives	Research Methodology		
	Biomedical	Clinical	Public Health
Social, economic and cultural	0.1%	1.1%	4.1%
Communicable diseases	13.9%	18.8%	13.7%
Noncommunicable diseases	37.6%	50.3%	10.4%
Nutrition and environment	2.8%	12.6%	20.0%
Violence and accidents		0.6%	0.3%
Health policies, systems and services research		3.1%	38.1%
Technological R&D	7.6%	12.6%	13.5%
Traditional medicine	0.4%		
Basic science	37.6%	1.0%	
Total	100.0%	100.0%	100.0%

Correspondingly, Chile supports 55.3% of clinical studies, with no investment in public health interventions, while Bolivia is responsible for 38.8% of those related to methodologies in public health.

Table 8 summarizes total funding dedication across research methodologies and objectives. Noncommunicable diseases represents 36.8% of the regional priorities, especially in biomedical research,

which receives 28.9% of the resources. Basic sciences is the second priority for public expenditure, with about 29.0%, and communicable diseases, especially biomedical research, is located in third place, with 14.5% total (10.6% biomedical). Clinical research represents a total of 13.9% of public funding, whereas projects on noncommunicable diseases receive half of this (7.0%). Public health interventions account for 9.4% of total research.

Table 8 Prioritization and relative share of investment (US\$ PPP), 2006

Objectives	Research Methodology			
	Biomedical	Clinical	Public Health	TOTAL
Social, economic and cultural	0.1%	0.1%	0.4%	0.6%
Communicable diseases	10.6%	2.6%	1.3%	14.5%
Noncommunicable diseases	28.9%	7.0%	1.0%	36.8%
Nutrition and environment	2.1%	1.8%	1.9%	5.7%
Violence and accidents		0.1%		0.1%
Health policies, systems and services research		0.4%	3.6%	4.0%
Technological R&D	5.9%	1.7%	1.3%	8.9%
Traditional medicine	0.3%			0.3%
Basic science	28.9%	0.1%		29.0%
TOTAL	76.7%	13.9%	9.4%	100.0%

Notes

- 1 We thank Martín Peralta Alcat, Esteban Peralta and Eugenia Barbieri for their inputs. Correspondence should be addressed to danielmaceira@cedes.org.
- 2 The Constitution of the World Health Organization states that “the enjoyment of the highest attainable standard of health is one of the fundamental rights of every human being without distinction of race, religion, political belief, economic and social condition”.
- 3 Such failures are connected with incentive problems that are often blamed on R&D development and implementation and on innovation.
- 4 There is no consensus on the functions or activities to be included in an innovation system. Edquist (2000) considers that the priority duty of an NIS is the quest for innovative processes, for which it should carry out a series of activities – among others: (i) creation of new knowledge, mainly in engineering, medicine and natural sciences; (ii) creation of human capital, production and reproduction of skills to be used in R&D activities; (iii) creation of new market products; (iv) creation and modification of the organizations’ needs to develop new fields of innovation and regulations and standards that have an impact on innovative organizations and innovation processes, providing incentives or eliminating obstacles to innovation; (v) financing of innovative processes or other activities that can facilitate trading and knowledge for their adoption; and (vi) provision of relevant consulting services for innovative processes (transfer of technology, trade information, legal advisory services).
- 5 This chapter is the outcome of a workshop called Funding of Health Research in Latin America (FISAL), held at Centro de estudios de estado y sociedad (CEDES) in September 2008. We wish to thank Fernando Aramayo Carrasco, Sergio Duarte Masi, Guillermo Paraje, Delia Sánchez and Bárbara Lignelli for their input and contributions.
- 6 Additionally, in the case of Chile, another “action” category was included – mental illness – given its high burden of disease. In the rest of the countries, mental illness was included in the noncommunicable diseases category.
- 7 See <http://www.mrc.ac.uk>.
- 8 The Cochrane Collaboration about evidence-based medicine defines supplementary medicine as all those healing practices and resources that go side by side with theories and beliefs that are not intrinsic to the politically prevailing health system in a society or culture within a given historical period. Some authors have not agreed with these proposals, pointing out that it is not true that alternative medicine is totally outside the conventional system. Indeed, some schools of medicine, hospitals and other United States health services offer non-conventional medicine as an alternative therapy and field of learning. In Peru, for instance, some schools of medicine have hosted traditional medicine conferences. It has been pointed out that, unlike classical western medicine, many of these supplementary disciplines claim not only alleviation of symptoms but also restoring of welfare, in a process of self-healing framed within a “holistic” perspective (Peña & Paco, 2007).
- 9 We thank Fernando Aramayo, Sergio Duarte Masi, Guillermo Paraje, Esteban Palta and Delia Sánchez for their contribution.
- 10 The last data available from the WHO correspond to 2004.

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Chapter 3

Argentina: Public funding of health research

Daniel Maceira

1 Introduction

The Argentine health system is highly fragmented in its funding, management and service provision (Maceira, 2008). To some extent, investment policies in public research on health suffer the same segmentation difficulties. Although there are national agencies that finance knowledge generation, either of a general nature or specific to the health sector, there are also provincial institutions that provide resources for research in this field. Regarding the national scope and scale, federal agencies that support research are the prevailing players and are thus the purpose of this study.

This paper will particularly address the National Council for Scientific and Technical Research (CONICET) and the Secretariat for Science and Technology (SECyT), placed in the structure of the pertinent ministry. These are the two main mechanisms that support research in Argentina, either through national fellowship programmes and the programme Career of Scientific Research in the former case, or through funds allocated to specific technological development and research projects in the latter case. The National Ministry of Health also manages two systematic research initiatives. The first is a programme called *Salud Investiga* (Research by Ministry of Health),

which grants research fellowships and, as in the two cases mentioned above, supports projects arising from public competition. The second initiative is the National Administration for Health Research Institutes and Laboratories (ANLIS), which focuses on financing lines of work at public institutions.

The following sections briefly describe the characteristics of these institutions within the National Innovation System of Argentina, analysing their scope, their evolution throughout time and their biases in terms of fields of work financed, on the basis of the categories established in the previous section. The study is supplemented by a description of the resource allocation criteria by age group, gender and geographical region, and then concludes with the identification of specialization patterns among funds and an exploration of the determining factors for funding public research in Argentina.

Table 1 Argentina: indicators overview

Demographic and socioeconomic indicators	
Population (millions), 2007 ^a	40
Urban population (% of total population), 2005 ^a	90.1
Human development index, 2006 ^b	0.860 (46 th)
Population living under the poverty line (% living on < US\$ 1.25/day), 2000–2006 ^b	4.5
Adult literacy rate (% of people aged 15 years and over), 2006 ^b	97.6
Access to improved drinking water sources (%), 2006 ^b	96
Gross national income (US\$ PPP billions), 2007 ^a	513.0
Gross national income (US\$ PPP per capita), 2007 ^a	12 990
Mortality and burden of disease indicators	
Life expectancy at birth (years), 2007 ^c	75
Infant mortality rate (probability of dying between birth and age 1 year per 1 000 live births), 2007 ^c	14
Age-standardized mortality rates by cause (per 100 000 population), 2004 ^c	
Noncommunicable disease	515
Cardiovascular	207
Cancer	139
Injuries	46
Distribution of years of life lost by broader causes (%), 2004 ^c	
Communicable disease	18
Noncommunicable disease	67
Injuries	15
Health expenditure indicators	
General government expenditure on health (% of total government expenditure), 2006 ^c	14.2
Per capita government expenditure on health (US\$ PPP), 2006 ^c	1 665

Note: PPP = Purchasing power parity

Sources:

^a World Bank, 2009.

^b United Nations, 2008.

^c World Health Organization, 2009.

2 Science and technology in Argentina

According to Chudnovsky & López (1995), the origin of the current science and technology system in Argentina goes back to the 1950s, from when four clear-cut stages can be identified:

- **1950–1968:** The first stage is placed within the context of the import substitution industrialization model and the emergence of new institutions in a situation of scarce local supply

of science and technology. Within this framework, innovations were essentially adaptations and, therefore, there was not much research and development (R&D) funding by the private sector (Katz & Bercovich, 1993). Until the enactment of Law 23 877 in 1990, no lines of credit were targeted to funding technological innovation projects

in the productive sector, relegating science and technology policies to a secondary level (Aspiazu & Nochteff, 1994), where public institutions and agencies carried out essentially administrative duties.

- **1969–1976:** In the second stage, according to Chudnovsky & López, prevalence of the laissez-faire notion in technology was left aside through the enactment of the first two laws on transfer of technology (1971 and 1974) and the creation of the National Council for Science and Technology (CONACyT), under CONICET. Science and technology policies were never integrated into economic and industrial initiatives. Following the 1976 military dictatorship, there was a progressive return to laissez-faire policies, through the most natural and immediate mechanism of imports. Within this context, in 1977 a new law was enacted on transfer of technology and in 1981 Law 22 426 was passed to significantly deregulate the technology import regime.
- **1977–1990:** Despite the complex Argentine macroeconomic context, the Advisory Working Group on Technological Development was created in 1987 for setting development policy in this field and coordinating the activities of existing agencies. Within this framework, science and technology slowly expanded, and from 1990 there was a gradual recovery of the budget allocated to the area. The country did not have a coordinated and explicit policy. However, according to Chudnovsky & López (1995, 1998), a process unfolded that led to an increase in resources assigned

to applied research and transfer of technology, thus enhancing the bonds between the science and technology and productive sectors and improving the levels of self-financing of official institutions. Several mechanisms were developed for this purpose, for instance credit incentives, productivity promotion programmes and the restructuring of institutions.

- **1990 to present:** Currently, the science, technology and innovation system in Argentina is very complex, given its institutional, financial and programme diversity, which contributes to a strong disarticulation and fragmentation of the system and establishes weak bonds between institutions (Chen & Dahlman, 2005). With the purpose of facilitating institutional planning, a science and technology plan was approved in 1997, formally adopting the idea of a national innovation system and articulating initiatives to foster R&D in the public and private sectors (Apólito, 1997).

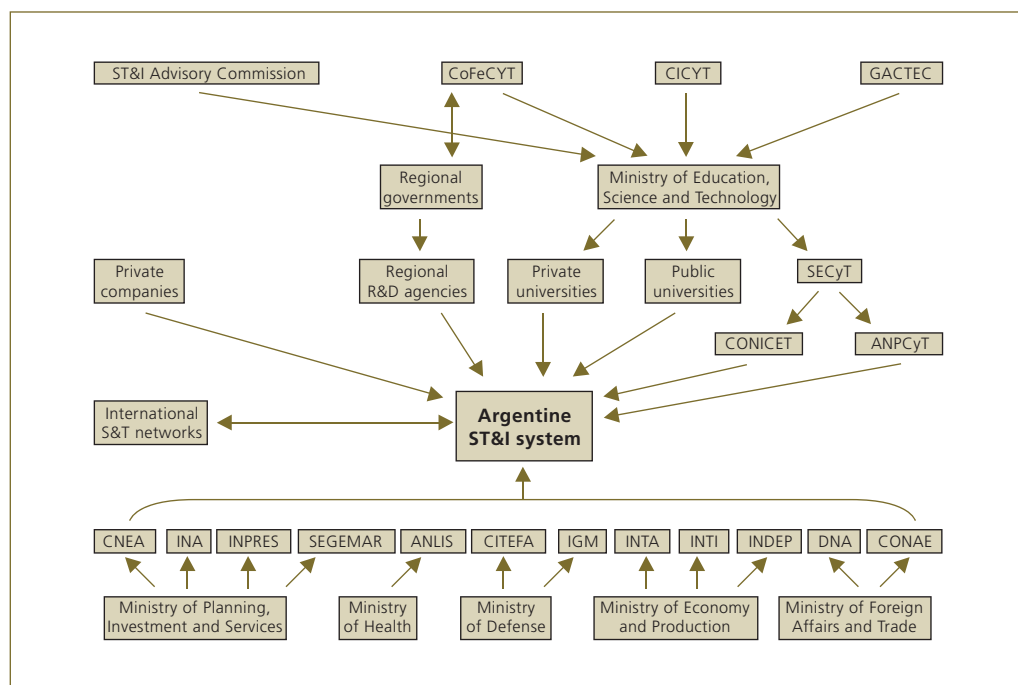
The following institutions are legally recognized by Law 25 467 (2001) (Figure 1):

- **National Agency for the Promotion of Science and Technology (ANPCyT):** sponsored by SECyT; manages the Scientific and Technological Research Fund (FONCyT) and the Argentine Technological Fund (FONTAR), which subsidize research activities, financing technological innovation and streamlining projects.
- **Interagency Council of Science and Technology (CICYT):** in charge of optimizing the use of resources.

- **Federal Council for Science and Technology (CoFeCYT):** promotes a balanced development of research activities.
- **National Council for Scientific and Technical Research (CONICET):** created in 1958 to promote and carry out research work (Thorn, 2005).
- **Cabinet for Science and Technology (GACTEC):** in charge of updating the national plan and fixing the research budget sponsored by the federal government.
- **National Science, Technology and Innovation Advisory Commission:** responsible for designing and implementing the national plan.
- **Secretariat for Science and Technology (SECyT):** department of science, technology and productive innovation within the structure of the Ministry of Education, Science and Technology – in charge of coordinating legislation, allocating budgetary resources and carrying out statistical analysis on research and innovation.

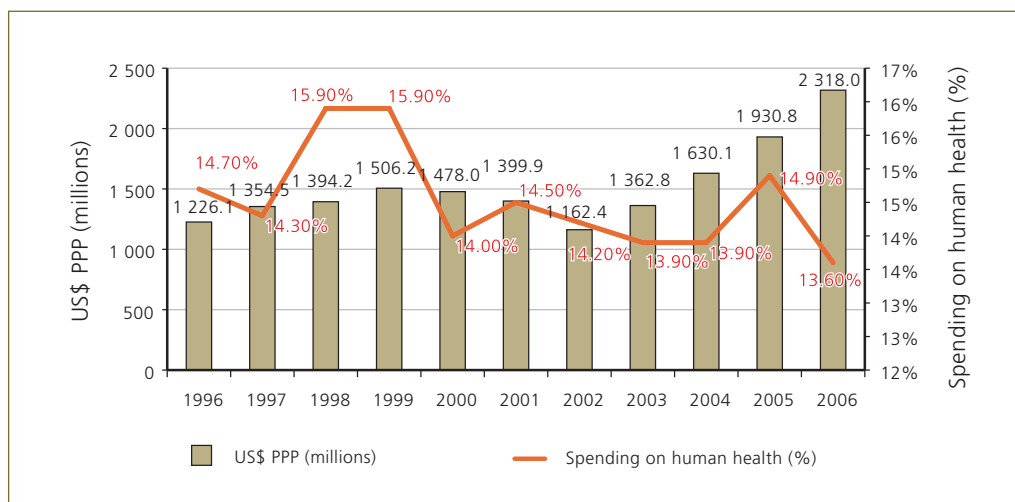
In 2006, financing in research totalled US\$ 2.31 billion adjusted for purchasing power parity (US\$ PPP) (0.49% of gross domestic product, GDP), following the upward trend that started in 2002 (Figure 2).

Figure 1 The science, technology and innovation system in Argentina



Source: Thorn. The World Bank, 2005.

Figure 2 Spending on research and development, 1996–2006



*US\$ PPP obtained using the average exchange rate of the Argentine Central Bank and applying the index of PPP published by the World Bank.

Source: Annual Science and Technology Indicators. Series SeCyT 1996–2007.

3 Institutions related to government financing of health

3.1 National Scientific and Technical Research Council (CONICET)

CONICET is the main agency for promoting science and technology in Argentina. It was set up as an independent agency within the structure of the President's Office, financed with National Treasury funds through the Secretariat of Finance, Ministry of Economy. It was provided with a wide range of instruments: career development assistance for scientific and technological researchers, support staff for research, the granting of fellowships, the financing of projects, and research executing units. It also establishes bonds with similar international governmental and nongovernmental agencies.

The career development programme for scientific researchers has allowed the development of a systematic funding model for science and technology in Argentina, using evaluation mechanisms for admission to scientific and technological careers, the development of continuous research lines, and promotion systems by categories linked to the professional performance of the staff members. Furthermore, it offers fellowships aimed at supporting new researchers, and it also systematically calls for the submission of projects. It carries out its activities in four main areas: (i) agriculture, engineering and architecture; (ii) exact and natural sciences; (iii) humanities and social sciences; and (iv) biological sciences and health.

3.2 National Agency for the Promotion of Science and Technology (ANPCyT)

This agency was created as a national institution within the structure of the Ministry of Science, Technology and Productive Innovation. Through FONCyT and FONTAR, it promotes the financing of research projects, mainly using resources from the National Treasury and Inter-American Development Bank (IDB) loans, among others. Its organization, financing and administration structure are managed by the Functional, Financial and Administrative Unit (UFFA).

FONCyT is currently under the Ministry of Science, Technology and Productive Innovation. FONCyT's mission is to support projects and activities aimed at generating new scientific and technological knowledge, in basic and applied topics, developed by researchers working for non-profit-making public and private institutions in the country. It obtains its funding from National Treasury funds, IDB loans and cooperation agreements with national and international agencies or institutions. FONCyT handles promotion and funding instruments to support different kinds of research project.

In all cases, three-year grants are awarded through open competition. The instruments could be any of the following: (i) scientific and technological research projects; (ii) targeted scientific and technological projects; (iii) research and development projects; (iv) equipment modernization projects; (v) strategic area projects; (vi) scientific meetings; and (vii) qualification certificates. Among others,

FONCyT finances research in the field of medical and social sciences related to health. Considering only the scientific and technological projects in the period 1998–2004, a total of 2587 grants were awarded, of which approximately 16% were in the field of medical sciences.

FONTAR manages domestically and internationally invested public and private sector resources (contributions from the National Treasury, credit lines from public banks, funds from multilateral organizations, etc.) to promote, through open competition, initiatives to upgrade company technology and competitiveness. For that purpose, it: (i) promotes and funds project implementation; (ii) technically, economically and financially evaluates such projects; (iii) technically assists in their development; and (iv) supervises the performance of subsidized projects, etc.

3.3 National Ministry of Health

As already mentioned, the Argentine health system has two main features: (i) decentralization in the allocation and management of provincial resources; and (ii) fragmentation of social security and private insurance mechanisms. Decentralization brings about dispersion in decision-making on the health spending targets, and only 16% of disbursements are made by the national ministry (Maceira, 2008). This includes public research in the field of health funded by the national health authority. Within this framework, the Ministry of Health has ordinary lines of research financed with local funds or international loans and carries out sporadic research work linked not only to health priorities but also to emergency issues.

The first group includes ANLIS. This operates as a decentralized public entity with the purpose of carrying out and coordinating actions to prevent infectious diseases, focusing mainly on research. The main purpose of this institution is to set up stronger bonds between scientific and technical policies and health actions within public health policies.

The National Commission on Research (by the Ministry of Health) was created in March 2002 by Resolution No. 170/2002 of the National Ministry of Health, within the Under-Secretariat for Health Relations and Research. It is in charge of managing the annual fellowship programme Ramón Carrillo – Arturo Oñativia, with National Treasury funding. The purpose of the commission is to reinforce the Ministry of Health's activities for prioritizing research and interventions in the field of health to reduce the gap between production and utilization of scientific evidence in clinical and health decision-making, political action and opinion-shaping. Moreover, the commission promotes and carries out collaborative multicentre studies on public health problems, according to the priority topics.

Finally, the Ministry of Health implements programmes and projects using external funding provided by different international organizations and agencies. Specifically, the Unit for the International Financing of Health is placed directly under the Minister of Health. This unit coordinates the management of financial and technical cooperation programmes and projects at the ministry, controlling the fulfilment of commitments and assessing the opportunity and timeliness of developing new undertakings. The Unit provides technical assistance in issues such as networking, project programming and evaluation, and in several other fields, including investments in architecture and equipment, and administrative, financial and budgetary innovations. The following were some of the main programmes of the ministry for 2008:

- project on essential functions and prioritized programmes in public health
- Nacer Plan – mother and child programme
- RemediAR – programme providing medication to low-income groups
- health surveillance and disease control programme
- strengthening of the strategy for primary health care.

4 Sources of information and methodology

The analysis of information on Argentine national government funds called for the consolidation of a database to allow the detection and comparison of trends in flows targeted to research in the field of health among the different institutions mentioned above. The database built for the lines of research stemming from

funds allocated to open competition is grounded on the database used by Maceira & Peralta Alcat (2008), which was then reclassified by research topics, adding FONTAR resources. This is supplemented with administrative information provided by ANLIS and taken from the estimates on the incidence

of research work on the Ministry of Health's budget delivery to that agency.

Each of the agencies provided information on grants, fellowships and funds allocated throughout the period 1967–2006 for medical sciences and social sciences related to health topics. Information provided by the institutions was homogenized according to a series of criteria and classified into 27 potential categories in accordance with the framework laid out in Chapter 2. The data were cleaned and annualized for the time period.

Likewise, variables were built on the geographical location of funds by province, gender and age of researcher. Jurisdictional location is a variable related to the place at which the fund awardee carries out the research work, while the sex of the chief researcher defines

gender breakdown. The latter excludes FONTAR, since grants in this case are assigned to legal persons (companies). It was possible to apply breakdown by age only in CONICET and Salud Investiga. Finally, an additional classification criterion was based on the nature of the recipient institutions of the grant (private agency, public agency, public hospital, private hospital or clinic, university), systematized only in the case of CONICET.

In order to carry out a comparative analysis among the different countries included in this study, the amounts (stated originally in current Argentine pesos) of each of the entries were then converted into US dollars adjusted for purchasing power parity (US\$ PPP). For this purpose, the International Monetary Fund (IMF, 2008) PPP index in US\$ for 2002–2006 was used.

5 Outcomes

This section shows the evolution of ANLIS and its institutes and then addresses descriptive statistics arising from the database, which includes CONICET, FONCyT, FONTAR and Salud Investiga.

5.1 National Administration of Health Institutes and Laboratories (ANLIS)

ANLIS is a decentralized institution placed within the structure of the Secretariat of Policies and Regulation, National Ministry of Health. Through direct research actions of its different institutions, or through training and consulting projects, ANLIS participates

in cooperation activities with the National Ministry of Health, other public sector institutions, civil society organizations, international agencies, and scientific and technological bodies. Table 2 shows the executing units (institutes and centres) and their relevant programmes. Based on budget delivery for 2008, Table 2 also includes the estimated incidence of investment of each executing unit in science and technology, based on information provided by ANLIS.

ANLIS allocated around 5% of its 2006 total budget to research, which resulted in an investment of US\$ PPP 1.5 million. This percentage, however, reflects a great dispersion among

Table 2 ANLIS investments in research (US\$ PPP), 2002–2006

Execution Unit	Programme	Investments in US\$ PPP					Research Category			
		Research (%) 2006	ACRONYM	2002	2003	2004	2005	2006	Methodology	Topic
Instituto Nacional de Enfermedades Infecciosas Agudas	Research, Teaching and Services on Bacterial, Fungal, Parasitic and Viral Infections	15.72%	INEI	304 413	356 814	371 610	460 727	565 596	Biomedical	Communicable diseases
Centro Nacional de Investigaciones Nutricionales	Research and Diagnosis of Nutritional Risk Factors	38.99%	CNIN	273 869	321 012	334 324	414 498	508 845	Public Health	Nutrition
Instituto Nacional de Parasitología Dr. Mario Fatala Chabán	Research, Teaching and Services on Parasitic Diseases	9.20%	INP	127 999	150 032	156 253	193 725	237 820	Clinical	Policy, Systems and Services
Instituto Nacional de Epidemiología Dr. J.H. Jara	Training and Epidemiological and Nosocomial Infections Services	4.44%	INE	39 605	46 423	48 348	59 942	73 586	Public Health	Policy, Systems and Services
Centro Nacional de Diagnóstico e Investigación en Endemo-Epidemias	Research, Development and Services on Endemic-Epidemias	21.66%	CENDIE	29 444	34 512	35 943	44 562	54 706	Clinical	Communicable diseases
Instituto Nacional de Enfermedades Respiratorias Dr. E. Coni	Control of Tuberculosis and Other Respiratory Diseases	2.94%	INER	29 226	34 257	35 678	44 233	54 302	Clinical	Communicable diseases
Centro Nacional de Genética Médica	Training and Attention of Genetic Risk Factors	39.09%	CNGM	22 961	26 913	28 029	34 751	42 661	Biomedical	Noncommunicable diseases
Centro Nacional de Control de Calidad de Biológicos	Quality Control of Biologicals	1.17%	CNCCB	13 071	15 321	15 956	19 782	24 285	Biomedical	Basic Research
Instituto Nacional de Producción de Biológicos	Development and Production of Biologicals	0.15%	INPB	2 227	2 610	2 718	3 370	4 137	Biomedical	Noncommunicable diseases
Instituto Nacional de Enfermedades Virales Humanas Dr. J.Maiztegui	Research, Teaching and Services on Human Viruses	0.01%	INEVH	1 169	1 370	1 427	1 769	2 171	Clinical	Communicable diseases
Centro Nacional de Red de Laboratorios	Coordination and Support to the Laboratories Network	0.00%	CNRL						Biomedical	Policy, Systems and Services
TOTAL				843 983	989 264	1 030 286	1 277 359	1 568 109		

Source: Based on information provided by ANLIS.

institutions, reaching a maximum of 39% in both the medical genetics and nutritional research institutes. It must be noted that the institution has a marked trend to favour programmes targeted to biomedical and clinical research methodologies, through two executing units (INE and CNIN) that carry out public health activities.

Bringing together all ANLIS institutes and centres based on the prevailing research topic, it was noted that in 2006 biomedical research topics accounted for approximately 41% of allocated resources, while public health and clinical research accounted for 37% and 22%, respectively.

5.2 Analysis of government funds for health research

This section reflects the results of two large groups of variables. The first group of variables identifies, for the aggregate of institutions and for each one individually, the general characteristics of the recipients of national government funds for health research, by age, gender, and provincial

and regional concentration for the 2002–2006 five-year period. The second group of variables looks at financing policies, criteria for allocation of funds to projects by topic and, therefore, the outcomes of prioritization strategies, at the aggregate level as well as within each of the four agencies of this study.²

5.2.1 General aspects Research by sex

Table 4 reflects a larger female share in health research financed with government funds, in a ratio of 59.22% to 40.78%. Despite the general behaviour identified in the study, there are differences between institutions. While Salud Investiga has 64% female participation, FONCyT equitably distributes funds between both sexes, and at CONICET, the institution with the greatest number of researchers (3841), only 40.48% are men.

Social sciences' contribution to health research

According to the data above, information provided by public research agencies can be included in two broad categories: medical sciences and social

Table 3 Researchers by institution and sex

Institution	Measure	Sex		Total
		Male	Female	
Salud Investiga	Number	270	487	757
	%	35.7	64.3	100
CONICET	Number	1 555	2 286	3 841
	%	40.5	59.5	100
FONCyT	Number	290	298	588
	%	49.3	50.7	100
Total	Number	2 115	3 071	5 186
	%	40.8	59.2	100

Source: Based on information provided by ANPCyT, CONICET and Salud Investiga.

Table 4 Thematic categories by institution

Institution	Measure	Category		Total
		Social Sciences	Medical Sciences	
Salud Investiga	Number	757		757
	%	100		100
CONICET	Number	146	3.695	3.841
	%	3.8	96.2	100
FONCyT	Number	40	548	588
	%	6.8	93.2	100
FONTAR	Number		178	178
	%		100	100
Total	Number	943	4.421	5.364
	%	17.6	82.4	100

Source: Based on information provided by ANPCyT, CONICET and Salud Investiga.

sciences. The latter takes into account all research work carried out on health topics by sociologists, economists, anthropologists, etc. Considering the three agencies (and four institutions), Table 4 shows that Salud Investiga is the main research funder within the framework of social sciences, through 757 projects. On the other hand, FONTAR, given its nature, almost exclusively finances projects related to medical science development. Little significance is attached to social sciences at CONICET and FONCyT, with 3.8% and 6.8% of health projects, respectively.

The study was able to compare two only institutions with regard to fund allocation to health research according to the age of the beneficiary: Salud Investiga and FONCyT. As can be noted in Figure 3, Salud Investiga is an institution comparatively biased to younger researchers, a fact that is duly explained in its institutional strategy. Approximately 10% of Salud Investiga fellows are under 30 years of age; if we also consider the group of researchers up to 40 years of age, that percentage

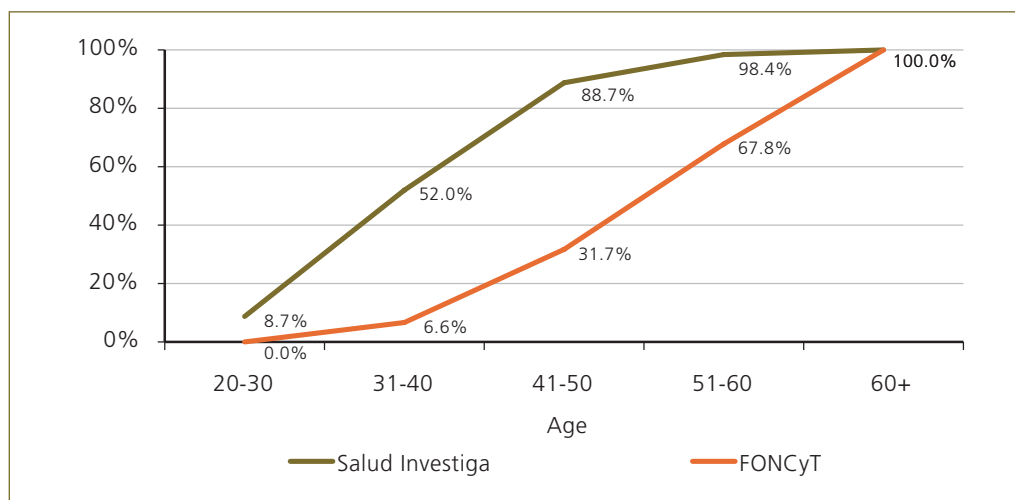
surpasses half of the resources committed by the institution (51.9%). FONCyT is different, with no participation at all of researchers up to under 30 years of age and only 6.63% up to 40 years of age. Those over 50 years of age have a 50% share in allocable funds. Researchers under 50 years of age account for 88% of the funds at Salud Investiga and for only 32% at FONCyT.

Although there is no information to quantify and determine the age profile at CONICET, it probably has a greater dispersion of fund allocation, given its organization and structure. This is because it has a sustained system of fellowships and has a career development programme for researchers that provides funding to scientific cadres with long-standing academic careers and experience.

Provincial and regional concentration patterns in fund allocation

Table 5 shows, by province and in descending order, the participation of each jurisdiction in the implementation

Figure 3 Cumulative age density by institution



Source: Based on information provided by ANPCyT, CONICET and Salud Investiga.

of government-funded health research projects in Argentina. The table includes information on the four allocable public funds. The first three columns show the number of fellowships and grants received by jurisdiction, their weight in percentage points over the total and cumulative amounts. The last three columns reflect each jurisdiction's share in the country's total number of inhabitants, the cumulative figure and an indicator of the number of health research projects per 10 000 inhabitants in each province.

It can be noted that 73.9% of fellowships and grants awarded by all four institutions are for Buenos Aires city and Buenos Aires Province, where 47.2% of the country's population lives. If we add Córdoba, Sante Fe and Mendoza, this percentage amounts to 94.8%, surpassing the population share of these jurisdictions in the country total (70% of the population).

Despite this, the incidence of projects by province does not follow the same pattern. Although in the capital city of the country financing density is higher than the national average (10.98 projects per 10 000 inhabitants), the provinces of Córdoba, Rio Negro and Mendoza have a ratio of over 1 project per 10 000 inhabitants, relegating Santa Fe to fifth place and Buenos Aires Province to eighth place. The minimum rates were found in Santiago del Estero (0.02), La Rioja (0.03), Catamarca (0.05), and San Juan (0.08). Finally, La Pampa, Santa Cruz and Tierra del Fuego have no health research projects financed by the national government.

5.2.2 Fund allocation by institution

In order to identify each institution's policy in the geographical allocation of resources, Figure 5 shows each province's share in the total of fellowships and grants awarded in 2002–2006. At the

Table 5 Fellowships and grants by province

Province	Number of Fellowships and Grants	Participation over the Total (%)	Cumulative Participation (%)	Population - Participation over the Total (%)	Cumulative Participation (%)	Researchers per 10,000 Inhabitants
Buenos Aires City	3 049	58.2	58.2	7.9	7.9	11.0
Buenos Aires	822	15.7	73.9	39.3	47.2	0.6
Cordoba	643	12.3	86.2	8.7	55.9	2.1
Santa Fe	270	5.2	91.4	8.5	64.5	0.9
Mendoza	179	3.4	94.8	4.5	69.0	1.1
Tucuman	93	1.8	96.6	3.8	72.8	0.7
Salta	29	0.6	97.1	3.1	75.8	0.3
Chubut	25	0.5	97.6	1.2	77.0	0.6
San Luis	19	0.4	98.0	1.0	78.1	0.5
Chaco	17	0.3	98.3	2.8	80.9	0.2
Entre Rios	17	0.3	98.6	3.3	84.2	0.1
Misiones	16	0.3	98.9	2.7	86.9	0.2
Corrientes	14	0.3	99.2	2.6	89.6	0.2
Jujuy	11	0.2	99.4	1.7	91.3	0.2
Rio Negro	9	0.2	99.6	0.2	91.4	1.7
Neuquen	8	0.2	99.7	1.3	92.8	0.2
Formosa	5	0.1	99.8	1.4	94.2	0.1
San Juan	5	0.1	99.9	1.8	95.9	0.1
Catamarca	2	0.0	99.9	1.0	96.9	0.1
Santiago del Estero	2	0.0	100.0	2.3	99.2	0.0
La Rioja	1	0.0	100.0	0.8	100.0	0.0
Total	5 236	100.0		100.0		

Source: Based on information provided by ANPCyT, CONICET and Salud Investiga.

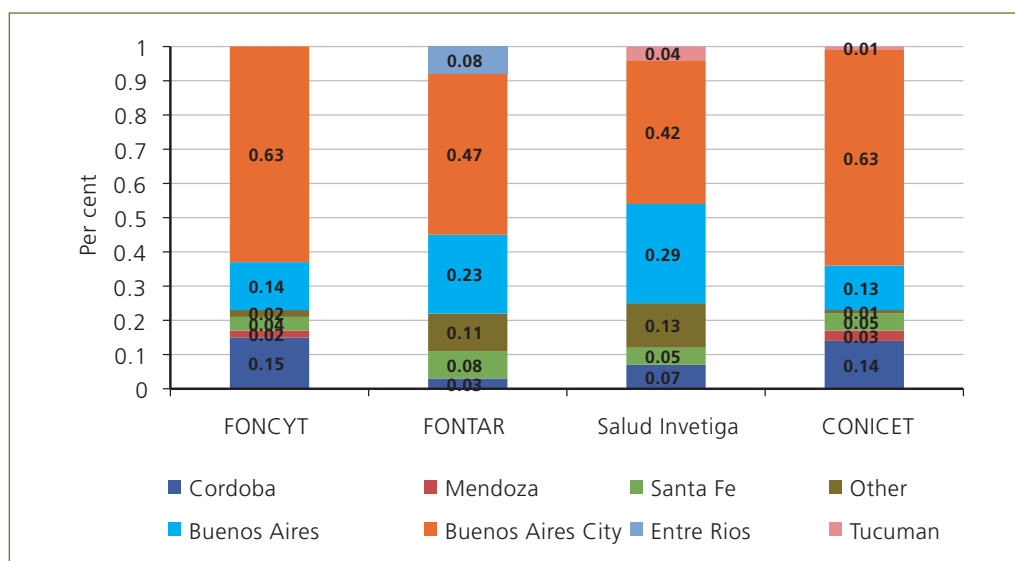
same time, Table 6 reflects the presence of each institution by province and average expenditure in US\$ PPP per 10 000 inhabitants for the year 2006.

From this analysis, it can be noted that Salud Investiga is a relatively more federal institution as far as resource allocation is concerned, and it awards grants in 21 of the 24 Argentine jurisdictions (23 provinces and the Buenos Aires Federal District). Furthermore, this institution has a lower relative share in Buenos Aires City. In line with the above, if we take a look at the amounts awarded to research (expressed in US\$ PPP) for 2002–2006, by region, the results are not significantly different.

For all four agencies, the Metropolitan and Pampa regions³ account for 83.53% in Salud Investiga, 94.3% in CONICET, 98.4% in FONCyT and 90.7% in FONTAR. CONICET leads the average disbursement by province, with US\$ PPP 9854 per 10 000 inhabitants, with an approximate ratio of 4 : 1 compared with FONCyT, its immediate follower.

At Salud Investiga, 71.9% of funds were allocated to the Metropolitan region and 11.7% to the Pampa region. Regarding the other three agencies, 77.3% (CONICET), 79.9% (FONCyT) and 72.7% (FONTAR) was awarded to the Metropolitan area. Northeast

Figure 4 Regional allocation by institution (%)



Source: Based on information provided by ANPCyT, CONICET and Salud Investiga.

Argentina, Cuyo and Patagonia are the regions that receive the lowest allocations in all four agencies. All three regions together account for 9.4% at Salud Investiga, 4.4% at CONICET, 1.4% at FONCYT and 6% at FONTAR.

Idiosyncrasy bias in regional research

Particularly in a country with a large gap in income distribution and with such diverse health profiles as Argentina, it is reasonable to find local idiosyncrasy

biases (regional/provincial) concerning needs in health research. A certain alignment could be expected between the place of residence of the funded project and its nature, according to the need for or importance of such projects within a given geographical context. Nonetheless, an analysis by region and topic shows that, in most cases, the Metropolitan region and especially Buenos Aires City attracts most investments in health research, as shown in Table 6. The only exceptions encountered are the

Table 6 Research topics by methodology and region: maximum and minimum measures

Methodology	Measure	Maximum (%)	Minimum (%)
Biomedical	Region	Metropolitan	Patagonia
	%	74.0	0.2
Clinical	Region	Metropolitan	Cuyo
	%	73.3	1.6
Public health	Region	Metropolitan	Northeast
	%	73.9	2.0

Source: Based on information provided by ANPCyT, CONICET and Salud Investiga.

lines of work of biomedicine–nutrition and biomedicine–violence, where the regions with the greatest level of fund

allocation are the Pampa and Northwest Argentina, with percentages amounting to 52.9% and 100%, respectively.

6 Flow of funds and research topics

6.1 Evolution of national government funds allocated to health research

Figure 5 shows the evolution of government funds allocated to health research for the five-year period under consideration, stated in US\$ PPP for all four institutions. The figure also includes resources allocated by ANLIS in its programmes' research components.

The five agencies reveal a growing trend throughout time. There was an increase of 82.9% in health-targeted funds between both ends of the five-year period. There are, however, significant differences between financing mechanisms. CONICET and Salud Investiga have an annual growth rate of 4.2% and 6.7%, respectively, and the annual average variation of FONCyT and FONTAR was 30.9% and 586.6%, respectively. In 2005 FONCyT displaced CONICET as the first source of grants for research in the Argentine health sector. On the other hand, ANLIS increased by 86% the ministerial funds allocated to research, coming close to Salud Investiga in 2006.

6.2 Financed topics

Based on the information available, within the total amount of allocated funds, the research team was able to establish health prioritization criteria for each institution separately and for the national innovation system as a whole (Table 7).

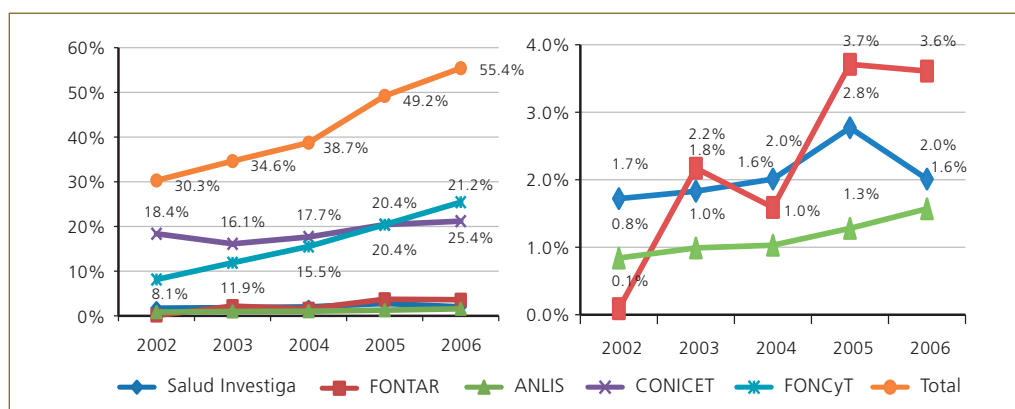
The fields of research, as already mentioned, were classified into 27 potential categories, which cut across three research methodologies and nine topics.

The period under analysis involved US\$ PPP 205.6 million in health research, distributed among 5411 projects (fellowships, institutional or personal grants, budgeted funds allocated to state-owned research centres). Related projects were not identified in only three categories.

Most of the projects (78%) focus on biomedical research, with a prevalence in noncommunicable diseases and basic sciences. The former research field, with 2040 projects, includes US\$ PPP 73.5 million for the five-year period, while the latter was allocated US\$ PPP 65.9 million through 1584 projects. As far as their importance in monetary terms is concerned, biomedical research in communicable diseases is ranked third (US\$ PPP 19 million and 406 projects), followed by technological R&D (US\$ PPP 9.5 million and 112 projects).

The remaining 22% of government funding of research is distributed equally between clinical research and public health research, with 604 and 575 projects, respectively. In terms of clinical research, again noncommunicable diseases account for the greatest amount, of approximately US\$ PPP 9 million

Figure 5 Annual growth of funds by institution (US\$ PPP), 2002–2006



Source: Based on information provided by ANPCyT, CONICET, ANLIS and Salud Investiga.

Table 7 Number and investments in research projects (US\$ PPP), 2002–2006

Objective	Research methodology			
	Biomedical	Clinical	Public health	TOTAL
Social, economic and cultural		484 476 (17)	1 064 274 (54)	1 548 750 (71)
Communicable diseases	18 927 589 (406)	4 015 940 (106)	650 011 (28)	23 593 540 (540)
Noncommunicable diseases	73 544 573 (2040)	8 942 604 (322)	1 663 808 (74)	84 150 985 (2436)
Nutrition and environment	1 214 130 (52)	1 329 865 (67)	2 491 685 (34)	5 035 679 (153)
Violence and accidents	17 000 (1)	170 946 (11)	227 167 (26)	415 113 (39)
Health policies, systems and services research		1 295 125 (42)	7 560 239 (312)	8 855 365 (354)
Technological R&D	9 538 996 (112)	2 140 484 (29)	2 679 556 (44)	14 359 037 (185)
Traditional medicine	859 738 (37)		5 400 (1)	865 138 (38)
Basic science	65 940 108 (1584)	801 897 (10)	3 542 (2)	66 745 547 (1595)
TOTAL	170 042 133 (4232)	19 181 338 (604)	16 345 682 (575)	205 569 153 (5411)

Note: Numbers in parentheses represent the total number of projects by methodology and category.

Source: Based on data from CONICET, ANPCyT, Salud Investiga and ANLIS.

(47%). Within the field of public health, research on health policies, systems and services amounted to US\$ PPP 7.56 million, or 46% of the total.

Analysed by objectives, Figure 6 shows basic science as the most important (32%), after research in noncommunicable diseases (41%). At the other end of the range, the areas receiving the least

amount of funding are those related to traditional medicine and violence and accidents (0.4% and 0.2%, respectively).

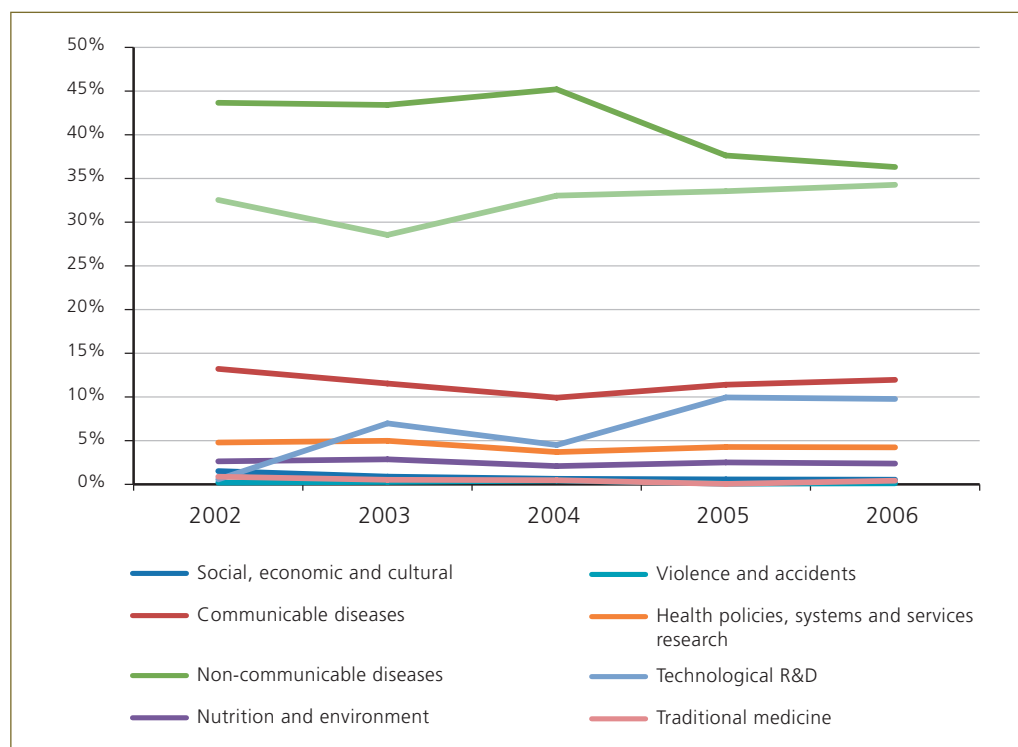
6.3 Coordination between institutions

From the strategic standpoint of a national innovation system, it is presumed that there is a mechanism to coordinate or divide tasks in fund allocation for the development of new activities in the field of health. The presence of specializations is thus analysed as to how funding priorities are established, mainly at FONCyT and CONICET, since they manage most of the research funds in Argentina.

In the field of technological research and development, and with over 92%, FONTAR's share is almost exclusive, supplemented only marginally by CONICET. Apart from this exception, FONTAR's share is low in other research topics.

Regarding the category of noncommunicable diseases, there is a slight prevalence of FONCyT (53.7%) compared with CONICET (48.7%) and Salud Investiga (32.5%). Likewise, research in non-communicable diseases unveils a similar distribution in terms of number of projects by institution, with CONICET taking a slight lead. Moreover, in basic sciences, project distribution shows CONICET and FONCyT as the main contributors.

Figure 6 Proportion of allocated funds by objective, 2002–2006



Source: Based on information provided by ANPCyT, CONICET and Salud Investiga.

Salud Investiga heads the studies related to social sciences, particularly in topics such as violence and accidents, socioeconomic studies, research on health and nutrition policies and systems.

6.3.1 Institutional bias

Table 8 represents project distribution according to the methodology and work programme venue for the five-year period under consideration.

Universities (public and private) are identified as the main recipients of funds, accounting for close to 50% of the grants. Of such projects, however, 80%

focus on biomedical issues, followed by 12.5% targeted to public health.

Public agencies and hospitals follow by order of importance, jointly totalling 603 projects. Their focus, however, differs and the former show a bias to biomedical topics and, of course, the latter to clinical and public health issues, amounting to 47% and 32.7%, respectively.

On the other hand, private agencies, with 129 projects, focus on public health research, while private hospitals, with only 47 projects, distribute funds equitably among the three selected disciplines.

Table 8 Projects by recipient institution and research methodology

Workplace	Measure	Research Methodology			Total
		Biomedical	Clinical	Public Health	
Public Hospital	Quantity	51	120	83	254
	%	20.0	47.2	32.7	100
Private Hospital	Quantity	17	15	15	47
	%	36.2	31.9	31.9	100
Public Agency	Quantity	188	38	123	349
	%	53.9	10.9	35.2	100
Private Agency	Quantity	28	24	77	129
	%	21.7	18.6	59.7	100
Universities	Quantity	498	46	78	622
	%	80.1	7.4	12.5	100
Total	Quantity	782	243	376	1 401
	%	55.8	17.3	26.8	100

Source: Based on information provided by ANPCyT, CONICET and Salud Investiga.

7 Econometric analysis

This section implements an econometric specification that allows identification of a potential relationship (economic and statistical) between the research methodologies and a set of variables that seem, a priori, relevant. This set

is particularly associated with the characteristics of each researcher (sex and age), place of residence (geographical region), amount allocated and public institutions in charge of financing the projects (Table 9).

Therefore, a series of logit-based estimates were made, assuming the presence of a decision-making mechanism based on which the probability of public investment in research within each category is linked to the group of regressors. In each, the probability of focusing on research in each of the established research categories is estimated (biomedical, clinical, public health), where the constant figure becomes the pivot of CONICET-funded Metropolitan projects. In this regard, the working hypotheses are translated into coefficient signals, significant and marginal effects.

Among the results, coefficients related to Salud Investiga are significant (at 1%) in all specifications. Analyses show that the probability of finding a project funded by this institution increases in the field of clinical and public health research (by 12% and 16%, respectively), the opposite of what happens in biomedical research.

Should the funding institution be FONCyT, then the probability of the funds being allocated to a biomedical category – when compared with CONICET – is reduced by approximately 11%. On the other hand, although such probability is higher in clinical or public health research, unlike Salud Investiga, the marginal effects differ and are less intensive in this case. Therefore, the existence of specialization mechanisms at institutions is not quite clear.

In terms of the researcher's sex, the study shows that in biomedical and clinical research, coefficients are significant. In the former area, females increase the probability of occurrence (by just over 3%);

the opposite happens in the second case – males increase the opportunities of identifying clinical projects (by approximately 2%). Contrariwise, this variable is not relevant in public health projects.

The study on the significance of the amount of the grant/fellowship indicates statistical relevance only in the cases of the biomedical and public health categories. Thus, the higher the amount of resources, the greater the probability of having a biomedical project and the lower the possibility of having a public health project. Nonetheless, given the marginal effects that appear, it is clear that although there is statistical significance in all of this, the same does not happen with economic significance, since coefficients are extremely low.

Finally, regarding geographical distribution of resources, there are positive, significant coefficients (and marginal effects) when compared with the Metropolitan area, in the Pampa and Cuyo regions, which lead to the possibility of biomedical studies. Furthermore, in clinical projects, Northeast Argentina and Patagonia have the most positive and significant coefficients. In the field of public health, the only region that alters research opportunities compared with the national average is Northwest Argentina.

Table 9 Factors of government-funded research by category

Regressors	Biomedical		Clinical		Public health	
	(1)	(2)	(1)	(2)	(1)	(2)
Funding institution (relative to Conicet)						
Conapris	-0.453 (0.000)*	-0.220 (0.000)*	0.128 (0.000)*	0.089 (0.000)*	0.165 (0.000)*	0.041 (0.000)*
FONCyT	-0.118 (0.000)*	-0.068 (0.000)*	0.049 (0.000)*	0.033 (0.001)*	0.056 (0.000)*	0.020 (0.001)*
FONTAR	-0.274 (0.000)*	-0.189 (0.000)*	0.074 (0.000)*	0.057 -0.137	0.135 (0.000)*	0.057 (0.000)*
Geographical region (relative to Metropolitan)						
Pampa	0.054 (0.001)*	0.029 (0.024)**	-0.016 -0.167	-0.012 -0.175	-0.023 (0.005)*	-0.008 (0.088)***
Northwest	-0.102 (0.001)*	-0.061 (0.011)**	0.03 -0.128	0.023 -0.129	0.021 (0.084)***	0.011 -0.123
Northeast	-0.048 -0.324	0.002 -0.949	0.062 (0.027)**	0.049 (0.024)**	-0.020 -0.279	-0.017 -0.103
Cuyo	0.0662 (0.051)***	0.115 (0.002)*	-0.078 (0.009)*	-0.057 (0.013)**	0.007 -0.636	-0.004 -0.655
Patagonia	-0.331 (0.000)*	-0.210 (0.000)*	0.111 (0.000)*	0.082 (0.000)*	0.019 -0.3	-0.003 -0.789
Sex	-0.036 (0.002)*	-0.014 -0.139	0.027 (0.001)*	0.011 (0.073)***	0.001 -0.806	0.002 -0.458
Amount in PPP U\$S	4.79E-7 (0.054)***	3.58E-7 (0.055)***	-5.64E-8 -0.751	-5.34E-8 -0.676	-3.54E-7 (0.013)**	-1.89E-7 (0.011)**
Objective (relative to SEC)						
Communicable diseases	-	2.067 (0.000)*	-	0.019 -0.357	-	-0.083 (0.000)*
Noncommunicable diseases	-	2.11 (0.000)*	-	-0.002 -0.917	-	-0.094 (0.000)*
Nutrition and environment	-	1.955 (0.000)*	-	0.068 (0.002)*	-	-0.065 (0.000)*
Violence and accidents	-	1.800 (0.000)*	-	0.031 -0.326	-	-0.049 (0.000)*
Health policies	-	-	-	-0.083	-	0.008
Systems and services research	-	-	-	(0.000)*	-	-0.289
Technological R&D	-	2.112 (0.000)*	-	-0.026 -0.542	-	-0.079 (0.000)*
Traditional medicine	-	-	-	-	-	-0.094 (0.001)*
Basic science	-	2.333 (0.000)*	-	-0.147 (0.000)*	-	-0.141 (0.000)*
Constant	0.312 (0.000)*	-1.913 (0.000)*	-0.231 (0.000)*	-0.139 (0.000)*	-0.165 (0.000)*	0.012 -0.101

* Significant at 1% ** Significant at 5% *** Significant at 10%
Source: Own development.

8 Conclusions

Investment in science and technology in Argentina has grown systematically in the past five years, although less than expected when considering national revenue. Government-financed research in health in 2002 was US\$ PPP 30.3 million, reaching US\$ PPP 55.4 million in 2006 (83% increase) and a total cumulative investment of US\$ 205.6 million throughout the five-year period.

These resources are channelled through five institutions, of which four use open competition. This distribution shows that CONICET and FONCyT are the two main sources of grants, either through programmes to support specific projects or through open competition, fellowships and systematic funding to researchers. At a significantly different level, Salud Investiga specializes in the financing of projects for young human resources in the field of public health, while FONTAR channels resources to technological R&D. ANLIS, within the structure of the Ministry of Health, is the only agency under study that invests its resources in its own institutions through open competition.

On average, the funds are targeted to women (57.2%), particularly in the Metropolitan area (51.2%), relegating social sciences to a secondary role.

The prevailing lines of work financed by the system as a whole are related to noncommunicable diseases first and then to basic sciences, an area that

has developed increasingly in the past three years. In both cases the main methodology is biomedicine, with minor although similar developments in clinical and public health research. Within the latter, it is worth highlighting investments in nutrition and the environment, socioeconomic and cultural topics and those related to health policy, systems and services. The two most relegated areas are traditional medicine and accidents and violence, which account for only 0.2% of the funds allocated to public research in health.

Whereas the epidemiological profile of a country is a suitable mechanism for resource allocation in health research, it is reasonable to note that Argentina made a significant investment in noncommunicable diseases vis-à-vis communicable diseases during the analysed period of time. However, as discussed in the comparative study, priority-setting mechanisms in health research are associated not only with epidemiological profiles. In this sense, reducing gaps between income groups would also require more relative investment in related noncommunicable diseases. Alternatively, to improve the efficiency of resources invested in health, it would be necessary to allocate funds for research in disciplines related to management, insurance and access. From this perspective, improving investments in health research devoted to public health should be part of a future agenda for the public sector strategy.

Notes

- 1 Daniel Maceira has a PhD in economics from Boston University. He is senior researcher at the Centre for the Study of the State and Society, director of the Health Care Area of the Centre for the Implementation of Public Policies Promoting Equity and Growth, and associate researcher of the investigative branch of the National Council for Scientific and Technological Research.
- 2 The analysis unit in this study is “research in health” and not “innovations in health”. It is worth highlighting that R&D is only one of the links of innovation. In order to delve deeper into the innovation process, other aspects should be taken into consideration, such as patent-protected technologies, modifications in human capital productivity (e.g. training, consultancies) and essentially the introduction of capital goods in the sector’s “productive process” which is no minor aspect in the field of health.
- 3 The following regions were taken into account: Metropolitan (Buenos Aires City and Buenos Aires Province), Pampa (Córdoba, Entre Ríos, La Pampa and Santa Fe), Northwest Argentina (Catamarca, Jujuy, la Rioja, Salta, Santiago del Estero and Tucumán), Northeast Argentina (Chaco, Corrientes, Formosa and Misiones), Cuyo (Mendoza, San Juan and San Luis) and Patagonia (Chubut, Neuquén, Río Negro, Santa Cruz and Tierra del Fuego).

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Chapter 4

Bolivia: Public funding of health research

Fernando Aramayo Carrasco^{1,2}

1 Introduction

Bolivia is a country locked in an ongoing debate about the best way to manage its health sector. Since the election of President Morales in 2005, traditional medicine has been reevaluated and social policy has been defined as a high priority by the government. Consequently, the previous focus on the economy, due to the traumatic hyperinflation of the 1980s, whereby macroeconomic stability and economic growth were the central concerns for the government, has been set aside.

Administrative decentralization and deconcentration, initiated in the second half of the 1990s, brought great benefits to the health sector, mainly because it allowed the presence of the state and, along with it, resources for areas of the country where access to health services was virtually non-existent. Thus, popular participation and administrative decentralization forged a decentralized concept of the health sector, revealing deficiencies particular to the different regions of the country, including cultural, social and economic obstacles.

At present, critics and the national government debate over the poor

results and impact of government policies regarding key indicators of the country's health system after an average yearly investment in the social sector of about US\$ 600 million. The Sector Development Plan of the Ministry of Health and Sports (MSD) – the state agency that regulates the health sector – reveals that currently 77% of the population is excluded from health services, especially in the regions of the Altiplano (high plains) and the rural valleys.

Diseases that require mandatory reporting and are part of the epidemiologic profile of the country are:

- measles
- German measles
- meningococcal meningitis
- hantavirus
- yellow fever
- whooping cough
- cholera
- haemorrhagic Bolivian fever
- classic dengue fever
- diphtheria
- human rabies
- plague
- haemorrhagic dengue fever.

Table 1 Social and economic indicators in Bolivia

Indicator	Value
Population (millions), 2007	9.83
Gross domestic product (US\$ million), 2007 ^a	13 039
Gross domestic product per capita, 2007	1 327
Economic growth (%), 2007	4.6
Inflation (%), 2007	11.73
Life expectancy at birth (years), 2005–2010 ^b	65.51
Gross mortality rate (deaths per 1000 inhabitants), 2005–2010 ^b	7.55
Infant mortality rate (deaths of children aged under 1 year per 1000 live births), 2005–2010 ^b	45.6

Note: ^aPreliminary; ^bEstimation for the period 2005–2010.

Source: Based on information provided by Instituto Nacional de Estadística.

2 Regulatory institutional framework

The state health innovation system in Bolivia is made up of government agencies and institutions of higher learning. The former are headed by the vice minister of science and technology,³ under the Ministry of Planning and Development, whose duties are determined by the Strategic Guidelines of the National Development Plan (PND) 2006–2011, which states that:

Science, technology and innovation (CTI) are fundamental instruments for development and their activities are of great priority for the government in all production and service sectors: manufacture, agriculture and farming, rural development, hydrocarbons, mining, education, health, economy, culture, environment, ancestral wisdom, among others; for these reasons they become transversal in nature in a worthy, sovereign, democratic, and productive Bolivia to live well.

In Bolivia, the creation of science, technology and innovation is carried out by numerous contributors: NGOs [nongovernmental organizations], consultants, government projects and programmes, and public and private research institutions. However, the information related to this sector is not divulged; in most cases, it is not systemized, so there are many difficulties in using it for the benefit of the country's development. In addition to the lack of a national policy on information, there are deficiencies regarding the

*development and implementation of mechanisms and/or platforms that can facilitate the systematization, diffusion, and consequently, access to information.*⁴

Despite this statement about the importance of science and technology in implementing the PND the health sector has yet to receive material support or resources. The government's key actor for scientific research and development (R&D) is the MSD, which is responsible for the sector's policies according to the Organization of Executive Power Act of 21 February 2006, which defines the duties of the ministry as follows:

- to design, to implement and to evaluate the performance of health programmes within the framework of the country's development policy;
- to regulate, to plan for, to control and to guide the national health system, made up of the short-term social security subsectors: public and private, for-profit and non-profit-making, and traditional medicine;
- to guarantee the population's wellness by promoting health, disease prevention, healing and rehabilitation;
- to direct, to regulate and to carry out policies for the entire health system;
- to standardize international cooperation in the health sector with the policies, priorities and rules established by the national government;
- to regulate the performance of educational and training institutes within the health sector, with the exception of public universities, in coordination with the Ministry of Education and Culture.

The role of the MSD is to govern and regulate the national health system. Its presence at the subnational level is represented by departmental health services, which are decentralized entities that function within the prefectures of the departments.

The following research institutes are part of the MSD:

- Bolivian Institute for the Blind (IBC)
- Bolivian Institute of Sports, Physical Education and Recreation (IBDEFER)
- National Institute of Health Laboratories (INLASA)
- National Institute of Occupational Health (INSO)
- National Institute of Public Health (INSP)
- National Institute of Health Insurance (INASES).

According to current regulations, the following institutes are under the jurisdiction of the Sucre Institute of Public Health:

- Santa Cruz Centre for Tropical Diseases (CENETROP)
- Institute of Nuclear Medicine (IMN)
- National Institute of Health Laboratories (INLASA)
- National Centre of Epidemiology and Environmental Health of the South (CENESA Sur).

However, as the Sucre Institute of Public Health is still not operational, the aforementioned institutes are still under national jurisdiction.

In March 2008, under the leadership of the MSD, the institutions involved in the health sector were invited to participate in the design of a National

Agenda of Research Priorities in Health. The following conclusions were reached regarding health research:

- The country's "research policy" has been laissez-faire rather than strengthening the MSD's direction and leadership.
- The endeavour to drive change did not produce the expected results, the situation remained with the same diagnosis and the same recommendations, the proposals were considered unfeasible, and the priorities were not clearly defined.
- The country has incipient scientific and technological development.
- The growth of infrastructure and scientific production has been moderate.

This assessment of the current situation regarding the development of science and technology underestimates the efforts of institutions such as the MSD that hire consultants in epidemiology and other areas and initiate research without the aid of grants (which do not exist in the public system).

In the same way, public institutions of higher education, whose role has been fundamental – especially in the health sector – are key actors in the system of scientific and technological innovation. These centres carry out basic, applied and experimental research.

2.1 Actors matrix

Additionally, clinical research performed in hospitals should also be considered. Unfortunately, there are no centralized records for this type of research or its results, or consequently of the resources

assigned to it. For this reason, the present study does not include it in the government innovation system.

Thus, it is possible to identify key national public actors for research in the health sector with existing physical, financial and human resources, which are the source for the study results presented below. These actors are:

- Vice-Ministry of Science and Technology (MPD) under the Ministry of Planning and Development

- Vice-Ministry of Health, under the MSD
- Vice-Ministry of Traditional Medicine and Intercultural Affairs, also under the MSD
- University Mayor of San Andrés (UMSA), which enjoys autonomous status as determined by the CPE.

Private laboratories that carry out for-profit research, whose projects and resources assigned are not made public, were not included in this study.

3 Methodology and sources

In Bolivia, data on expenditures in health R&D are rarely available. For this reason, the only data source is the general budget of the MSD for 2002–2006 found at the General Accounting Office of the Republic. This allows us to know the entire expenditures, including the MSD expenditures.

The database of the Accounting Office for the years 2002–2006 covers expenditure data classified according to the categories mentioned in Table 3.

The information of this database was processed as follows:

- Select the expenditures on R&D of the Ministry of Health.
- Obtain the total amount of assigned resources (investment and current cost) according to the item of expenditure of the functional unit.
- Obtain the expenses by INLASA, the only institute that incurs in R&D costs within the expenditure structure of the ministry.
- Estimate resource allocation in R&D in epidemiology based on the total expenditure of the ministry.⁵

- Add both quantities and convert them to purchasing power parity (PPP) with their respective coefficients.
- Produce tables with the estimated technical coefficients.

Table 2 presents the variables classifying spending and investment from the treasury's database. Such data allowed the identification of variables and indicators to create the structure of the database for the study. In this way, in the original database, the expenditure assigned to the code of the MSD was filtered first, so expenditure by neither universities nor municipal governments was considered. A similar criterion was adopted for the institutes.

In the same way, both current expenses and investments, with the exception of those used to buy equipment, furniture or materials, were considered as expenditures assigned to health. Afterwards, the type of programme developed by each functional unit was verified, emphasizing INLASA and the Epidemiology Unit of the MSD. For the year 2006, the adopted projects and their direction, as well as their

objectives, were identified. It was possible, then, to corroborate that the projects do not have an exclusive orientation towards biomedical or public health research;

rather, their methodology combines both areas. Afterwards, the data supplied by the Epidemiology Unit of the MSD were weighted.

4 Results

4.1 Descriptive analysis

Within the MSD, the programmes⁶ that carry out research in health are National Control of Tuberculosis, Fight Against Great Endemic Diseases, National System of Health Information, Epidemiologic Shield Programme (EE), Integral Health Project and the National Institute of Health Laboratories. All of these programmes under the ministry carry out their activities by different research methodologies, both in the area of biomedicine and public health and within the framework of definitions adopted by the present study. However, no programme of the ministry carries out clinical research.

Table 3 shows that the greatest concentration of MSD resources assigned to R&D goes to INSALA (5%), which focuses its activities in the biomedical area (almost 80%); the rest of its activities are dedicated to public health. Although quite far from the INSALA, EE comes in second place (2.8%) in the share of resources assigned to research. The third in share is PROSIN II (0.6%), which focuses almost 100% of its activities on public health. The System of Health Information (SNIS) had the lowest share of expenditure in 2006; given its type, it devotes all of its activities to public health.

Table 3 Investment in health research by MSD programmes (bolivianos (BOB) PPP), 2006

Programme	Amount	%
Total expenditure	16 704 706	100.0
Current expenditure	15 146 726	90.67
Investment	1 557 980	9.33
Tuberculosis	59 889	0.36
Major endemic diseases	61 681	0.37
SNIS	31 652	0.19
EE	472 872	2.83
PROSIN II	99 841	0.60
INLASA	832 044	4.98

Source: Ministerio de Salud y Deportes – Unidad de Epidemiología.

The research activities of INLASA and EE continuously incorporate the social, economic and cultural characteristics of the country, and they traverse studies and research projects. However, in order to be able to define the direction of the research carried out by both institutions, this research has given higher priority to those that study context.

Table 4 describes the INLASA and EE annual shares of the total expenditure of the ministry for the period 2002–2006; both represent an important percentage of the total amount of investment assigned to R&D. Table 4 corroborates that the ministry concentrates a great part of its energy and resources in epidemiological control.

Table 4 Research programmes as a share of total expenditure of the MSD, 2002–2006

Year	Total expenditure (BOB)	INLASA	Epidemiology	R&D expenditure (BOB)	R&D expenditure (US\$ PPP)
2002	236 134 275	0.5%	0.5%	2 332 564	1 169 205
2003	284 114 711	0.3%	0.5%	2 218 533	1 068 143
2004	342 860 287	0.3%	0.5%	2 772 927	1 269 074
2005	430 963 551	0.3%	0.5%	3 379 715	1 515 567
2006	337 713 475	0.6%	0.5%	3 779 659	1 557 980

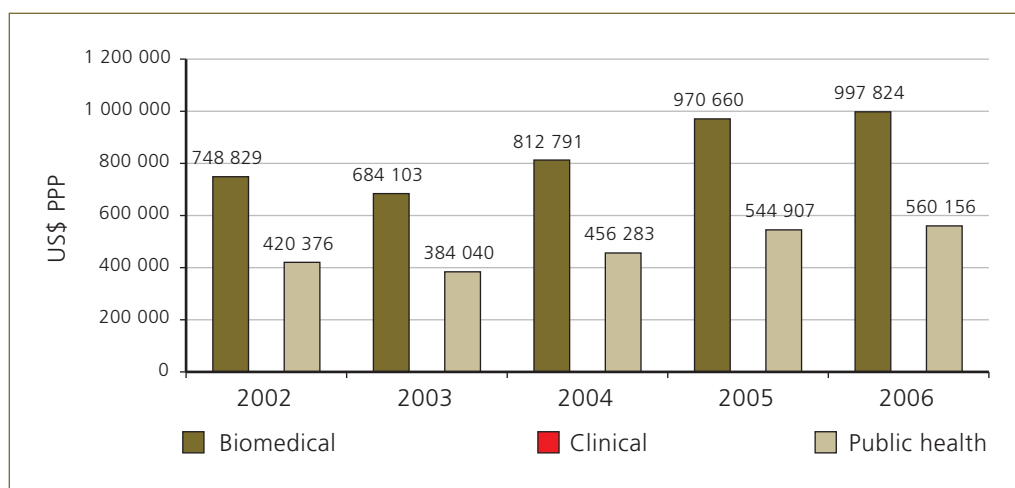
Source: Contaduría General de la República.

The annual evolution of resources assigned to R&D in health by the MSD illustrates the expenditure level for the period 2002–2006 in terms of purchasing power parity (PPP), a trend that increased until 2006, when the slope was reversed and showed a lower level of resources assigned to R&D. In 2005, available resources for public investment decreased significantly as a result of the political situation of the country.

These matrices were created applying the technical coefficients from the data provided by the Unit of Epidemiology

of the MSD for 2006 regarding the methodology and the objective of the Unit's programmes and projects. Additionally, in order to calculate the share of the executed budget devoted to R&D, they were adjusted by technical coefficients provided by the National Administration of Laboratories and Health Institutes research in Argentina (ANLIS). Subsequently, the programmes and projects were classified as biomedical, clinical or public health research, in accordance with their objectives. All amounts were converted to PPP in the database.

Figure 1 R&D expenditure by the MSD (US\$ PPP), 2002–2006



Source: General Accounting Office of the Republic and Health and Sports (Epidemiology Unit).

Table 5 Matrix of technical coefficients, 2006

		Methodology		
		Biomedical	Clinical	Public health
Objective	Context			
	Socioeconomic – cultural	3.1%		0.6%
	Communicable diseases	39.0%		13.5%
	Problem			
	Noncommunicable diseases			0.6%
	Nutrition and environment	22.0%		4.8%
	Violence and accidents			0.6%
Action				
Research in policies, system and health services			15.8%	
Technological R&D				
Traditional medicine				

Source: Unidad de Epidemiología del MSD.

Table 6 shows annual expenditure for the time period 2002–2006. This information explains the variations in expenditure in relation to the total amount of expenditure of the MSD.

It is important to compare the direction in health research to the demand identified in 2007 by the MSD, which defined 10 subagendas for health research during the National Workshop of Leadership in Health Research (October 2007).

This allowed the regrouping of the 16 agendas that were initially identified under criteria such as “violence and accidents” within the subject “health promotion”. Following similar reasoning, it considered “non-transmittable diseases” to be distributed in various subjects (breast and uterine cancer in “women’s health”, diabetes and other food-related diseases in “nutrition and food safety”, and other non-transmittable diseases in “health promotion”). Also,

Table 6 Classification of investments by MSD, by research methodology and objective (US\$ PPP), 2002–2006

	2002			2003			2004			2005			2006		
	Research methodology			Research methodology			Research methodology			Research methodology			Research methodology		
	Biomedical	Clinical	Public health	Biomedical	Clinical	Public health	Biomedical	Clinical	Public health	Biomedical	Clinical	Public health	Biomedical	Clinical	Public health
Context															
Social, economic and cultural	35 801	7 191	32 707	38 859	6 569	38 859	7 805	46 407	9 321	47 705	9 582				
Communicable diseases	45 537	158 264	41 601	494 266	144 584	494 266	171 782	590 268	205 147	606 786	210 888				
Noncommunicable diseases		7 191			6 569		7 805		9 321		9 582				
Problem															
Nutrition and environment	257 658	56 145	235 387	279 666	51 292	279 666	60 941	333 986	72 778	343 332	74 814				
Violence and accidents		7 191			6 569		7 805		9 321		9 582				
Objective															
Research in policies, systems and health services		184 395			168 457		200 146		23 902		245 709				
Technological R&D															
Traditional medicine															

Source: Based on information provided by Ministerio de Salud y Deportes

given current government policy, workshop participants determined that “the health of the excluded population” must be a central axis to be applied to all health research subagendas. The 10 subagendas in order of priority were:

- children’s health
- women’s health
- health systems
- nutrition and food safety
- health promotion
- transmittable diseases
- environmental health
- health of indigenous-native peoples
- health and culture – traditional medicine
- plants with medicinal properties: technological development and innovation.

5 The case of the University Mayor of San Andrés

UMSA, through its Department of Research, Graduate Studies and Social Interaction (DIPGIS), is the entity in charge of planning, coordinating, advancing, evaluating and tracking research activities of the institutes and specialized centres under it.

This university, which does not hold formal links with the described research system, has 37 research institutes in different areas of science, under a particular department or college, and has adequate infrastructure, with its own equipment and a group of researchers. In particular, the health area is composed of the Research Institute in Health and Development (INSAD); the Institute of Genetics; the Bolivian Institute of High Altitude Biology (IBBA); the Institute of Laboratories Services for Diagnosis and Health Research (SELADIS); the Institute of Research in Pharmacology and Biochemistry; and the Centre for Information and Documentation of Medicine.

5.1 Research lines

The various institutes and specialized centres that develop research activities

in the health field have different focuses:

- INSAD: biomedical and social;
- Institute of Genetics: cytogenetics, toxicological genetics and molecular genetics;
- IBBA: adaptation or non-adaptation to life at high altitudes and human biodiversity;
- SELADIS: neoplasia, allergies, infectious diseases, autoimmunity, endocrine and metabolic diseases, reference values, clinical histo-compatibility, forensic genetics, analysis of finished pharmaceutical formulas and galenic preparations, food control and analysis, toxicological control and analysis in all areas, immunomodulators, biological activity of natural products, control of environmental pollutants, study of the effects of pesticide, metals and other pollutants and their consequence over health (infections–immunology–nutrition–neurology);
- Institute of Research in Pharmacology and Biochemistry: pharmacological chemistry, pharmacology and microbial biotechnology;
- Centre for Information and Documentation of Medicine: rational use of pharmaceuticals.

5.2 Research projects by research methodology

The classifications used by the Department of Research, Postgraduate Studies and Social Interaction for research activities carried out by the institutes or research centres consists of the following:

- Basic research: experimental or theoretical work that is undertaken mainly to obtain new knowledge about the fundamentals of phenomena or observable facts, without the purpose of any particular application or use.
- Applied research: original work developed to obtain new knowledge, but fundamentally geared towards a specific practical objective.
- Experimental development: systematic work that makes use of existing knowledge obtained from research or practical experience and directed towards the production of new materials, products or devices; the launching of new processes, systems and services; or the substantial improvement of existing ones.

Table 7 Projects by institute and research methodology

Institute	Total projects		METHODOLOGY						
	%	Number of projects	Biomedical	Clinic	Public health	%	Number of projects	%	Number of projects
Instituto de genética	11	10	10	9	1	1	0	0	
Instituto de biología de la altura	58	52	6	5	29	26	24	21	
Servicios de laboratorio de diagnóstico e investigación en salud	24	21	7	6	8	7	9	8	
Instituto de investigaciones fármaco bioquímicas	7	6	4	4	2	2	0	0	
Total	100	89	27	24	40	36	33	29	

Source: UMSA.

Table 7 summarises results obtained from a cross-analysis of the weight of the projects in each institute according to research methodology. The table underscores the fact that the greatest concentration of projects is found at IBBA, where clinical and public health research have higher priority; these two research methodologies, when added, represent 73% of total projects.

Within the IBBA clinical research, “noncommunicable diseases and addictions” are the focus of the most research. In public health research, the Institute of Laboratories Services for Diagnosis and Health Research focuses on “nutrition and the environment”.

6 Conclusions

The system of innovation in health in Bolivia is formed by public institutions such as the MSD and also by institutes belonging to the university system, as can be seen in the case of UMSA.

As revealed in the present study, it is very complex to perform a fully detailed analysis that enables one to discern the number of projects and their methodological orientation, as well as their objective, especially in the case of programmes developed by MSD. The empirical approximations carried out still describe insufficient elements to conclude whether the expenditures assigned to research in health, given the priorities resulting from the health profile of the country, are adequate or not.

Similarly, more research is required to study the criteria under which MSD and UMSA determine their research priorities. Such analysis should identify the decision-making processes through which health expenditures are directed and, consequently, the way in which the country's priorities in health are fulfilled. It is important to perform this kind of approximation with consideration to the institutes or other entities within the public university system that carry out research in health.

The study highlights the direction of MSD programmes regarding its methodology in biomedical research and public health, but the question remains: how does the system of national innovation develop clinical research? In addition, it is critical to include in the analysis hospitals where this type of research is carried out. However, it is clear that clinical research is of high priority for the innovation endeavours of UMSA institutes. Given the above, the question is: who records the information and how is the information recorded so as to avoid saturation, so that the priorities for research expenditure can become balanced, especially regarding its objectives?

In short, it is necessary to reflect on mechanisms that would allow the effective operation of the country's innovation system, so that priorities in expenditure and investment can clearly be oriented in relation to the health priorities of the country. Coordination between institutions is a critical issue, due to its role in health research, as demonstrated in the present study. The organization of this coordination is another issue that must be decision-makers.

Notes

- 1 Fernando Aramayo Carrasco is researcher of management and public policies. Fernando received his Masters in Public Policy and Management from the Harvard Institute for International Development, Catholic University of San Pablo (Bolivia). He currently works as a consultant for various international cooperation organizations, such as AECID (Spanish Agency for International Cooperation), GTZ (German Technical Cooperation), IDB, USAID, UNDP, and the World Bank.
- 2 This work benefited from the collaboration of Dr Rosemary Durán and Leonardo Téllez, and the valuable contribution of Dr María Bolivia Rothe, Chief of the Epidemiology Unit at the MSD. I would also like to thank the helpful attitude of Eduardo Vacaflares, General Director of Administrative Matters, and Ciro Puma, responsible for the National Budget at the MSD.
- 3 Agency of direction, coordination and management of actions defined in scientific, technological and innovation politics, Law 2209 of 8 June 2001.
- 4 <http://www.cienciaytecnologia.gob.bo/programas/SIBICYT/ResumenEjecutivo.htm>.
- 5 According to the parameters stated by Dr María Bolivia Rothe, Director of the Epidemiology Unit.
- 6 Although there are both projects and programmes, INLASA is an institute and the Epidemiologic Shield (EE) is under the responsibility of the Epidemiology Unit. For the purpose of this study all of them are called “programmes” in order to avoid confusions when classifying the research sphere according to the method of research and its objective.

Chapter 5

Chile: Public funding of health research¹

Guillermo Raúl Paraje²

1 Economic and sanitary context

The most recent Pan-American Health Organization report, *Health in the Americas, 2007*, indicates that the main causes for mortality in Chile are cardiovascular diseases, followed by neoplasias and external reasons related mainly to accidents (men) and communicable diseases (women).

Analysing disability-adjusted life years (DALYs) in Chile in 2002, seventy-six per cent of the DALYs correspond to noncommunicable diseases; the three foremost are neuropsychiatric conditions (almost 30% of DALYs correspond to these conditions), neoplasia (10%) and cardiovascular illnesses (10%). The remaining DALYs are shared among

injuries caused by accidents and violence and communicable diseases. This shows that Chile's epidemiological profile is closer to that of the developed world rather than developing countries.

However, this epidemiological profile is relatively new. Thanks to intense economic growth, mainly between 1987 and 1998, and relatively successful sanitary and social policies, Chile's sanitary indicators have improved greatly. For instance, from 1983 to 2003, the infant mortality rate fell by more than half (WHO, 2007). Similar models of rapid improvement in sanitary indicators can be observed in general in maternal and adult health.

Table 1 Estimated disability-adjusted life years (DALYs) (thousands) by cause, 2002

	DALYs	%
Communicable, maternal and perinatal conditions	233	10.7
Nutritional conditions	10	0.5
Noncommunicable diseases	1 002	45.8
Injuries	276	12.6
Neuropsychiatric conditions	666	30.5
Total DALYs	2188	100

Source: World Health Organization.

2 Public institutions that finance health research

Although other public entities participate in the design and allocation of funds, the National Commission for Scientific and Technological Research (CONICYT) greatly centralizes the management of resources provided by Chile's public system of health financing. Often these organizations form part of CONICYT advisory councils.

2.1 National Commission for Scientific and Technological Research

At present, CONICYT is in charge of allocating resources to train human capital and to fund research and technical development projects. CONICYT's scientific policies are accomplished exclusively by managing

its funds and numerous programmes, some of which focus on specific areas such as the Astronomy Programme, the Red Tide Science and Technology Programme and the National Fund for Health Research. However, the bulk of the funds available to CONICYT have no specific assignment per field, at least not explicitly. The largest funds, in terms of volume of resources, that CONICYT manages are:

- National Fund for Scientific and Technological Development (FONDECYT)
- Fund for the Promotion of Scientific and Technological Development (FONDEF).

Combined, these two funds represent 54% of CONICYT's available funds (according to the 2008 budget) and constitute the cornerstone of public funding of research projects (awarded by bidding process).

2.2 National Fund for Scientific and Technological Development (FONDECYT)

Created in 1981, FONDECYT is Chile's oldest and most important programme that manages awardable funds. Within FONDECYT, funds are assigned under the responsibility of two superior councils – a Science Council of four members and a Technological Development Council of six members – which define research programmes, select projects, assign the resources provided by CONICYT and supervise projects under execution.

These superior councils are supported by 23 groups made up of experts from different areas,³ which select project evaluators, analyse their evaluations and propose projects to be financed by the respective superior councils, which then either approve or reject them.

The objectives of FONDECYT programmes range from financing research and development projects to the education of specialized human resources, among others.

Regular Programme of Research Projects

As FONDECYT's most well-resourced programme, the main objective of this programme is to promote basic research. It funds projects of up to four years' duration, in every area of knowledge. Amounts awarded may be used to pay for professional fees, trips, a supporting staff, and operative and capital expenses. Financed projects are expected to be published in international scientific journals and presented at seminars and congresses. Over 9000 articles have been published as a result of projects financed by this fund.

Regular Competition for Research Initiation

Created in 2006, FONDECYT'S most recent programme has the purpose of initiating young researchers, often scientists who have recently completed their PhD, in the national scientific arena. This programme funds research projects of two or three years' duration in all scientific areas.

Incentive for International Cooperation

Organized for the first time in 1996, this programme seeks to support the execution of certain projects financed by the Regular Programme and the Regular Competition for Research Initiation by funding initiatives for international cooperation. These funds are available only once a year and may pay for air travel and accommodation expenses for foreign researchers who make relevant contributions towards the execution of the research project.

Postdoctoral

The purpose of this programme is to provide funds to help scientists who have recently obtained their PhD to join a national scientific institution or network. The programme finances projects to be developed within a maximum period of two years and that are backed by an institution or a sponsoring researcher. The programme covers professional fees, travel and operative expenses.

2.3 Fund for the Promotion of Scientific and Technological Development (FONDEF)

One of the main objectives of FONDEF is to facilitate the transfer of knowledge and improve the links between researchers/universities and nongovernmental institutions. Unlike FONDECYT, funds within the FONDEF framework tend to finance applied projects, being assigned to institutions rather than researchers, and must cover a minimum of one-fifth of the project's total cost.

Eligible for these awardable funds are non-profit-making organizations that have an explicit objective for research and development and a legal existence of at least five years. These generally include public or private universities, professional institutions, public or private technological and research institutions, corporations and foundations.

Originally, only six specific areas were included within this programme: agriculture, forestry, computer science, manufacturing, mining and commercial fishing. Three new areas have been added: energy and water management, education and health. The latter was incorporated thanks to the creation of the Fund for Health Research (FONIS).

2.4 National Fund for Health Research (FONIS)

Recently created in 2004, the purpose of this fund is to evaluate the sanitary technologies of Chile that are either new or have not yet proven cost effective. This programme targets the research areas of sanitary management, primary attention, and occupational and environmental health, in addition to others established in Chile's 2000–2010 sanitary objectives.⁴

FONIS is co-administrated and co-financed by CONICYT and the Ministry of Health. Projects typically focus on public health. In 2004, FONIS funded 25 projects. In 2005 and 2006, the number of awarded projects rose to 31 and 27, respectively.

3 Methodology and sources of information

The following analysis is based on the construction of a database of projects financed by CONICYT through its several programmes in the field of health. As a result, the projects considered in this study include all FONDECYT projects (regular, international cooperation, junior researchers, doctoral and postdoctoral programmes), FONDEF projects related to health and, since 2004, all FONIS projects.

Once we received the original data from various CONICYT boards, projects were classified according to field;⁵ to this end, we used the project title.⁶ Our first classification was to determine three “methodological” areas: biomedical, clinical and public health research. In addition, we considered 10 thematic areas, which cut across the methodological areas. They are as follows:

- basic science
- social, economic and cultural factors
- communicable diseases
- noncommunicable diseases and addictions

- nutrition and the environment
- violence and accidents
- health policy, systems and services
- sanitary research and technological development
- traditional medicine
- mental illness (excluding addictions).

This last area was included (particularly in the case of Chile) after relevant actors of science policy expressed interest in measuring the scientific activity in this area. Neuropsychiatric conditions represented 26% of DALYs in 2002. They consequently constitute a very important area in the illness profile of the population.

The projects analysed vary in duration from under a year to 58 months. For this reason, we annualized the funds awarded. The payment schedule to project executors is regarded as linear (i.e. the same proportion each year) and the payment begins when projects are awarded. In some programmes, a project may be awarded funds towards the end

Table 2 Overview of funding databases

	FONDECYT, 2002-2006	FONDEF, 2002-2006	FONIS, 2004-2006	Total
Number of projects	648	39	81	768
Average amount of projects (US\$ PPP)	157 388	473 133	44 000	161 463
% Metropolitan region	80.2	41.0	60.5	76.2
Average age of researchers (years)	51.7	50.3		51.6
% Women in charge of projects	28.5	25.6	50.6	30.7

Source: Own development

of one year but it does not start until the following year. Because of the disparity of criteria between different funds and within each fund, we considered the year the project was actually awarded funds as the starting point.

All cash amounts have been converted to constant US dollars adjusted for purchasing power parity (US\$ PPP) in order to increase the comparability of data across countries and projects.

In addition, we processed information on the main researchers' gender and age. Ages of the main researchers of FONIS projects were not reported;⁷ in the case of FONDEF, this information was unavailable in roughly one third of the projects. In all cases, we considered the location of the headquarters of the institution in charge of executing each project and from where the main researchers hailed.

The period analysed is 2002–2006, but because of the duration of some projects we included projects that were awarded funds from 1999 through 2006. Thus, projects whose execution began before 2002 and concluded within the period under examination were taken into

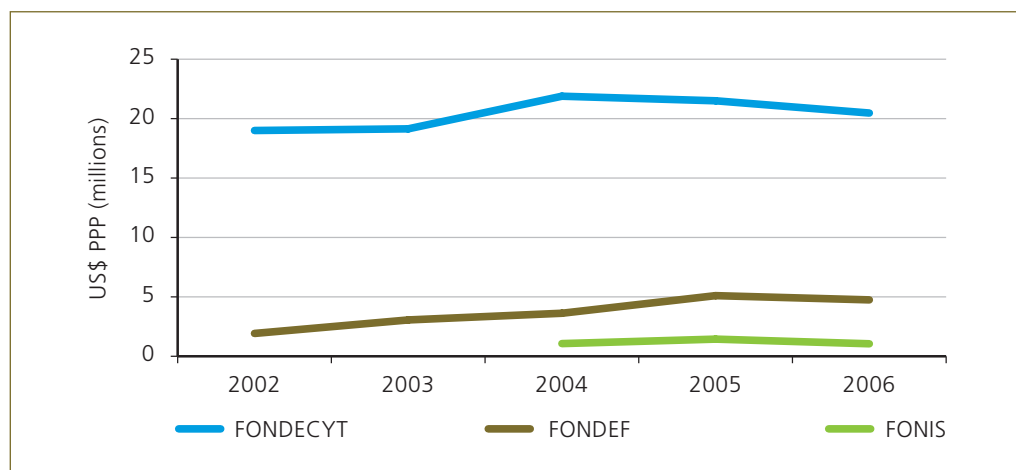
account. In these cases, we used only annualized amounts for the period 2002–2006.

Table 2 and Figure 1 were created by the author after processing information supplied by FONDECYT, FONDEF and FONIS.

Table 3 presents a summary of the awardable funds that were used in this work. We considered 768 projects, 85% of which correspond to FONDECYT projects (in any of the different types), 11% to FONIS projects and the remainder to FONDEF projects. These last two have a higher average amount, nearly US\$ PPP 473 000 dollars, whereas FONDECYT averages US\$ PPP 157 000 and FONIS averages US\$ PPP 44 000.

Figure 1 shows the annual evolution of resources assigned to each fund. In all three cases, resources increased in real terms. FONDECYT awarded the greatest resources in 2004, while FONDEF and FONIS did so in 2005. It is observed, however, that the availability of resources from the three funds for health purposes decreased in real terms in 2006.

Figure 1 Investments in health research by fund (US\$ PPP millions), 2002–2006

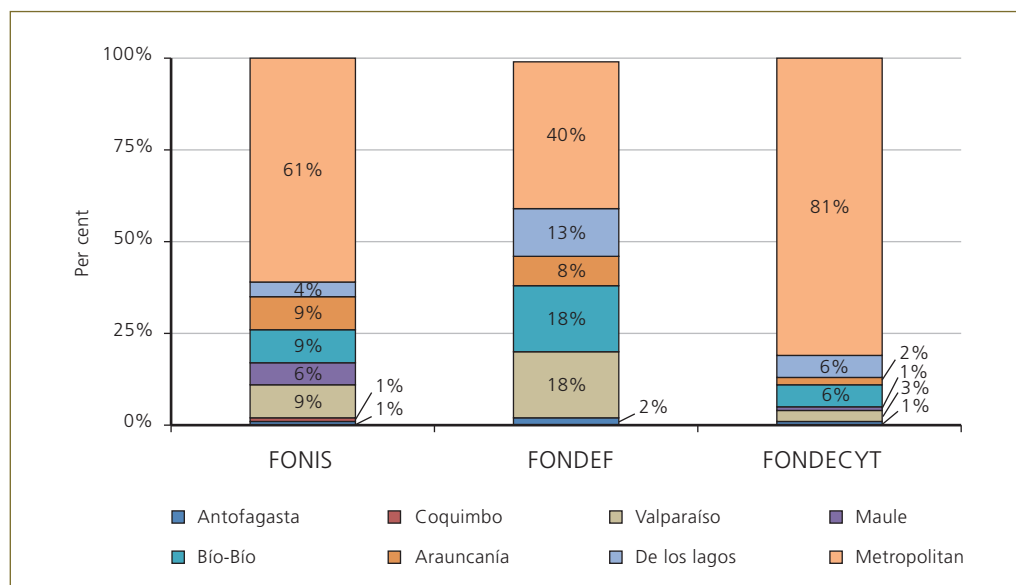


3.1 Geographical distribution of financed projects

Figure 2 shows the regional distribution of projects awarded by each of the funds considered, while Figure 3 presents the total awarded amounts for the period. Both figures demonstrate that funds were concentrated heavily in Santiago's Metropolitan Region.

In the case of FONDECYT, this concentration reached 81%, both in projects (Figure 1) and in total amounts assigned by this fund. At FONIS, the Metropolitan Region accounts for 61% of the projects and 65% of the fund's resources. On the other hand, of the funds considered, FONDEF is the least concentrated in the Metropolitan Region, since 41% of the projects funded

Figure 2 Proportional distribution of projects by region and fund



by this programme are led by researchers affiliated to that region. These projects account for 36% of FONDEF's total resources.

It is evident that of Chile's 13 regions, only 9 are represented in the map of health research. Undoubtedly this distribution reflects the importance within the country of certain institutions of higher education, whose headquarters are located in the Metropolitan Region, although all regions have other higher learning institutions and their branches. As a result, this concentration is not an indication of the absence of institutions capable of participating in the research process.

Likewise, the absence of research in some regions cannot be explained by a lack of critical mass, since developing research in some of the areas we considered, such as health administration and health economics, does not require heavy

investment in equipment or a large number of researchers.

3.2 Distribution of projects by research methodology

As explained in Chapter 2, we used the titles of funded projects to classify them by research objective and methodology. Figure 3 shows the distribution per methodology of projects that were funded within the framework of each programme. The figure shows clearly that there is some (non-explicit) "specialization" among the funds considered. At FONIS, two thirds of the financed projects were assigned to public health, while biomedical research received a minimum. At FONDEF, the relationship is reversed: 73% of the financed projects belong to biomedical research and only 4% correspond to public health. FONDEF allocates approximately a third of the funds to each of these three areas.

Figure 3 Projects by research methodology

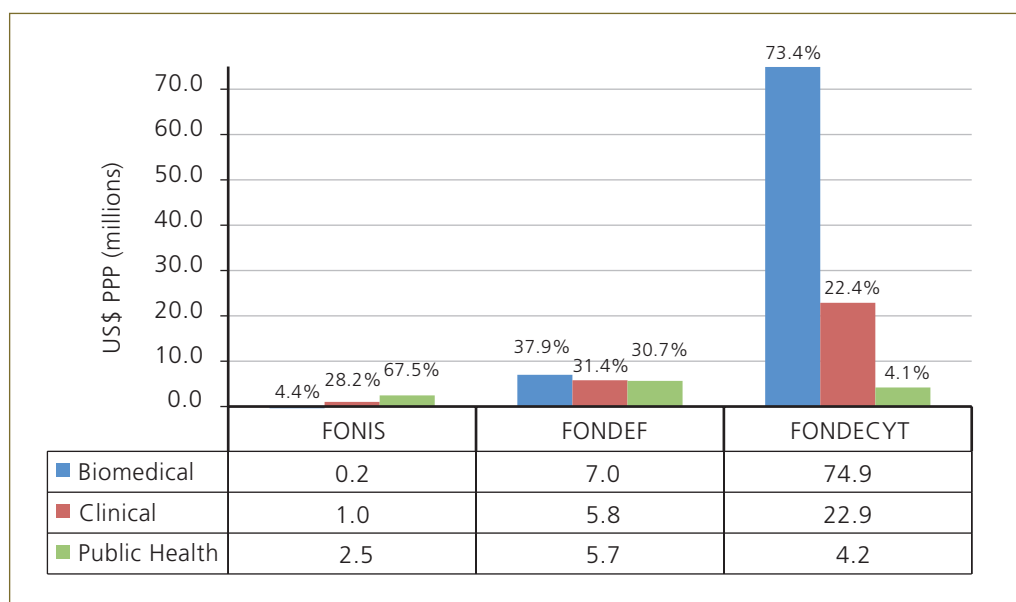


Figure 4 Projects by research objectives (per cent per fund)

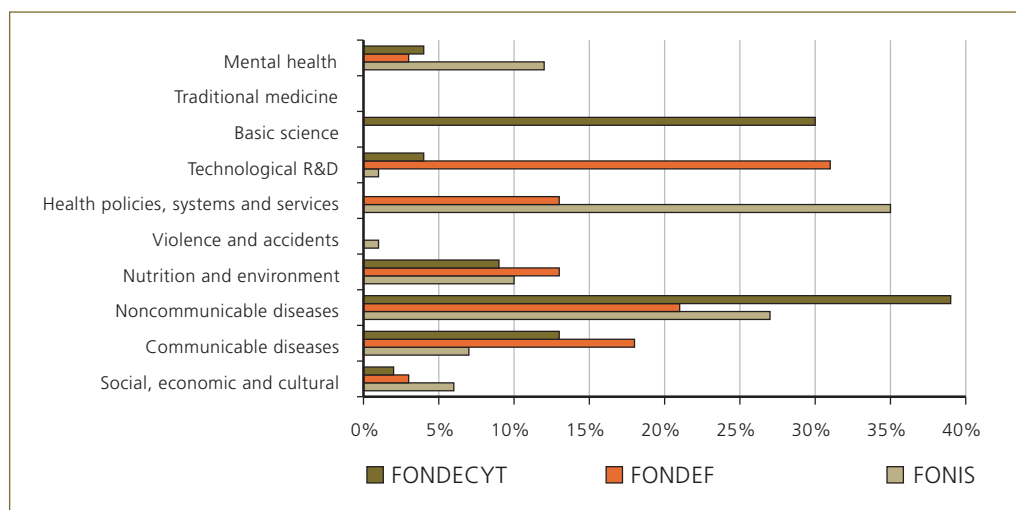


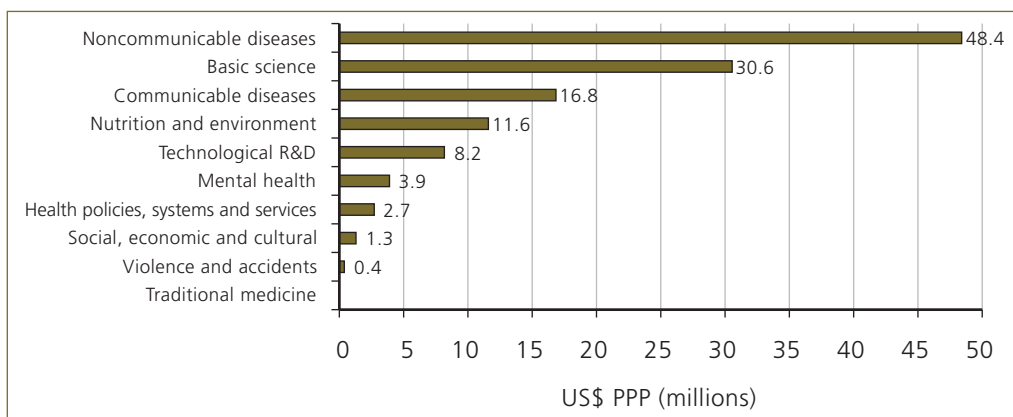
Figure 4 shows project distribution within each fund according to research objective. Thus, for example, the project area to which FONIS awarded the most funding was health policy, systems and services – somewhat over one third of the total projects it financed. The categories with the most projects funded were noncommunicable diseases and addictions (27%) and mental illness (12%). In the case of FONDEF, the areas most frequently awarded resources were technological research and development (31%), followed by noncommunicable diseases and addictions (21%) and communicable diseases (18%). Finally, FONDECYT most frequently funded the research areas of noncommunicable diseases and addictions (39%), basic science (30%) and communicable diseases (13%).

Again, some specialization of the funds is noticeable. Projects that require the acquisition of sophisticated equipment

and are oriented towards technological research are covered by FONDEF; this fund has a strong tendency to link this research to productive activity. In contrast, FONIS is relatively specialized in issues of public health, whereas FONDECYT deals with basic research.

In this case, it is also necessary to consider the total amounts allotted to each objective (regardless of which fund had allotted the resources) in order to have an accurate appreciation of the importance of each objective throughout the country. Figure 5 shows that the most funded area was noncommunicable diseases and addictions (39% of the total), followed by basic science (24%) and communicable diseases (13%). Other objectives that may be deemed important in terms of DALYs, such as research in mental illness or violence and accidents, have relatively low participation: only 3.4% and 0.3%, respectively, of the total amount financed.

Figure 5 Total amount funded by objective (US\$ PPP millions)



3.3 Finance by region

According to the information displayed in Figure 2, it is clear that the distribution of resources among regions is far from equal. The Metropolitan Region captures most of the resources of all the funds available. However, we are interested in knowing which objectives are most frequently researched in the regions. This aspect is illustrated in Table 3.

Within the Metropolitan Region, projects that receive greater funding tend to be for research in noncommunicable diseases and addictions (researchers in this region receive 43% of the total resources) and basic science (23% of the total). A similar situation occurs

in the Valparaíso region (34% in both categories) and Bío-Bío (33% and 25%, respectively). In these latter two regions, projects linked to research and technological development have significant investments – 28% in the Valparaíso region and 10% in Bío-Bío. The Tarapacá region receives resources mainly in nutrition and the environment (67%), while in Antofagasta the most financed objective was basic science (44%), as it was in both Maule (54%) and Región de los Lagos (42%).

Areas connected to public health or mental illness did not have a significant share in any of the regions. The highest percentage reached by research in mental illness was found in the Maule region: 7% of total cases.

4 Econometric analysis

This section includes an econometric analysis in order to investigate possible determinants of the (*ex post*) probability of a biomedical research project obtaining financing as compared with other project areas (clinical research and

public health). The same procedure is used for research in clinical and public health. We mention *ex post* probability because the stage before project selection cannot be considered: information on rejected projects and variables that

Table 3 Amount invested by objective and region (%)

Objective	Metropolitan region	Tarapacá	Antofagasta	Coquimbo
Social, economic and cultural	1.2	7.7		
Communicable diseases	14.1		32.0	
Noncommunicable diseases	43.5	18.2		100
Nutrition and environment	9.4	67.1	5.7	
Violence and accidents	0.1			
Health policies, systems and services	2.3			
Technological R&D	3.5		18.7	
Basic science	22.8	6.9	43.6	
Traditional medicine				
Mental health	3.2			
Total	100	100	100	100

Objective	Valparaíso	Maule	Bío-Bío	Araucanía	De los lagos
Social, economic and cultural			0.3	4.9	
Communicable diseases	1.8	9.6	21.9	10.0	9.9
Noncommunicable diseases		29.4	33.0	39.3	36.4
Nutrition and environment	34.4			1.8	
Violence and accidents	0.6				
Health policies, systems and services	0.8		3.3	4.0	1.0
Technological R&D	28.0		10.4	30.6	11.0
Basic science	33.9	53.8	25.7	6.5	41.5
Traditional medicine					
Mental health	0.5	7.1	5.4	3.0	0.1
Total	100	100	100	100	100

Source: Developed by the author

may explain decisions of rejection or approval is not available. Rather, this work considers awarded projects and examines which variables may determine the choice of the methodological area. In each case, the dependent variable is dichotomous and takes the value of 1 for projects of the considered area and 0 in the remaining cases.

The independent variables are the variables of funds (FONDECYT was omitted), the main researcher's gender (female is omitted), a set of regional dichotomous variables and the total amount awarded for each project. For the last variable, we used only projects

that started and concluded within the period analysed, in order to avoid biasing the results with projects that were incomplete. This reduced the sample from 768 projects to 390: 299 for FONDECYT, 79 for FONIS and 12 for FONDEF. Regressions were estimated using a logit model.

Table 4 shows the results of these exercises. In both biomedical research and public health, the only variables whose coefficients are relevant are the funds' variables. In biomedical research, both FONIS and FONDEF register an exceptionally negative coefficient. This indicates that, other things being equal,

Table 4 Probability (*ex post*) of receiving funding by methodological area

	Biomedical			Clinical			Public Health		
	Coefficient	Standard Error	z Stat.	Coefficient	Standard Error	z Stat.	Coefficient	Standard Error	z Stat.
Gender (ref. woman)	0.272	0.282	0.970	-0.128	0.270	-0.480	-0.161	0.370	-0.430
FONIS	-4.019	0.633	-6.350 *	0.133	0.330	0.410	3.505	0.410	8.460 *
FONDEF	-2.636	0.810	-3.250 *	0.800	0.690	1.160	2.74	0.740	3.700 *
Tarapacá				2.158	1.180	1.830 **	0.238	0.590	0.150
Antofagasta					0.520				
Valparaíso	0.772	0.697	1.110	0.366	0.810	0.700	-1.328	0.760	-1.760
Maule	0.214	0.969	0.220	-0.335	0.440	-0.410	0.166	0.910	0.180
Bio-Bio	-0.711	0.504	-1.410	0.692	0.630	1.580	-0.305	0.650	-0.470
Araucanía	-0.792	0.837	-0.950	0.289	0.760	0.450	0.260	0.760	0.340
Los Lagos	0.800	0.629	1.270	-1.116	0.000	-1.480	0.180	0.730	0.250
Total Amount (thousands US\$ PPP)	0.001	0.001	1.500	-0.001	0.280	-1.430	0.000	0.000	-0.240
Constant	0.557	0.284	1.960 *	-0.982		-3.480 *	-2.619	0.420	-6.180 *
Number of obs	384			388			388		
LR chi2(11)	149.7 *			16.3 **			134.8 *		
Pseudo R2	0.286			0.038			0.359		

Note: *Significant at 95%; **significant at 90%.

Source: Developed by the author

FONDECYT funds the bulk of projects in this area and has strong statistical importance. A similar situation occurs with public health, although in this case with reversed signs: both FONIS and FONDEF have a greater presence than FONDECYT regarding public health (thus, its coefficients have positive signs and are relevant). In the case of clinical research, these variables have no statistical importance.

The gender variable has no importance in any of the three funds, indicating that the researcher's gender does not explain the (*ex post*) assignment of projects per area. Likewise, regional variables are not relevant (except for Tarapacá in clinical research). Nor does region explain the assignment of projects per methodological area. Finally, cash amounts for each project do not seem to explain this distribution among methodological areas. In all cases, coefficients were irrelevant.

5 Conclusions

The analysis of Chile's health research projects financed by awardable public funds from 2002 to 2006 brings to light a series of interesting points that may be considered in order to evaluate how the funds in charge of administrating resources operate.

The first point is that the funds have no explicit mechanisms for setting priorities or for coordination among them, even though they all work under the guidelines of the same institution (CONICYT). However, due to each fund's allocation criteria, this does not mean that there

is no implicit priority-setting process by which a specialization may be created. For example, FONDECYT allocates resources to all objectives considered, but with an emphasis on basic science and noncommunicable diseases. One of the reasons for this may be that, upon evaluating the main researchers' backgrounds before deciding to fund a project, it considers articles published in international magazines (e.g. those indexed in the Thomson ISI Web of Science). The choice of subject and the availability of magazines impose some restrictions: it is somewhat easier to have an article published in basic science than, say, public health. Conversely, FONIS funds projects that have a sanitary impact according to the Health Ministry's sanitary objectives. This produces an evident bias towards projects in public health. It may be more efficient for researchers if the funds had specific areas for financing.

The second point is the heavy concentration of research activity at Metropolitan Region institutions. Many regions in the country did not get a single health

research project funded during the five years analysed. Certainly, this replicates the regional distribution of institutions and researchers. However, if the purpose is to use scientific research as a tool for regional development, then it seems that greater incentives should be given for the development of scientific communities in the regions. Allotting resources for research activities may not be the best tool for this purpose; rather, it should be a part of a more integral strategy to draw researchers to the country's interior.

Finally, it was observed that the participation of funded areas imperfectly reflects the country's sanitary profile. Some areas – mental illnesses, and violence and accidents – seem to receive fewer resources than they should when we consider their impact on the population's health. This is not to say that there is a bias against this type of research (one explanation is that the scientific community has little interest in researching these issues), but it is remarkable that Chile lacks special funds to promote knowledge-building in these areas.

Notes

- 1 This work is part of a research project funded by the Global Forum for Health Research. The author is grateful to Daniel Maceira, Delia Sánchez, María Gabriela Paraje and Jorge Sances for their contributions. The author would also like to thank Luis Gutiérrez, María Angélica Sánchez, Thierry de Saint-Pierre, Katherine Villarroel, Leonardo Mena and María Soledad Navarrete for their collaboration and appreciates the comments from participants of an Adolfo Ibáñez University workshop and a debate at the Colegio Médico in Chile, where this work was presented. The author is solely responsible for any errors.
- 2 Guillermo Raúl Paraje has an MPhil and PhD in economics from the University of Cambridge. He is a professor and a full-time researcher at the School of Business at the Universidad Adolfo Ibanez, Santiago de Chile.
- 3 These groups belong to the following fields: mathematics; physics and astronomy; biology; chemistry; engineering; medicine; agriculture, farming and forestry; animal health and husbandry; architecture, urbanism, geography and arts; juridical and political sciences; economics and administration; education; anthropology and archaeology; sociology; linguistics, literature and philology; history; philosophy; and psychology. Some fields are included in more than one group.
- 4 These objectives endeavour to improve the population's sanitary indicators (i.e. maternal and infant mortality), cope with the challenges of an ageing society and unhealthy behaviour (such as tobacco consumption, obesity, sedentariness and unsafe sex), and decrease social inequities in health and health access.
- 5 The author is especially grateful for the contribution of Dr María Gabriela Parajes who helped in classifying projects per area.
- 6 Some projects were difficult to classify by title. In other cases, the title may give an erroneous impression of what the project entailed. In this sense, this exercise should be taken as statistical, potentially presenting a certain degree of error. The results shown by this study should be considered in light of these observations.
- 7 Researchers' ages are not available at FONIS since there are no online application forms for their projects.

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Chapter 6

Paraguay: Public funding of health research

Sergio Duarte Masi¹

1 Introduction: the economic and sanitary context

According to the World Health Organization (2009), in 2007 life expectancy at birth in Paraguay was 74 years and the infant mortality rate was 24 deaths per 1000 live births. The leading causes of death in Paraguay in 2003 were diseases of the circulatory system (28.2%), diseases of the perinatal period (14.8%), communicable diseases (12.9%), external causes (10.9%) and tumours (7.4%) (PAHO, 2007b) (Figure 1).

Table 1 Paraguayan indicators

Population (millions), 2007*	6
Urban population (% of total pop.), 2005*	58.5
Human development index (HDI), 2006**	0,752 (98 th)
Population living under the poverty line (% living on < 1.25 US\$ per day), 2000-2006**	9.3
Adult literacy rate (% aged 15 years and over), 2006**	93.6
Access to improved drinking water sources (%), 2006**	77
Gross national income (GNI) US\$ PPP (billions), 2007*	26.8
Gross national income (GNI) US\$ PPP per capita, 2007*	4380
Life expectancy at birth (years), 2007***	74
Infant mortality rate (IMR) (probability of dying between birth and age 1 year per 1 000 live births), 2007***	24

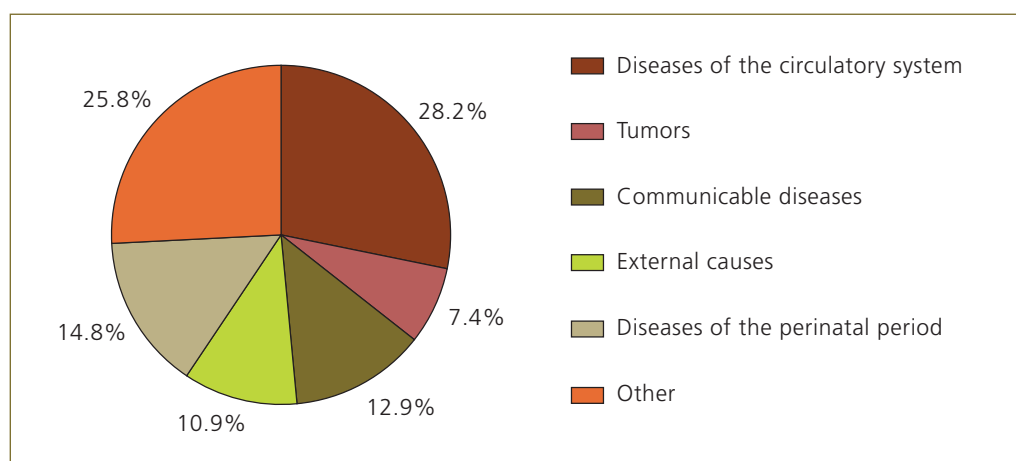
Sources/Notes:

*World Bank, World Development Report 2009

**United Nations, United Nations Development Indices, 2008

***World Health Organization, World Health Statistics, 2009

Figure 1 Distribution of deaths reported under medical care with defined causes, 2003



Source: Pan-American Health Organization (2007b).

2 Paraguay's national science and technology system

“In the history of Paraguay, consolidating the development of science and technology had little bearing on the formulation of public policies. Reasons abound, but the results were always the same: a perceptible lag in the culture and tradition of scientific research, and insufficient integration between science and technology and the production of goods and services” (Oxilia, 2001).

In the mid twentieth century, General Stroessner rose to power in Paraguay and governed for 35 years, until 1989. Throughout this long period, not one single policy of the Stroessner administration addressed the development of the national science and technology sector as a high priority and, consequently, the sector dropped behind even more. Thus, despite collaboration from international organizations² to create institutions for administration, planning and research and development (R&D), Paraguay was unable to create an effective structure of financial support for research or a coordinating unit during this period. Nor was it possible to create public policy for the country's science and technology sector, although there was some movement towards this goal.

Although interest in science and technology has grown in Paraguay, it remains clearly focused on researching and developing technology for agriculture and agro-industrial production. The main characteristic of this stage was the definition, albeit not very systematically, of a public policy of science and technology focused on economic growth. This period witnessed the creation of three key

institutions: the Secretariat for Technical Planning in 1962, the National Institute of Technology and Standardization (INTN) in 1963 and the National Department of Technology in 1976.

As for the science and technology sector, between the 1960s and 1970s, three aspects that were considered high priority were promoted:

- improving the infrastructure of science and technology education;
- planning and coordinating the sector;
- researching and developing areas connected to key economic sectors (agriculture and stockbreeding).

In February 1989, Paraguay underwent great political change, with the ousting of General Stroessner. For this reason, measures taken by the transition government of 1989–1993 essentially aimed at consolidating the country's newly implanted democratic process and the institutional strengthening of public administration. Little concrete action focused on the science and technology sector.

It is important to note that all of Paraguay's science and technology legalization was enacted while great changes were taking place on the international scene. In the 1990s Science and technology began to play a key role in the countries' social and economic development. In effect, the most outstanding worldwide change in science and technology in recent decades was an explicit recognition of the sector's commitment to seeking solutions for social issues and economic and cultural development.

Since 1997, with clearly defined functions – framing and proposing policies and strategies for scientific and technological development, coordinating science and technology activities, and training the country’s human resources, among others – the National Council of Science and Technology (CONACYT) has given the sector a renewed boost. This has been achieved by carrying out a diagnosis of the Paraguayan science and technology sector, organizing symposiums and congresses, training staff, participating in regional and international activities, proposing scientific policy, and sponsoring projects that promote interaction among the system’s actors.

The creation of CONACYT coincided with an exceptional downturn in Paraguay’s economy. This seriously affected the country amid a political and financial crisis caused by the dynamics of trade with neighbouring countries and international finance, and short-term cutbacks geared towards halting inflation and improving the trade balance. As a result, policies tending to control spending were put forward, however this did not hinder accomplishment of the more modest objectives, whether short- or long-term, of providing the science and technology sector with financial aid.

3 The national innovation system in health in Paraguay

The Regional Consultation of Latin America and the Caribbean, which took place before the 1999 World Conference on Science, acknowledged in its Santo Domingo Declaration that knowledge alone does not bring about change in economies or society, but can do so only within a framework of social and national systems for science, technology and innovation. At the meeting it was stated that “Social/national systems of science, technology and innovation form networks of institutions, resources, interactions and relationships, mechanisms and tools for policy, in addition to scientific and technological activities that promote, articulate and materialize the innovation processes and technological diffusion within society by generating, importing, adapting and diffusing technology.”

Continuing along this conceptual line of what may be labelled a “national

innovation system”, in Paraguay there are several environments that comprise such a system:

- the government/legislative environment, with the presence of CONACYT, which responds to the president of the republic and helps to manage and coordinate the system;
- the academic environment, made up of a total of 36 educational centres, both public and private universities;
- the productive environment, made up of both public and private businesses dealing in goods and services, most belonging to trade associations or guilds;
- interface structures, such as management centres and consultancies, and university outreach;
- the technological environment, made up of public and private structures established for technical development;
- the financial environment, national and international.

These environments in Paraguay are not sufficiently developed, sound or interconnected enough to allow them to operate as a system. Thus, the national experience has confirmed the need to review and update concepts and priorities in the use of its scientific and technological potential and how these environments interrelate, with the intent of shaping a policy to develop Paraguay's national innovation system.

An exploratory study of CONACYT, carried out with cooperation from Colombia through the participation of experts from the Francisco José de Caldas Institute for the Development of Science and Technology of Colombia (Colciencias) and Colombia's National Learning Service (SENA), produced the following hypotheses:³

- The principal agents in the national innovation system have been established, but their interrelations have not.

- There is a lack of overall coordination among agents.
- The financial subsystem and facilitator, the government, is deficient in promoting and financing innovation projects for small and medium-sized businesses.
- Technological development centres, research centres, productive chains and clusters need to gain experience and knowledge in developing innovative projects, along with the companies, service providers and laboratories.
- Universities should implement clear and effective policies to encourage educators to take part in business-related innovation projects. The government should support this kind of initiative through co-funding and oversight, by making successful cases known and promoting positive results.

4 Paraguay's framework for science and technology

CONACYT is an autonomous public organization of mixed composition that operates under the president of the republic. It manages and coordinates the National System for Science, Technology, Innovation and Quality, and supports the country's scientific and technological development. The CONACYT council is guided by specific policies and programmes promoted by the public sector and duly coordinated with the private sector.

The CONACYT council is made up of representatives from the following institutions:

- Paraguayan Association for Quality
- Association of Small and Medium Businesses

- Rural Association of Paraguay
- Federation of Production, Industry and Commerce
- Labour union centres
- Ministry of Agriculture and Stockbreeding
- Ministry of Education and Culture
- Ministry of Industry and Commerce, through INTN
- Ministry of Public Health and Social Welfare (MSPyBS)
- Private universities
- Public universities
- Scientific Society of Paraguay
- Technical Department of Economic and Social Planning of the Republic's Presidency
- Paraguayan Industrial Union.

The National Accreditation Department (ONA) is a CONACYT institution in charge of ensuring transparency and impartiality when applying conformity to evaluation systems. ONA is in charge of accrediting certification and inspection associations, testing and calibration laboratories, auditor certification boards and training centres.

The National Science and Technology Fund (FONACYT) is a CONACYT department in charge of funding scientific research and technological development programmes and projects for the adaptation and diffusion of new technologies. The fund is still being strengthened.

4.1 The university domain

The university domain was static until the mid 1990s, when there was a true boom in the creation of universities. During this period most universities offered programmes in the social sciences, especially business-related subjects.

In 2008, the number of universities in Paraguay surpassed 37 institutions. The general opinion is that Paraguay's higher education system is undergoing a deep crisis, a debate taking place mostly beyond the university's domain, promoted by intellectuals, professionals, university unions and student associations.

Results of CONACYT research activities between 2001 and 2006 suggest that Paraguayan universities transfer rather than generate knowledge, with the exception of a few education centres such as the National University

of Asunción (UNA) and Our Lady of Asunción Catholic University. These institutions are considered to have generated the most knowledge in the country and have achieved remarkable interaction with the business sector.

4.2 The government sector

In Paraguay, according to surveys conducted by CONACYT since 2001, the government is responsible for 74.2% of expenditure in R&D, although Paraguay's expenditure is one of the lowest in the region (0.08% of gross domestic product (GDP), according to a 2006 survey).

The following government institutions make up Paraguay's innovation system:

- **Ministry of Agriculture and Stockbreeding:** Operates in R&D and instructs human resources, mainly through its centres – National Agronomy Institute, Agricultural Research Board and Animal Protection Board.
- **Ministry of Education and Culture:** Operates in R&D and instructs human resources in the areas of superior education and the arts.
- **Ministry of Industry and Commerce:** Operates in R&D and instructs human resources in the area of political sciences and public administration through INTN.
- **MSPyBS:** Operates in R&D and instructs human resources in the areas of technology and medical sciences through the following institutions: Central Public Health Laboratory, National Health Institute, National Food and Nutrition Institute and the Institute of Tropical Medicine.

- **Ministry of Public Works and Communication:** Operates in applied research.
- **Technical Planning Department:** Coordinates scientific and technological activities and international technical cooperation.

4.3 Nongovernmental organizations

Private non-profit-making organizations play an important role in the research activity of Paraguay. They account

for 7% of human resources devoted to research and execute approximately 4.5% of R&D expenditure in terms of the national GDP.

4.4 Technological sector and interface structures

The technological sector and interface structures are perhaps the least developed sectors in Paraguay. They focus mainly on services and quality control, mostly divided among the agricultural and livestock sector.

5 Health sector funding in Paraguay

From 1997 to 2004, the health sector in Paraguay represented an average 7.2% of GDP. This percentage fluctuated throughout the period, from 6.3% in 1997, reaching a maximum of 8.4% in 2001, and dropping to 6.5% in 2004. Paraguay's health expenditure increased from 1.3 billion to 2.7 billion guarani at current prices in the same period.

According to indicators collected by CONACYT since 2001, health is the sector whose research activities generated the most international publications, represented by 23% of the total population of researchers (168 people in 2006), 46 of whom belong to the public sector.

CONACYT is the main organization dedicated to the promotion of science and technology in Paraguay. It was created under the same law as FONACYT. However, CONACYT began its operations later in 2008, launching PR 126, BID-CONACYT, a support programme for science, technology and

innovation, in which health is one of the highest priority areas.

UNA is the oldest, most important state organization of higher education in Paraguay. It has the largest student population (30 000–40 000 students) and academic staff (about 5000 teachers) and is the most internationally renowned. UNA is allotted the most government funds of any of Paraguay's four public universities. Additionally, it has produced the largest number of scientific publications domestically. In terms of research, UNA has its own fund to sponsor awardable research projects for its 12 schools and its research centres: the Training and Service Centre, the National Centre of Computer Science, the National Energy Board and the Institute for Research in Health Sciences.

The Institute for Health Science Research (IICS) was established in 1980 in order to create, implement and promote scientific research in the area of health sciences, by contributing knowledge and solutions

for the country's most outstanding issues, training human resources and developing specialized services for the improvement of the community's health.

At present, IICS employs approximately 111 researchers, 23% of whom are dedicated to areas related to biotechnology such as biochemical research methods, biochemistry and molecular biochemistry, microbiological applications, cellular biology, genetics and biomedicine. In addition, researchers are dedicated to other knowledge areas with the following distribution: engineering science 3.5%, human science 3.5% and health sciences 70%. Thus, 35% of its research activity is focused on basic research, 60% on applied research and 5% on technological development.

In the bibliometric study undertaken by CONACYT in 2005, IICS appears as one of the Paraguayan entities that generated the most publications internationally, particularly in the area of health care.

6 Research in the Paraguayan health sector

In order to analyse health projects, we considered 24 categories, which in turn may be grouped into three objectives: (i) the social, economic and cultural context; (ii) facing problems (communicable diseases, noncommunicable diseases and addictions; nutrition and the environment; violence and accidents); and (iii) actions – research on health policy, systems and services; research and technological development; and traditional medicine.

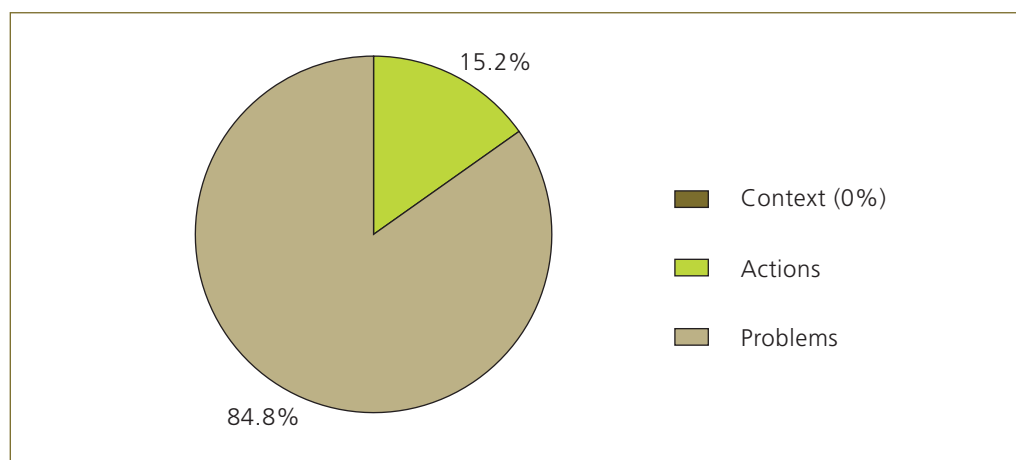
The study of the 178 projects developed between 2002 and 2006 that were

In 1996 the health ministry's Central Public Health Laboratory was founded with the mission of providing laboratory assistance, being the nation's laboratory of record and the head of the National Laboratory System; regulating, evaluating and supervising clinical laboratories in the country's public and private sector; performing applied research in response to high-priority and health policy issues focusing on the most frequent pathologies in Paraguay; carrying out activities of permanent education and helping train health workers; and supporting the epidemiological surveillance in ministry public health and social welfare programmes.

The Central Public Health Laboratory currently employs 55 researchers, who carry out activities in biochemical research methods, biochemistry and molecular biochemistry, microbiological applications, general health and diagnosis, laboratory oversight, epidemiological research and production of reagents.

awarded funds revealed that public research focused mostly on facing problems (84.8%), mainly in areas of communicable diseases: dengue fever, visceral leishmaniasis, Chagas disease, hantavirus and zoonoses. Paraguay has a national plan to prevent Chagas disease by interrupting its vectorial transmission, which in Paraguay is due exclusively to *Triatoma infestans*. Much research focuses on this issue. Projects related to actions represent 15.2%, while we were unable to record any projects that focused on context. This distribution is seen in Figure 2.

Figure 2 Objectives of health R&D projects, 2002–2006



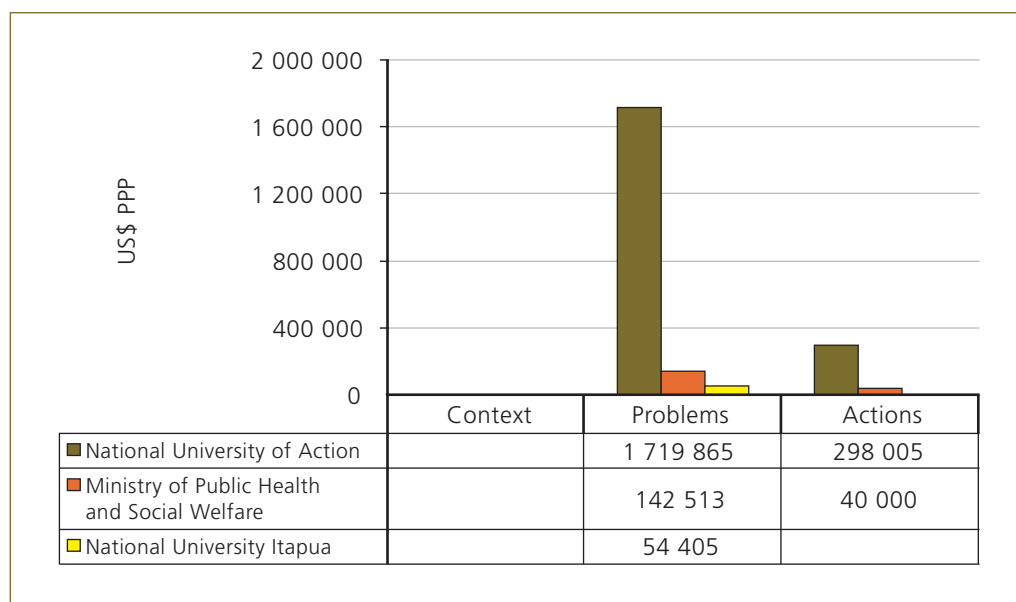
As would be expected, awarded funding coincides with research objectives: out of a total health investment of US\$ 2 289 564 adjusted for purchasing power parity (PPP) for the period 2002–2006, 89.95% was awarded to problems and 10.05% to actions. If we were to group this cumulative amount by sectors, 54.68% was performed by IICS at UNA and 35.27% by MSPyBS (not counting related activities in hospitals and health-care centres). The remaining 10.05% corresponds to the National University of Itapúa, which had no health projects until 2006.

Table 2 shows ungrouped objectives in three macro-categories. From 2002 to 2006, within “Problems”, emphasis was put on communicable diseases, with a total of 80 studies distributed evenly among the following categories: biomedical (23 studies), clinical medicine (30 studies) and public health (27 studies). The second priority of the “Problems” category was noncommunicable diseases and addictions, with a total of 66 studies, classifiable into 12 studies in biomedical, 30 in clinical medicine

and 24 in public health. For the same period, in the “Actions” category, the area that stands out is technical research and development, with 23 studies, 19 of which centred on biomedicine and 4 on clinical medicine. In the same way, it is important to point out that in “Actions” Paraguay did not have any projects on basic science.

This objective can also be analysed in each of the two sectors we examined: UNA, through the IICS, on the one hand and the laboratories belonging to MSPyBS on the other hand. A priori, the “Problems” category does not show an evident focus or dedication across both sectors, but the number of IICS projects (119 dedicated to “Problems”) significantly exceeds the 27 of MSPyBS. In both cases there is interest in addressing communicable diseases and noncommunicable diseases and addictions. Also, we observed a balanced distribution among biomedicine, clinical medicine and public health in both sectors. However, when comparing studies of the “Actions” category, especially biomedical research and

Figure 3 Investments in health R&D by objective (US\$ PPP), 2002–2006



technological development, IICS stands out, with 23 studies in 2002–2006; thus, we may consider it an entity with this specialization. Figure 4 shows the evolution of the total number of health projects. Almost every sector that Paraguay has addressed grew, with the exception of nutrition and the

environment, which remained almost static. In 2006, there was sudden interest in researching issues related to health policy, systems and services. Of note is that MSPyBS projects indicate a marked interest in the area of communicable diseases in contrast with noncommunicable diseases.

Table 2 Distribution of health R&D projects by objective and methodology, 2002–2006

		Research methodology			TOTAL	
		Biomedical	Clinical	Public health		
Objectives	Context	Social, economic and cultural				
	Problems	Communicable diseases	23	30	27	80
		Noncommunicable diseases	12	30	24	66
		Nutrition and environment			5	5
		Violence and accidents				
	Actions	Health policies, systems and services research			4	4
		Technological R&D	19	4		23
		Basic science				
		Traditional medicine				
	TOTAL		54	64	60	178

Source: Own development

Figure 4 Number of health R&D projects by objective, 2002–2006

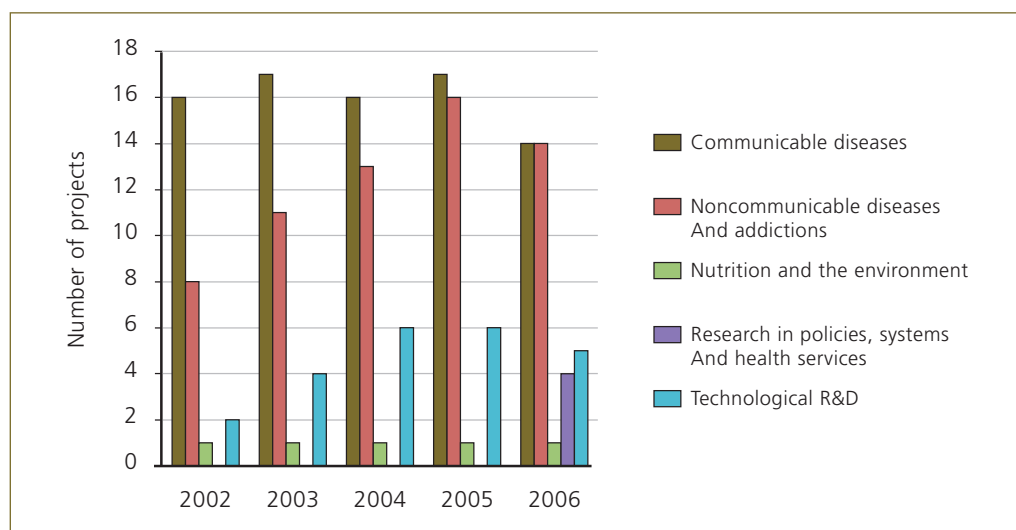


Figure 5 shows the evolution of projects in the three areas related to the study: biomedicine, clinical medicine and public health. The sector that experienced the greatest increase was public health, with almost 89%, reaching 17 projects in 2006 – up from 9 projects in 2002. Growth in other areas was less perceptible. Again, IICS explains this evolution, as this is not the case with MSPyBS.

After analysing the awarding of funds, it was observed that 54.7% correspond to IICS/UNA funds and 35.27% to MSPyBS funds. In both sectors, the bulk of the funds are allocated to communicable diseases (61.7%), followed by noncommunicable diseases and addictions (26.3%), and to a lesser extent technological development (8.3%), specifically at IICS/UNA. To reiterate, Paraguay had no projects in the field of basic sciences.

Figure 5 Number of health R&D projects by methodology, 2002–2006

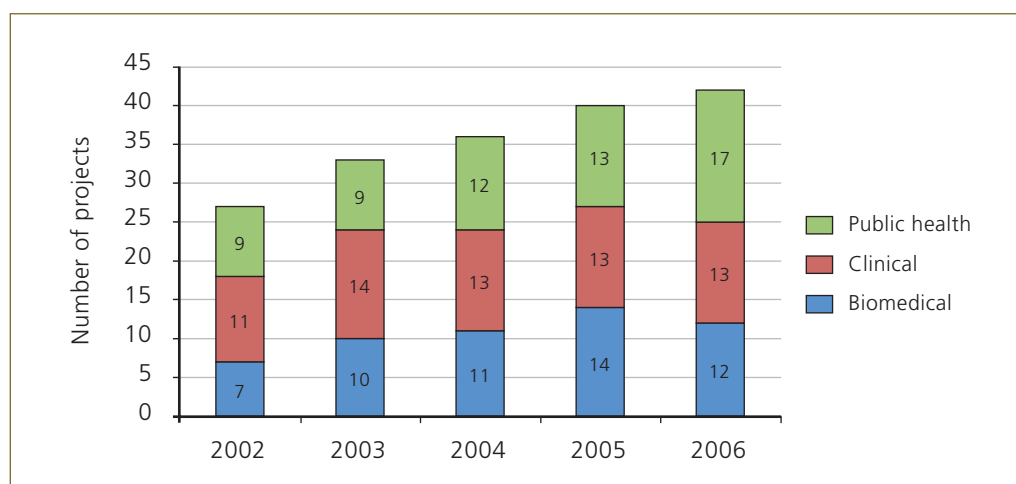


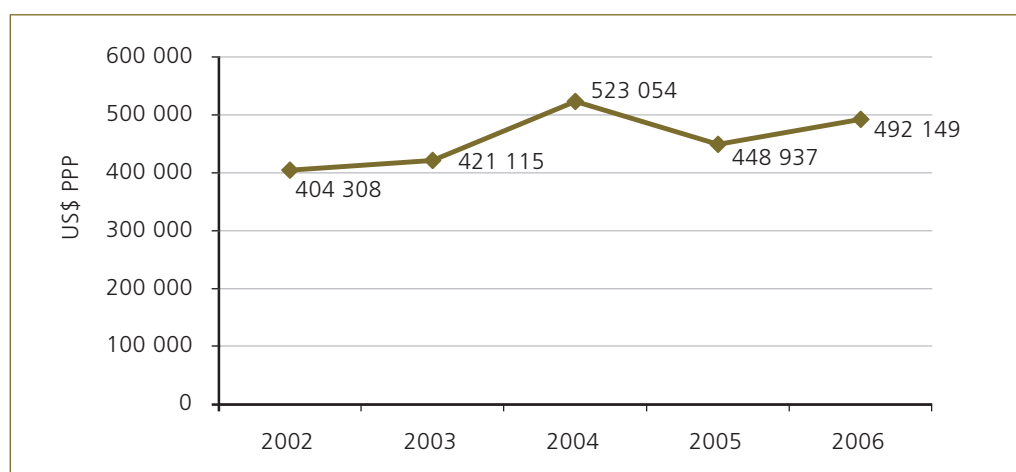
Table 3 Proportion of investments in health R&D, 2002–2006

		Research methodology			TOTAL		
		Biomedical	Clinical	Public health			
Objectives	Context	Social, economic and cultural		-	-		
	Problems	Communicable diseases		20.6%	15.8%	25.3%	61.7%
		Noncommunicable diseases		6.0%	11.3%	9.1%	26.3%
		Nutrition and environment				1.9%	1.9%
		Violence and accidents					
	Actions	Health policies, systems and services research				1.7%	1.7%
		Technological R&D		6.9%	1.4%		8.3%
		Basic science					
		Traditional medicine					
TOTAL		33.5%	28.5%	37.9%	100.0%		

Source: Own development

Figure 6 shows the evolution of health project funding from 2002 to 2006. The trend towards growth is noticeable. The rise in IICS’s funding of health research, vis-à-vis the stagnant position of MSPyBS, is remarkable.

Figure 6 Evolution of health R&D investments (US\$ PPP), 2002–2006



7 Conclusion

The purpose of this report is to contribute towards a direction of study that could potentially be used as a tool in public policy decision-making, particularly in revising the national agenda for health research. Although private-sector research (which in the case of Paraguay is significant) was not considered, this study is a good approximation towards assessing what is being done in terms of health R&D, especially in the public sector.

For this reason, throughout this report we analysed two large, significant segments: on the one hand the academic sector, represented by UNA and its Health Sciences Research Centre, and on the other hand MSPyBS, with its research laboratories.

The main conclusions arising from this study may be that there is an upward trend in the allocation of funds for publicly run health research, and there is a strong focus on Asunción and the Central Department region, in addition to the recently originated hub at Itapúa National University.

This study did not identify a specific specialization among institutions, but rather found a marked difference between the number of projects developed by UNA and by MSPyBS. The university accounts for almost all health research activity in Paraguay.

The research activities in Paraguay that have had more international visibility in later years are those that cover the areas of health. A bibliometric study developed by CONACYT in 2006 revealed this situation (Duarte Masi, 2006). A study of projects between 2002 and 2006 in the areas of health revealed that public research focused mainly on areas of communicable diseases such as dengue, visceral leishmaniasis, Chagas disease, hantavirus and zoonoses.

There is likely to be a quantitative and qualitative shift with the work of CONACYT through its Research and Innovation Support Programme, which began in 2007 and is not covered in this study. Among other things, this programme will support and finance research and innovation in health. Consequently, in subsequent studies, Paraguay is expected to present a more favourable situation compared with other Latin American countries.

Notes

- 1 Sergio Duarte Masi has a PhD in science education from the Evangelical University in Paraguay. He is a teacher at the School of Chemical Sciences of the National University of Asunción, the Catholic University, the Autonomous University of Asunción, the American University and UCSA-EDAN in Paraguay.
- 2 From the mid 1950s to the late 1970s, the United States of America supported the development of Latin American countries, including Paraguay, as part of its policy of using Latin America as a buffer against communism. Within this context in 1961, President John F Kennedy promoted the Alliance for Progress plan. Almost simultaneously, Paraguay strengthened its relations with other Latin American countries and in 1962 joined the Latin American Free Trade Association created by the 1960 Treaty of Montevideo (Caballero Aquino, 1988).
- 3 In 2003 the participants of the mentioned study were Dr Julio Mario Rodríguez Devis, Director of Innovation Area, as a representative of Colciencias and Dr Claudia Marcela Farfán Perdomo, Consultant of the Programme of Incubators of Technological Basis, on behalf of SENA.

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Chapter 7

Uruguay: Public funding of health research

Delia Sánchez¹

1 Introduction: economic and health background

Uruguay is a small country located in the southern cone of South America. Its gross domestic product (GDP) per capita was US\$ 9962 adjusted for purchasing power parity (US\$ PPP) in 2007. The country's economy suffered a severe fall in 2002, from which it is recovering.

A United Nations Development Programme (UNDP, 2005a) report divides Uruguay's recent economic history into three stages. The report states that from 1985 to 1994 the country's economy grew and poverty rates fell from 46.2% to 15.3%. Between 1995 and 1998 there was stagnation and social indicators worsened. Between 1999 and 2004 the country suffered the impact of the second most important economic crisis in its modern history, with poverty levels doubling from 15.3% to 32.1%, while absolute poverty rose from 1.2% to 4% of the total population.

During the 1990s, Uruguay's human development index (HDI) ranked from 37 to 40 among the 174 countries for which it is measured; it went down to 46 in 2002 (UNDP, 2005b), a position that remained unchanged in the 2006–2007 report (UNDP, 2006/2007).

1.1 Demographic situation

The data in Figure 1, analysed together with the main causes of death (see below), stress the fact that Uruguay has completed its demo-epidemiological transition (Omran, 1971). This phenomenon occurred in Uruguay several decades earlier than in the rest of Latin America (Calvo, 2008). Nevertheless, the increase in the number of people living in poverty, particularly in the younger age groups, raises the possibility of an increase of conditions traditionally related to poverty, such as infectious and parasitic diseases.

1.2 Health situation

Considering its sensitivity to both socioeconomic conditions and the actions of health systems, information on infant mortality is presented first. The main causes of infant mortality are those related to prematurity and congenital diseases, which is the reason for neonatal mortality being continually higher than post-neonatal mortality.

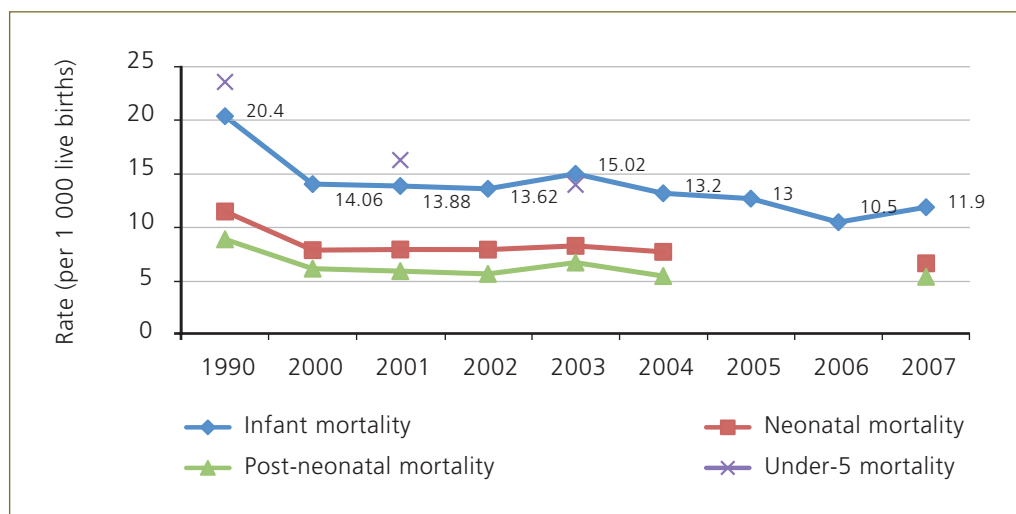
Differences in health status within the country are large but not well documented, except those on differences in infant mortality indicators.

Table 1 Uruguayan indicators, 2007

Country Indicators	Value
Population	3 241 003
Life Expectancy at Birth (years)	75.8
Crude Birth Rate	14.30
Crude Death Rate	10.3
Illiteracy Rate	3.21
Global Fertility Rate	2.02
Annual Population Growth Rate	3.05

Source: <http://www.ine.gub.uy/>, accessed 12 August 2009.

Figure 1 Infant, neonatal, post-neonatal and under-5 mortality, 1990 and 2000–2007



Sources: 1990, 2000–2003: Uruguay National Institute of Statistics; 2004–2007: MSP Unidad de Estadística.

The main causes of death in 2007 were ischaemic heart disease, cancer, traffic accidents and suicide. This profile shows the importance of lifestyle-related factors and population ageing. Although the main risk factors for several of these diseases are known and preventable, no significant progress has been achieved in their control.

Uruguay has good coverage for prevention programmes (with a high percentage of coverage for vaccines), surveillance and control programmes for communicable diseases, success in the control of regional pathologies (Chagas and hydatid diseases), and actions in the field of emergent diseases (e.g.

hantavirus, leptospirosis) and potentially introducible diseases (dengue, *Aedes aegypti*, encephalitis) or reintroducible diseases (rabies).

The total age-adjusted mortality rate for communicable diseases in 2003–2005 was 40.3 per 100 000 inhabitants, significantly lower than that for Latin America as a whole (74.4 per 100 000) (PAHO, 2008).

Although communicable diseases are not among the main causes of death, they may have a negative incidence in morbidity and contribute to a decrease in the quality of living, particularly for populations known to be at risk.

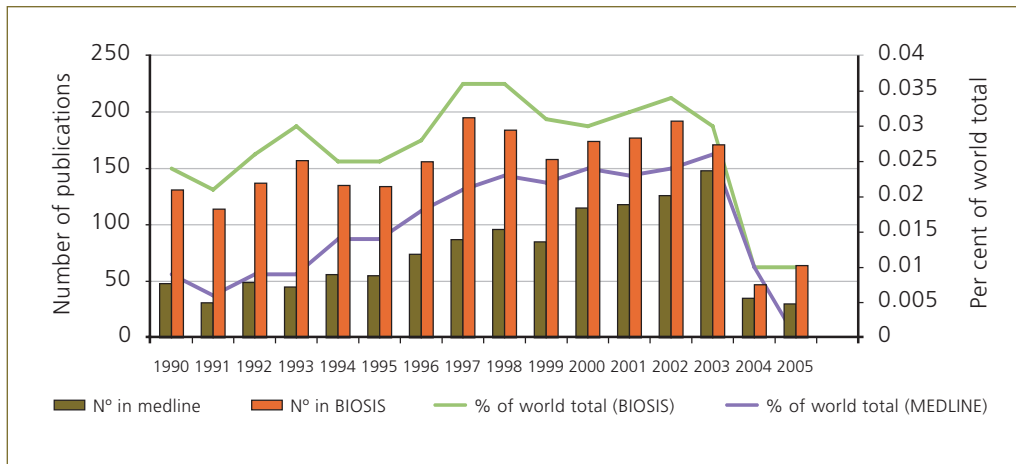
2 Health research in Uruguay

2.1 Health research production

As shown in Figure 2, the number of Uruguayan publications in BIOSIS and

MEDLINE from 1990 to 2005 was very low, never higher than 0.03% of the world total, according to data obtained from the Iberoamerican Network of Science and

Figure 2 Number of publications in international databases, 1990–2005



Source: <http://www.riicyt.edu.ar>, accessed 12 August 2009.

Technology Indicators. Nevertheless, there is a difference in their behaviour: while the number of publications indexed in BIOSIS stayed relatively constant from 1990 to 2003, publications indexed in MEDLINE, which numbered only 48 in 1990 (0.009% of the world total), increased continuously, reaching 0.026% of the world total in 2003. In 2004 and 2005, Uruguayan publications in both bases showed a sharp decrease, perhaps as a consequence of the economic crisis of 2002.

Besides publication biases, which have already been discussed by many authors, we may assume that, given the different profile of these databases, one oriented more towards basic science and the other towards clinical research and health in general, we might be facing two scientific communities with different degrees of consolidation and international presence. Nevertheless, the available data are not enough to explain the factors that intervened in the first 13 years of the period to triple the number of papers

in MEDLINE; nor can they explain whether this is a consequence of a real increase in health research, a change in publishing strategies of national researchers, or the inclusion of new journals in the aforementioned bases.

2.2 Health research institutions

2.2.1 University of the Republic

The School of Medicine at the University of the Republic is the main producer of health research in the country. There is a research promotion policy with funding provided or administered by the Manuel Pérez Foundation. Nevertheless, the school has not developed a research priority agenda and projects respond to the intellectual curiosity and demands of researchers.

In a survey carried out in 2002 by the Scientific Research Sectoral Commission (CSIC), the University of the Republic's research promotion agency, the School of Medicine identified 26 active research

groups, none of them from the Department of Preventive and Social Medicine, which is in charge of epidemiology, health systems research and technology assessment. Except for psychiatry and oncology, most groups involved in clinical research were also excluded. Since the methodology involved self-definition as a researcher, these omissions show a problem in researchers' self-perception, maybe related to a different value attached to basic versus clinical and health policy and systems research.

Of these 26 self-identified groups, 9 work in neurosciences and physiology, 5 in pharmacology and 2 in oncology. Their main sources of funding were CSIC and the National Scientific and Technical Research Council (CONICYT). Only seven groups reported receiving foreign funding.

Other schools in the University of the Republic also perform research in or for health, among them the School of Science, with 11 groups of active researchers in biomedicine, and the Schools of Chemistry, Psychology, Social Sciences, Humanities and Educational Science, and Odontology.

2.2.2 Clemente Estable Institute for Biological Research (IIBCE)

This institute, which is a dependence of the Ministry of Education and Culture,

has 19 research units grouped in four large areas: neurosciences, agrarian biotechnology, environmental sciences and biomedical sciences. Over half of the institute's human resources are concentrated in the area of biomedicine. IIBCE has 19 full-time and 117 part-time researchers, besides honorary collaborators.

The institute's research lines are defined by the researchers and funding is obtained from national competitive funds – the Programme for Technological Development (PDT), the Clemente Estable Fund (FCE), CSIC and the National Institute for Agricultural Research – and international sources – the National Institutes of Health, the Wellcome Trust, the Academy of Sciences for the Developing World and the International Atomic Energy Agency.

2.2.3 Private research centres

Private research centres play a key role in the field of public health research, particularly health policy and systems research. They include the Uruguayan Centre of Information and Studies, the Centre for Economic Research, the Latin American Centre of Human Economics and the Group of Studies in Economics, Organization and Social Policies.

3 Health research promotion and funding structure

The national health research promotion and funding structure includes the National Research and Innovation Agency (ANII), the Directorate of Innovation,

Science and Technology for Development (DICYT) of the Ministry of Education and Culture, CONICYT and CSIC of the University of the Republic.

The Innovation Ministerial Cabinet, which is the upper echelon, includes the ministries of education and culture, economics and finances, industry, energy and mining, and livestock, agriculture and fishing and the director of the Planning and Budget Offices. Its main objective is to coordinate and articulate governmental actions related to innovation, science and technology activities for development.

ANII functions as a public non-state body, designed as a relatively small and agile organization. Its main objectives include drawing, organizing and administering plans, programmes and instruments geared to scientific and technological development and the deployment and strengthening of innovation capabilities. Another objective is to foster the relationship and coordination between knowledge producers and users.

DICYT belongs to the Ministry of Education and Culture and was created in 2001 with the goal of creating and fostering the ministry's policies, guidelines, strategies and priorities in the field of innovation, science and technology. It was also created with the aim of coordinating the ministry's actions with those of other branches of the executive, as well as with other public and private entities related directly or indirectly to those policies, functioning as the system's support in matters of technical elaboration, assessment and follow-up and the

generation of information relevant for decision-making. Managing the National Researchers Fund and the FCE is also among its objectives.

The main functions of CONICYT are to:

- submit plans, general policy guidelines and priorities related to science, technology and innovation to the Innovation Ministerial Cabinet, the Executive and Legislative. In particular, its previous opinion is requested on the National Strategic Plan on Science, Technology and Innovation (PENCTI), elaborated by the Innovation Cabinet, as well as on the plans and programmes to be implemented by ANII;
- to draw up proposals of bases and guidelines, areas of interest and policy instruments on science, technology and innovation;
- to propose the creation and standardization of science, technology and innovation programmes;
- to promote and foster the development of research in all areas of knowledge;
- to promote actions conducive to strengthening the national science, technology and innovation system;
- to follow up on the functioning of different programmes of ANII, particularly PENCTI.

CSIC is an organization within the University of the Republic with the objective of comprehensively promoting research at the university through the implementation of a variety of programmes.

4 Research funding instruments

The objective of the National Researchers Fund² is “to foster scientific, technological and cultural research in all areas of knowledge” and it is earmarked for highly dedicated active researchers living in the country. It is administered by an honorary commission headed by the minister of education and culture and formed by the rector of the University of the Republic and the president of CONICYT. Since 2005 it is included in the same budget line as the FCE.

The FCE³ is a research support programme created in 1996 and funded from the national budget. It funds research projects in all areas of knowledge through open calls to researchers from public or private non-profit-making institutions.

The PDT⁴ is administered by DICYT. It is a five-year-long programme funded by a loan of US\$ 20 million from the Inter-American Development Bank and a local contribution of US\$ 6.67 million. It consists of three subprogrammes:

- **Subprogramme I – Support to Innovation and Competitiveness Improvement of Enterprises:** supports individual enterprises through non-refundable cofunding of no more than 50% of the cost of innovation projects (in products or processes), management or quality, that improve competitiveness, profitability and productivity of small and medium size Uruguayan enterprises.
- **Subprogramme II – Science and Technology Development and**

Application: aims to increase the scientific and technological knowledge generating capacity in pre-identified areas of social and economic interest. Beneficiaries are public and private non-profit-making research and development (R&D) centres. It funds research projects and postgraduate studies abroad. Until 2004 it made calls for proposals in the following areas of opportunity: food technologies, non-food-related agro-industries, use and conservation of aquatic resources, use and conservation of natural resources, information technologies, energy, transport and logistics. Only in 2006 did it make a call for proposals in the health area.

- **Subprogramme III – Institutional Strengthening of the National Innovation System:** coordinates science and technology activities with a systematic approach to innovation, to foster regional and international links and to disseminate scientific and technological advances to the community.

4.1 CSIC⁵ competitive funds – projects linked to the productive sector

These calls for proposals have three different modes:

- **Mode 1:** joint projects between the university and the productive sector, where the latter makes contributions in cash.
- **Mode 2:** university initiative projects with the objective of strengthening the capacity to relate with the productive sector. Under this mode

a project in the health thematic area was funded in 2002 (out of 24 funded) with \$U 400 000 (US\$ PPP 35 758), and three more were funded in 2004 (out of 30 funded) with \$U 1 199 326 (US\$ PPP 107 216).

- **Mode 3:** exchange with the productive sector. This funds research fellowships in different areas of the national productive sector and the University of the Republic.

4.2 Research and development programme

The R&D programme's objective is to foster and strengthen research in all

areas of knowledge and disciplines. All of the programme's calls for proposals covered two modalities: research initiation and R&D. In 2000 only research initiation projects were called for, and in 2006 three modalities were allowed:⁶ R&D, Initiation Mode 1 (for young teachers at the University of the Republic) and Initiation Mode 2 (for young people facing their first research experience), with maximum sums of \$U 500 000 (US\$ PPP 36 414), \$U 300 000 (US\$ PPP 21 848) and \$U 130 000 (US\$ PPP 9467), respectively. The call was expected to fund 80 R&D projects, 37 Initiation Mode 1 projects and 41 Initiation Mode 2 projects.

5 Methodology

National research funding agencies were requested to provide information on research projects in the biomedicine, medicine and health categories funded with the instruments listed above and that were called and allocated between 2002 and 2006. Information was provided directly by DICYT for the FCE and PDT projects, and gathered from the institutional web page in the case of CSIC.

No results are included for the National Researchers Fund because its mechanism is not that of calling for projects. The Ministry of Health does not have any specific research fund, and so it is not included. Nevertheless, it carries out research in different areas, with its operational resources.

We identified 121 funded projects using these criteria. Because of the times when calls for proposals were made (as

described above), no projects funded in 2002 or 2003 were identified.

Data gathered include name of researcher, name of project, amount funded (in Uruguayan pesos), year, funder and type of call. Funding was converted into constant US\$ PPP. Based on the name of the project, each project was included in one of 25 categories according to research methodology and research problem, including an extra category for basic research.

There were no exact data on CSIC funding for each project in the year 2004, but the agency has a ceiling by category and, based on historical experience, it was assumed that each funded project received the highest available amount, hence the repetition of figures, be it for research initiation or research and development (the category for consolidated researchers).

No information was provided on researchers' ages, since it is not available for third parties in the funders' databases. In the CSIC calls, one may assume that initiation calls are allocated to young researchers and research and development projects to older researchers, but it is the researcher's academic background rather than their age that is judged.

Data on the different funders and projects were entered in an Excel spreadsheet and analysed using SPSS 16 software. Variables studied were the same as those used by Maceira and Peralta Alcat (2007) in their paper on public health research in Argentina, which are explained in depth in the joint paper on health research funding in Argentina, Chile, Paraguay and Uruguay, of which this paper is a part.

6 Results

Since the different agencies do not make calls for projects every year, during the study period data were obtained only for projects approved in the years 2004, 2005 and 2006. Most projects correspond to years 2004 and 2006 (52 and 62 projects, respectively).

Table 2 shows a summary of the projects identified according to the 25 categories, including the number of projects in each one, and the amount of funding in US\$ PPP by year. The small amount of funding available for research in 2005 seems to accompany the decrease in the number of Uruguayan publications in the same year. The amount available in 2006 was more than twice the amount allocated to health research in 2004.

Projects were found in only 16 of the 27 categories: 35.2% of them in biomedical research on noncommunicable diseases, followed by clinical research on noncommunicable diseases (19.7%) and biomedical research on communicable

diseases (16.4%), as may be seen in Table 3. In the case of research on basic science, only two projects were identified. None of the projects was undertaken outside of the capital region of Montevideo.

CSIC is the main funder of health research projects, at least in terms of the number of projects, which reached 77, while the FCE funded only 10 projects and the PDT funded 34 projects during the period under study. This is coherent with the FCE's emphasis on basic research and with the fact that only in 2006 did the PDT include health as an area of opportunity.

Although CSIC funded projects in 15 of the 25 categories, this agency's funding was also devoted mainly to biomedical research of noncommunicable diseases, clinical research in noncommunicable diseases and biomedical research of communicable diseases. The other two funders showed much greater concentration of categories.

Table 2 Number of projects by category (US\$ PPP), 2004–2006

Category		2004		2005		2006	
		Number of projects	US\$ PPP	Number of projects	US\$ PPP	Number of projects	US\$ PPP
Basic Science*				1	34 648	1	36 268
Social, economic and cultural	Biomedical						
	Clinical						
	Public health	5	77 323			3	58 283
Communicable diseases	Biomedical	8	119 298	3	88 220	9	164 256
	Clinical	1	17 674				
	Public health					1	22 289
Noncommunicable diseases	Biomedical	14	214 295	2	37 519	27	745 617
	Clinical	12	189 994			12	321 498
	Public health	4	37 555			3	94 757
Nutrition and environment	Biomedical					1	36 395
	Clinical					1	28 818
	Public health	1	6 627				
Violence and accidents	Biomedical						
	Clinical						
	Public health	1	17 674				
Health policies, systems and services research	Biomedical						
	Clinical						
	Public health	3	30 928			1	6 876
Technological R&D	Biomedical	1	6 627	1	34 481	3	56 230
	Clinical						
	Public health						
Traditional medicine	Biomedical	1	17 674				
	Clinical	1	6 627				
	Public health						
Total		52	742 296	7	194 868	62	1 571 287

* It was not possible to disaggregate basic science projects by research methodology.

Figure 3 Total number of projects by category (US\$ PPP), 2004–2006

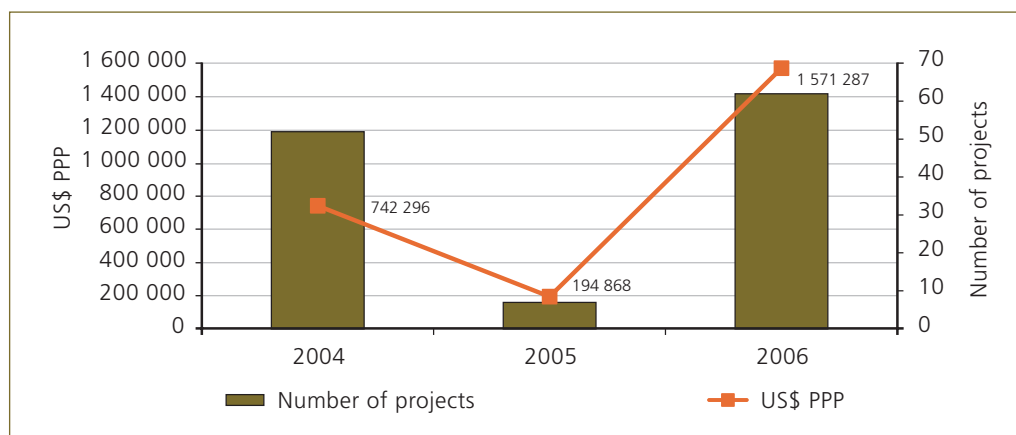


Table 3 Number of projects by category, 2002–2006

		Research methodology						Total	
		Biomedical		Clinical		Public health		N°	%
		N°	%	N°	%	N°	%		
Context	Social, economic and cultural					8	6.6%	8	6.6%
	Communicable diseases	20	16.5%	1	0.8%	1	0.8%	22	18.2%
Objective	Problems Noncommunicable diseases	43	35.5%	24	19.8%	7	5.8%	74	61.2%
	Nutrition and environment	1	0.8%	1	0.8%	1	0.8%	3	2.5%
	Violence and accidents					1	0.8%	1	0.8%
	Health policies, systems and services research					4	3.3%	4	3.3%
Actions	Technological R&D	5	4.1%					5	4.1%
	Traditional medicine	1	0.8%	1	0.8%			2	1.7%
	Basic science*							2	1.7%
Total		70	57.9%	27	22.3%	22	18.2%	121	1

Note: * it was not possible to disaggregate basic science projects by research methodology.

Source: Developed by the author.

Regarding the importance of each funder according to the amounts offered, Table 4 shows that the average for PDT was US\$ PPP 27 368, for FCE the average was US\$ PPP 19 553 and for CSIC it was US\$ PPP 17 953. The average amount of all projects was US\$ PPP 20 731.

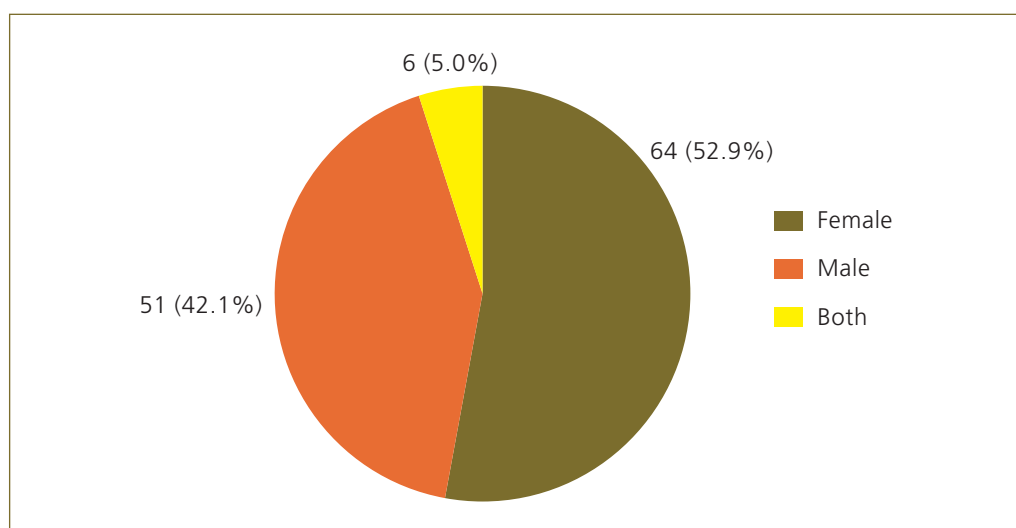
Regarding the sex distribution of researchers, Figure 4 shows a 10% difference in favour of females. When analysed by project category, a greater concentration of male researchers is shown in clinical research, while females form the majority in the remaining categories.

Table 4 Investments in projects by funder (US\$ PPP), 2002–2006^a

Funder	Number of Projects	Average Amount (US\$ PPP)	Standard Deviation	Total (US\$ PPP)	Per Cent of Total
CSIC	77	17 954	10 125.90	1 382 453	55.1
FCE	10	19 553	5 765.22	195 532	7.8
PDT	34	27 368	12 507.38	930 502	37.1
Total	121	20 731	11 312.06	2 508 487	100.0

^a Basic science projects, both funded by PDT, were not distributed by research methodology.

Figure 4 Distribution of researchers by sex, 2004–2006



Overall, in 2006 with 62 health research projects, the amount of money allocated was significantly more than that of previous years. There are, however, no relevant differences regarding the main categories or the predominance of women among researchers, except in the case of clinical research on noncommunicable diseases

(where women comprise only 18% of researchers) and biomedical research on communicable and noncommunicable diseases (44% and 48%, respectively, of researchers). Biomedical research covered 64% of all projects approved in 2006 and a similar percentage (65%) of the available money.

8 Conclusions

The small number of observations (121 for a five-year observation period) may underestimate health research participation, since the sample responds to the decisions made by funding

agencies from whom information was requested on human health research projects.⁷ Projects identified as basic research, and therefore not included in this paper, may have a health application

in the medium or long term. Another reason for underestimation is that there is research funded not by competitive funds but from regular activities of the Ministry of Health Services, particularly the Epidemiology Division and the Public Health Laboratory, which have not been included.

Even with the previous considerations, this paper shows that health research is scarce, as is national funding devoted to it, particularly when the importance of the health sector in the national GDP is considered.

Average amounts available per project are small in comparison with the international context and the funds that the same teams get from international sources, which have not been considered in this work. Other research has shown that the number of research teams that usually have access to international research funds is limited (Sánchez, 2006) and concentrated in some biomedical disciplines. Therefore, these teams may have continuity in the development of research lines and the training of new generations of researchers, which makes them more competitive at the national level.

The predominance of biomedical research with an emphasis on chronic noncommunicable diseases corresponds both to the reality of the academic sector and to the country's demo-epidemiological situation. This project has covered a limited timespan, and so it is not possible to derive consequences on the evolution of health research funding during the twentieth century, as the demo-epidemiological transition took place.

The scarce funding of public health research (18% of all projects) during the period is surprising in the context of the preparations for the health sector reform that became effective in 2007. This situation is multicausal, since it shows a deficit in both supply and demand. Furthermore, unlike with biomedical researchers, full-time commitment to academic activities is the exception in this field.

In this context, the University of the Republic has played a key role in keeping health research alive, while funding agencies depending on the national state have had a limited presence, except the call for projects made by PDT in 2006. This seems to correspond to a perception of health research as “nonstrategic”, which in turn correlates with the absence of the Ministry of Health from the newly created Innovation Ministerial Cabinet.

The lack of research investment by the national pharmaceutical industry probably contributes to this situation, since no academy–industry partnerships are fostered in this area and pressure is not made for the allocation of larger funds to it.

The increase in funding allocated to health research in 2006 is auspicious in that it shows the beginning of a trend and not an isolated phenomenon.

The presence of women among researchers is noteworthy but not surprising, since they represent over half of all university students in the country. Furthermore, income levels of Uruguayan researchers are low in comparison with other options available

to people with a similar education level, although the activity has much social prestige. This dual condition of greater

educational level and lower income than men correlates with existing information on the situation of women in Uruguay.⁸

Notes

- 1 Delia Sánchez graduated from the Program of International Health of the Pan American Health Organization, Washington, USA. She is a researcher in the Group of Organizational Studies and Social Policy, and a professor at the Department of Preventive Medicine, Faculty of Medicine, University of the Republic.
- 2 See http://www.dicyt.gub.uy/index.php?option=com_content&task=view&id=69&Itemid=100, accessed 12 August 2009.
- 3 See http://www.dicyt.gub.uy/index.php?option=com_content&task=blogcategory&id=0&Itemid=81&PHPSESSID=2a1735191eb84e67753ba1c8ff214462, accessed 12 August 2009.
- 4 See <http://www.dicyt.gub.uy/pdt/pdt.html>, accessed 12 August 2009.
- 5 See <http://www.csic.edu.uy/CSIC%20en%20cifras/PORTADA.htm>, accessed 12 August 2009.
- 6 See <http://www.csic.edu.uy>, accessed 12 August 2009.
- 7 When this study was finishing, SECYT identified three projects funded by PDT that were not included in the analysis, but these do not modify the relationship among categories or the conclusions.
- 8 See http://www.midesgub.uy/inamu/informe_cedaw.pdf.

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Chapter 8

Brazil: Financing resource flows in health R&D

Cid Manso de Mello Vianna, Rosângela Caetano, Rondineli Mendes da Silva,
Mariana Miranda Autran Sampaio and Rodolfo Rego Deusdará Rodrigues

1 Introduction

Since the 1980s, concerted efforts both in Brazil and internationally have strengthened the idea that health research is essential in order to elaborate and to implement national health policies. These efforts have contributed to reducing inequalities in health in developing countries and to improvements in health care.

A detailed mapping of resources flows can contribute to decision-making in developed countries and developing countries, supporting the selection and better allocation of resources to finance research and development in health (R&D/H). This mapping can also help in the reallocation of resources to the most important conditions and determinants of health, identifying areas that do not

attract enough investment and avoiding research duplication efforts. These measures may have a significant impact on the reduction of the health burden and harm in developing countries, in particular the poorest ones.

Despite the challenges in establishing a Brazilian monitoring system for investments in R&D/H, in particular for private-sector investments and aggregated information from academic institutions and governmental bodies, a concerted effort has been undertaken to measure resources. This chapter presents an estimation of financing resources flows applied in R&D/H in Brazil, from 2003 to 2005, comparing with the results achieved between 2000 and 2002.

2 Total expenditure on financial flows in research and development for health in Brazil, 2003–2005, by source

Between 2003 and 2005, Brazil invested US\$ 1 481 500 000 in R&D/H (in current American dollars), with an annual average of US\$ 493.8 million. The public sector invested around US\$1.1 billion, with an annual average of US\$ 367.5 million, corresponding to 74.3% of the total expenditure in R&D/H. The federal government was responsible for 45.3% of total investments, while the states invested 29%. As a share of public

expenditure, the federal government contributed 61% of investments, whereas state governments contributed 39%.

Table 1 shows the impact of the exchange tax variation in the amount of investment in R&D/H in Brazil. It also shows the underlining positive evolution in these amounts during the period 2000–2005.

Table 1 Total expenditure by source of R&D/H funding (US\$ millions*), 2003–2005

Source of resources	2003	2004	2005	2003–2005	Annual average
Federal government	169.4	204.8	301.5	675.7	225.2
Ministry of Health	37.0	46.0	82.8	165.8	55.3
Ministry of Science and Technology	37.4	55.6	83.6	176.7	58.9
Ministry of Education	92.8	100.9	132.4	326.1	108.7
Other ministries	2.2	2.3	2.6	7.1	2.4
State government	125.1	133.8	167.9	426.8	142.3
Educational State Secretariat	83.7	87.7	105.8	277.3	92.4
Research support foundation (FAPs)	37.9	42.2	57.9	138.0	46.0
Other institutions	3.4	3.8	4.3	11.5	3.8
Public sector	294.5	338.5	469.4	1102.5	367.5
Private sector	104.3	109.2	131.7	345.3	115.1
International organizations	8.2	9.8	15.8	33.8	11.3
Total	407.0	457.6	616.9	1481.5	493.8

*Note: To convert from Brazilian real to US dollars, the average annual exchange rate was used, as quoted by the Federal Bank of Brazil.

Table 2 Total expenditure by source of R&D/H funding in Brazil (constant (2000) US\$ millions*), 2003–2005

Source of resources	2003	2004	2005	2003–2005	Annual average
Federal government	284.2	327.8	400.3	1012.4	337.5
Ministry of Health	62.1	73.6	110.0	245.7	81.9
Ministry of Science and Technology	62.8	89.0	111.0	262.9	87.6
Ministry of Education	155.7	161.6	175.8	493.1	164.4
Other ministries	3.6	3.6	3.5	10.7	3.6
State government	209.8	214.2	223.0	647.0	215.7
Educational State Secretariat	140.5	140.5	140.5	421.5	140.5
Research support foundation (FAPs)	63.6	67.6	76.8	208.1	69.4
Other institutions	5.7	6.1	5.7	17.4	5.8
Public sector	494.0	542.0	623.3	1659.4	553.1
Private sector	174.9	174.9	174.9	524.8	174.9
International organizations	13.8	15.6	21.0	50.4	16.8
Total	682.7	732.6	819.2	2234.5	744.8

*Note: To convert from Brazilian real to US dollars, the average exchange rate for the year 2000 was used, as quoted by the Federal Bank of Brazil.

Table 2 presents the resource values invested in constant 2000 US\$. As there were significant variations in the exchange rate between 2003 and 2005, the analysis in constant terms allows a better comprehension of the total

amount invested and its evolution during the studied period. Between 2003 and 2005, Brazil invested US\$ 2234.5 million in R&D/H, with an average of constant (2000) US\$ 744.8 million.

Figure 1 Expenditure by source (constant (2000) US\$ millions), 2003–2005

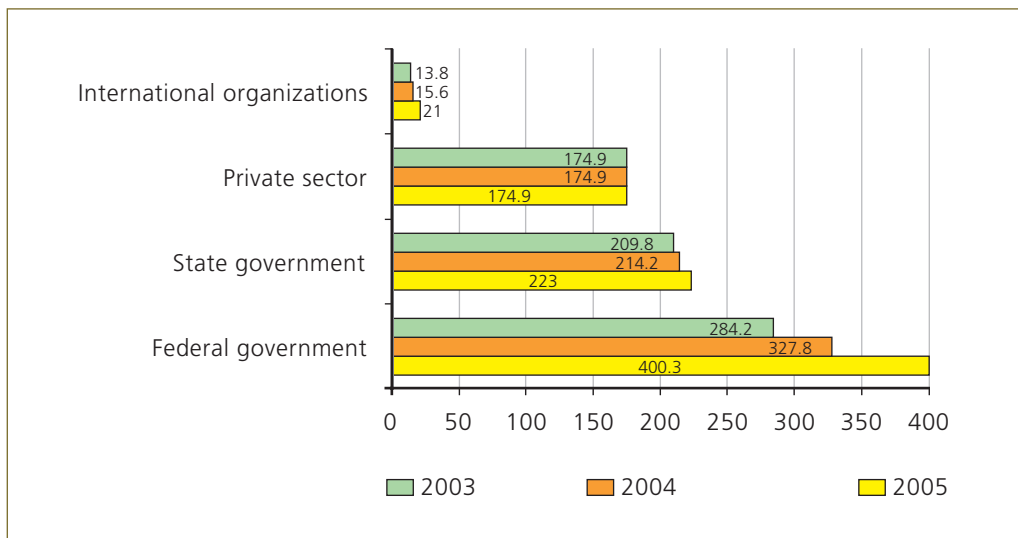
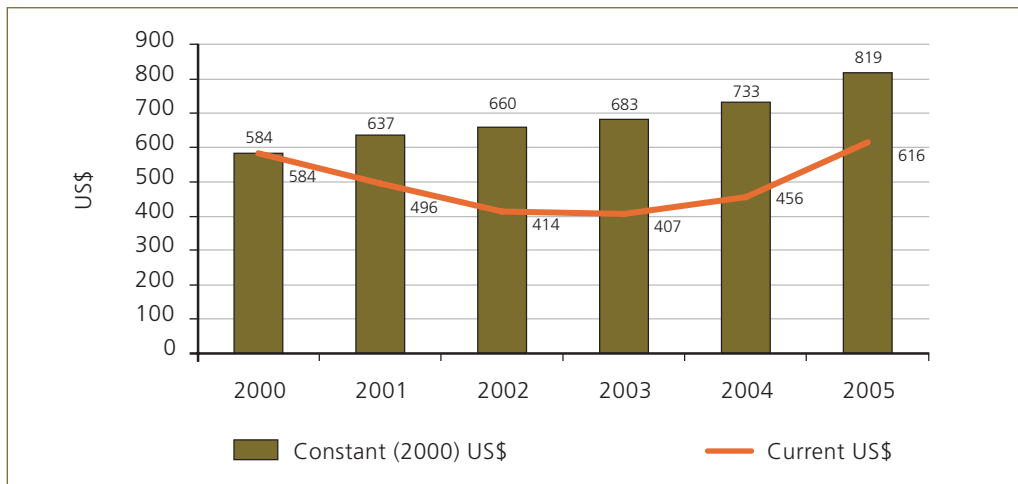


Figure 2 shows the evolution of investments in R&D/H in the period 2000–2005 in both constant (2000) and current US\$. Using constant (2000) US\$, the investments in R&D/H

increased by 28.6% between 2000 and 2005; however, in current US\$, investments increased by 5.2% over the five-year period, bolstered by an annual increase of 26% from 2004 to 2005.

Figure 2 Total expenditure on R&D/H, 2000–2005



Examining the investments in R&D/H by the Ministry of Health, it is important to note that resources in R&D/H soared after the establishment of the Department of Science and Technology in 2000. In particular, after the Secretariat of Science, Technology and Strategic Inputs Creation was

created in 2003, investments soared once again due to the new status of R&D/H, which receives a specific and continuous budget. Over the five-year period, investments by the Ministry of Health in R&D/H increased by 243.8%, with a notable 48.6% annual increase between 2004 and 2005 (Figure 3).

Figure 3 Ministry of Health expenditure in R&D/H (constant (2000) US\$ millions), 2000–2005

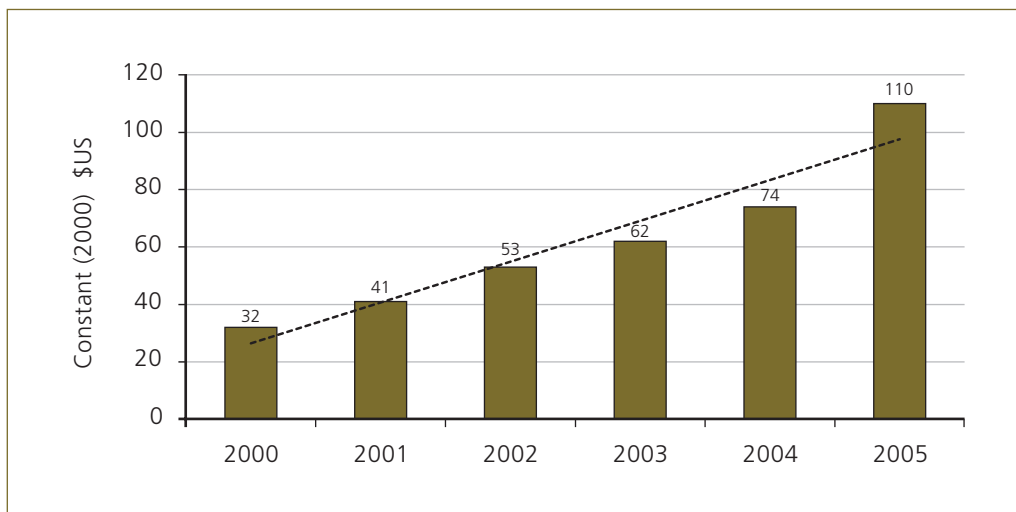
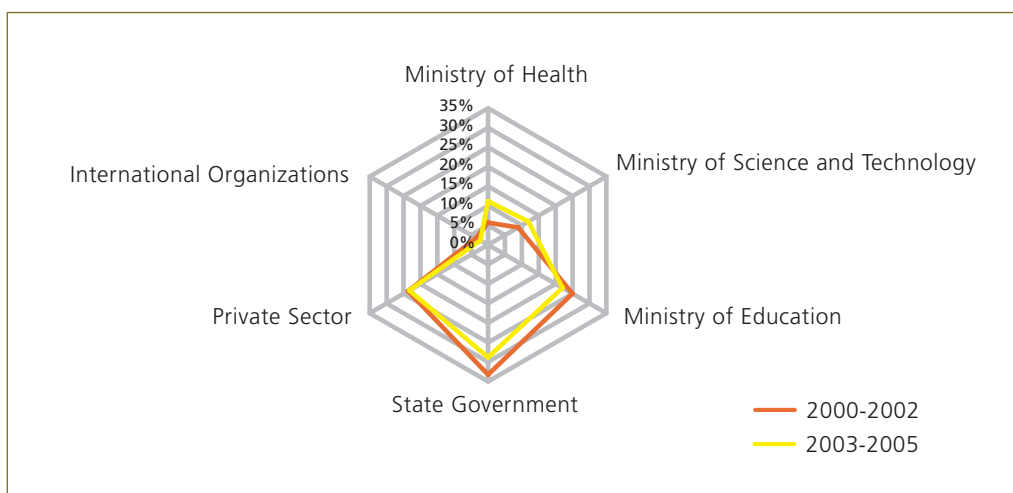


Figure 4 shows the changes in the investment structure in R&D/H during the periods 2000–2002 and 2003–2005. The most significant variation was the decrease in expenditure from the international sector. This coincides with the completion of a rather large project – Reorganization and Reinforcement of the Brazilian Public Health System (REFORSUS) – which

had a significant loan from the Inter-American Development Bank. This in turn reinforced the role of the Brazilian public sector in sustaining financial resources flow for health research. The other notable changes are the increases in the proportion of funding from the Ministry of Health, which went from 5.7% to 11.2% of the total expenditure on R&D/H.

Figure 4 Comparison of investments in R&D/H by source, 2000–2002 and 2003–2005



3 Total expenditure on financial flows in research and development for health in Brazil, by sector of performance

It is important to make the distinction between the funders of research and the sectors of performance, since numerous bodies serve as financial instruments but do not necessarily undertake research. Table 3 presents the distribution of resources invested in R&D/H by the organizations undertaking the research (sector of performance). Universities, research institutions and bounded foundations were included for the period 2003–2005, with expenditure of US\$

Table 3 Total expenditure by sector of performance of R&D/H (US\$ millions*), 2003–2005

User	2003	2004	2005	2003–2005	Annual average
Federal government	33.5	41.1	58.0	132.7	44.2
Ministry of health	30.3	34.4	50.3	114.9	38.3
Other ministries	3.3	6.7	7.8	17.8	5.9
State/municipal government	12.9	15.6	20.1	48.7	16.2
Public sector	46.4	56.7	78.2	181.3	60.4
Universities/research institutions	268.5	304.3	416.0	988.9	329.6
Private sector	90.9	96.5	122.7	310.1	103.4
Pharmaceutical industry	66.0	69.2	83.4	218.6	72.9
Medical devices industry	24.2	25.3	30.6	80.1	26.7
Other private institutions	0.7	2.0	8.7	11.4	3.8
International sector	1.1	1.2	1.3	3.6	1.2
Total	407.0	457.6	616.9	1 481.5	493.8

Note: *To convert from Brazilian real to US dollars, the average annual exchange rate was used, as quoted by the Federal Bank of Brazil.

988.9 million and an annual average of US\$ 329.6 million, corresponding to 66.7% of the total amount invested. It is important to highlight that the private sector accounted for 21% of the total, equivalent to US\$ 310.1 million for the period 2003–2005, with an annual average of US\$ 103.4 million.

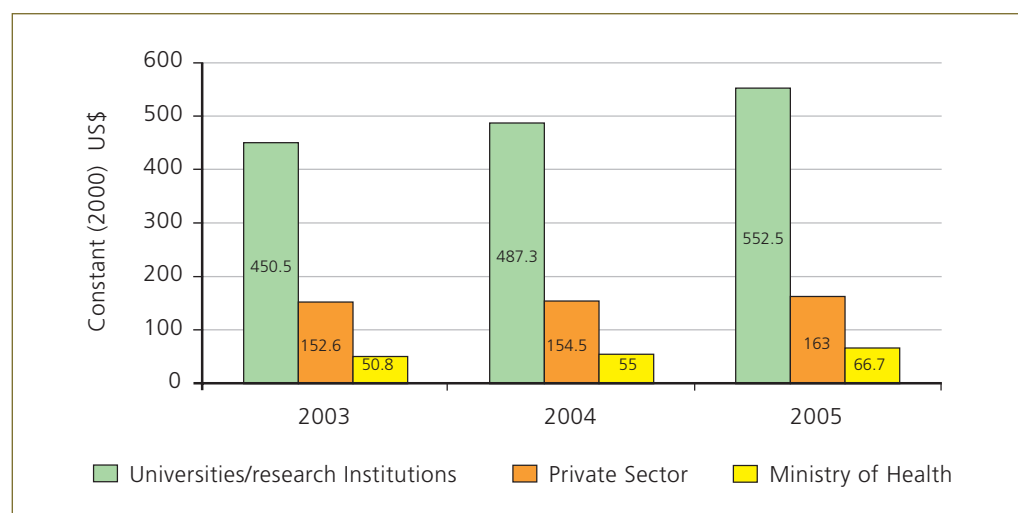
Table 4 Total expenditure by sector of performance of R&D/H (constant (2000) \$US millions*), 2003–2005

User	2003	2004	2005	2003–2005	Annual average
Federal government	56.3	65.8	77.0	199.1	66.4
Ministry of health	50.8	55.0	66.7	172.5	57.5
Other ministries	5.5	10.8	10.3	26.6	8.9
State/municipal government	21.6	25.0	26.8	73.4	24.5
Public sector	77.9	90.8	103.8	272.5	90.8
Universities/research institutions	450.5	487.3	552.5	1 490.2	496.7
Private sector	152.6	154.5	163.0	470.0	156.7
Pharmaceutical industry	110.8	110.8	110.8	332.3	110.8
Medical devices industry	40.6	40.6	40.6	121.7	40.6
Other private institutions	1.2	3.1	11.6	16.0	5.3
International sector	1.8	1.8	1.8	5.5	1.8
Total	682.7	732.6	819.2	2 234.5	744.8

Note: *To convert from Brazilian real to US dollars, the average exchange rate for the year 2000 was used, as quoted by the Federal Bank of Brazil.

Figure 5 shows the evolution of resource use in R&D/H by the main users. The universities and research institutions and the Ministry of Health have significantly increased their investments throughout the time period.

Figure 5 Investments by sector of performance of R&D/H (constant (2000) US\$ millions), 2003–2005



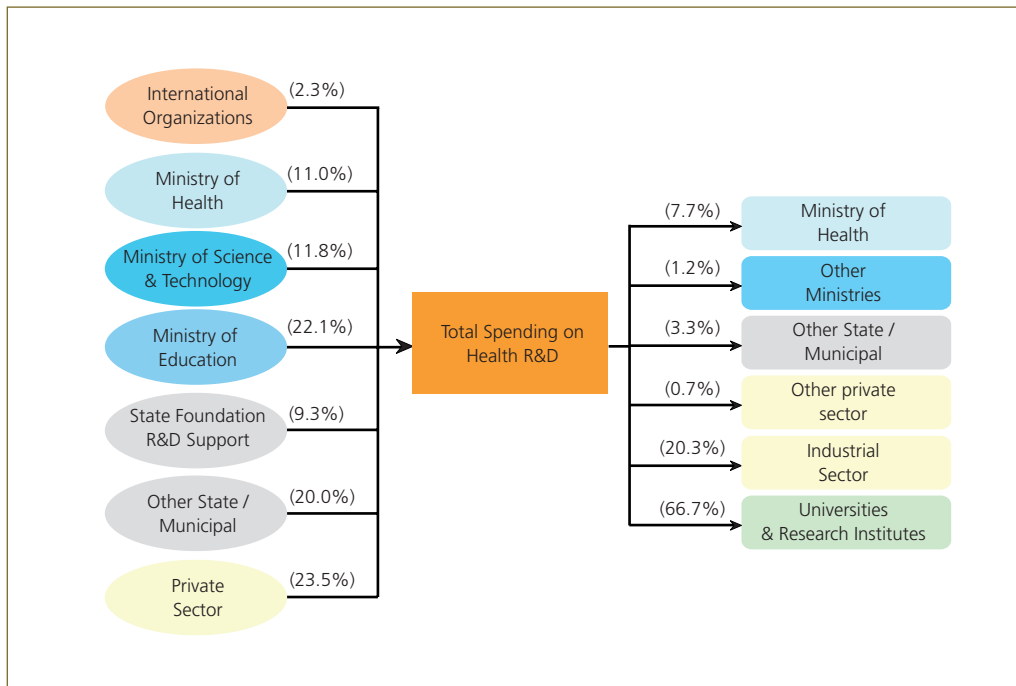
3.1 Financial flow diagrams for R&D/H in Brazil

With information on the funders of research and the sectors of performance, it is possible to create a diagram outlining the funding flows of R&D/H in Brazil, as shown in Figure 6.

Considering individual efforts in the institutional categories, the private

sector appears as the main source of resources, being responsible for 23.5% of the total investments, followed by the Ministry of Education, with 22.1%. The Ministry of Health accounts for a significant amount of this investment, around 11.0%. In relation to the sectors of performance, the universities and research institutions receive more than half of the expenditure (66.7%), followed by the industrial sector (21.1%) and the Ministry of Health (7.7%).

Figure 6 Financial flows by institution: annual average, 2003–2005



4 Conclusion

The main objective of this work was to map and measure the financing resource flows in R&D/H in Brazil between the years 2003 and 2005. The total annual average expenditure in R&D/H was about US\$ 1481.5 million. The public sector invested an average of US\$ 1012

million per annum and the Ministry of Health US\$ 165.8 million.

Although the investment in R&D/H in Brazil grew incrementally between 2000 and 2005 (approximately 40% in US\$), the expenditure in health research

is still relatively small. Accounting for the fact that global investments in health research in 2005 were US\$ 160.3 billion, that for Brazil corresponds to 0.38% of this total.

An important factor to highlight is the variation in the share of public, private and international investments in health research. While the global average is 51%,

41% and 8% for the public, private and non-profit-making sectors, respectively, in Brazil the effort to provide financing originates predominantly in the public sector. As a result, in the distribution of resources, the public sector invests 71.5%, while the private sector invests 24.4% and international institutions correspond to the remaining 4.1%.



Chapter 9

Cuba: Financing of research and innovation for health

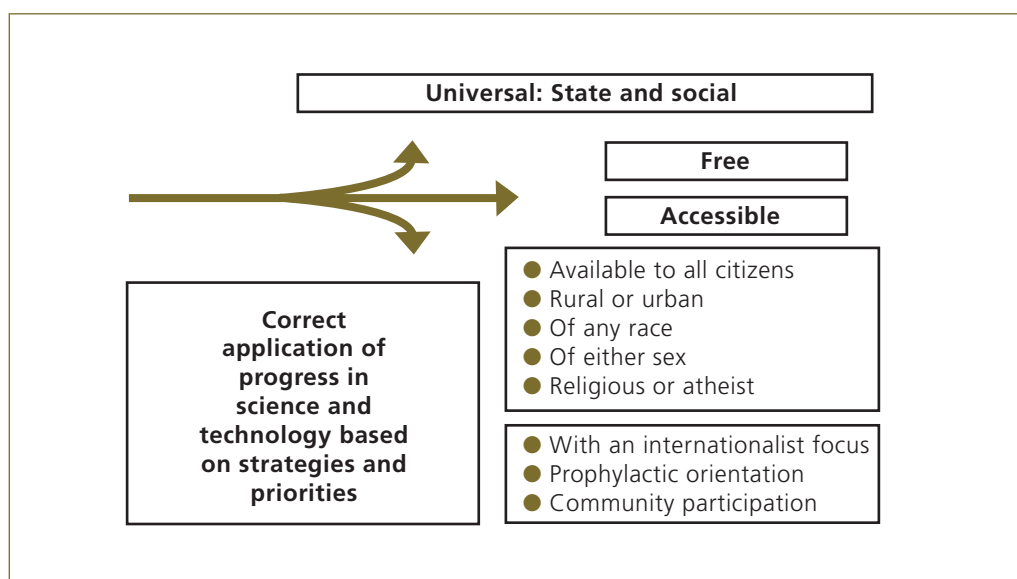
Adolfo S Álvarez Blanco and Niviola J Cabrera Cruz¹

1 Background

On 15 January 1960, at the ceremony to mark the twentieth anniversary of the Cuban Speleological Society, Commander-in-Chief Fidel Castro declared: “The future of our country must be a future for men of science, it has to be a future for men of thinking.” In that same year, the Ministry of Health became the Ministry of Public

Health (MINSAP) and the National Health System (SNS) was created for all Cubans, free of charge and accessible by those of any race, sex or religion, atheists, city-dwellers and rural inhabitants, on the basis of international collaboration, a prophylactic approach and community participation (Figure 1).

Figure 1 Principles of the Cuban health system



The first major decision taken on health services was to create the Rural Social Medical Service, in accordance with Law 723 (Official Gazette of 1 February 1960), which was subsequently extended to include the Dental Service (Rojas Ochoa).

Another early decision focused on training human resources. MINSAP was charged with training assistants and technicians, postgraduate training, and the introduction of the residency system for doctors and stomatologists. The

Victoria de Girón Basic and Preclinical Science Institute was founded on 17 October 1962 and the schools of medicine of Santiago de Cuba and Santa Clara were established in 1962 and 1966, respectively (Rojas Ochoa).

On 1 December 1966, MINSAP set up the current eight national institutes of research into medical specialties – endocrinology and metabolic diseases; cardiology and cardiovascular surgery; neurology and neurosurgery; oncology and radiobiology; gastroenterology;

nephrology; angiology and vascular surgery; and haematology and immunology – with the aims of:

- investigating the key issues in each medical specialty;
- providing the highest level of medical education;
- creating more efficient health services (Álvarez Blanco, 2004).

At the same time, Cuba set up the National Commission for the Academy of Science, which included 15 scientific centres. It also established the National Centre for Scientific Research in 1965, which educated over 20 000 scientists; introduced the Science Policy in 1975, which set down the mid- and long-term strategies for scientific and technological development, among other guidelines; created the State Committee on Science and Technology in 1976; and drew up the National Plan for Science and Technology for the period 1976–1980.

The 1980s ushered in a new era for Cuban science and saw the creation of the research centres: the Centre for Biological Research in 1982 and the Centre for Genetic Engineering and Biotechnology in 1986.

The fall of socialism put an end to the material resources that had supported the established economic and technological paradigm. The devised structural basis and its associated systems paved the way for the creation of a production structure that had not existed previously

in the country and for the development of a human potential qualified in diverse areas of knowledge, all of which proved vital for the subsequent phases, despite the United States (US) blockade against Cuba, which was stepped up after 1990 with the Torricelli Law (1992), the Helms Burton Act (1996) and the Sanctions Reform Act (Álvarez Blanco, 2008).

In 1995, the Ministry of Science, Technology and the Environment (CITMA) was established to take charge of this activity and, in 1998, this body set up the National System of Science and Technological Innovation (SCITS), which has continued to grow to this day. The System of Science and Technological Innovation in Health has 47 accredited research centres and works in close collaboration with the country's scientific poles: the Western Scientific Pole in Havana, with 38 research centres, and the 12 regional poles dotted around the country, in addition to the universities and research centres of Organizations of the Central Government Administration (OACE).

Across the country, 49.3% of workers in the science sector are women, as are 37.6% of university students. In the National System of Science and Technological Innovation, 53% of workers are women and 60.5% of university students are women, across the 220 science and technology units, of which 115 are research centres (Table 1).

Figure 2 Centres in Cuba that are social actors of the system of science and technological innovation

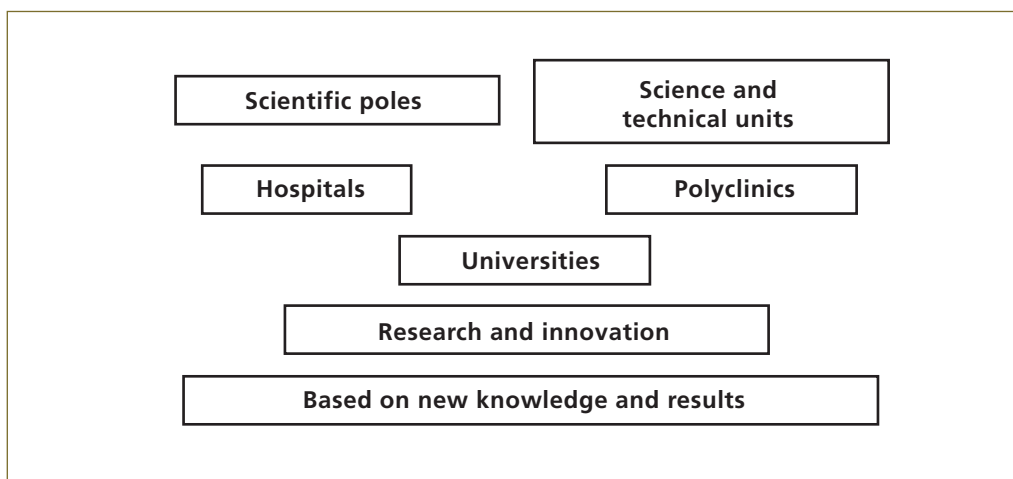
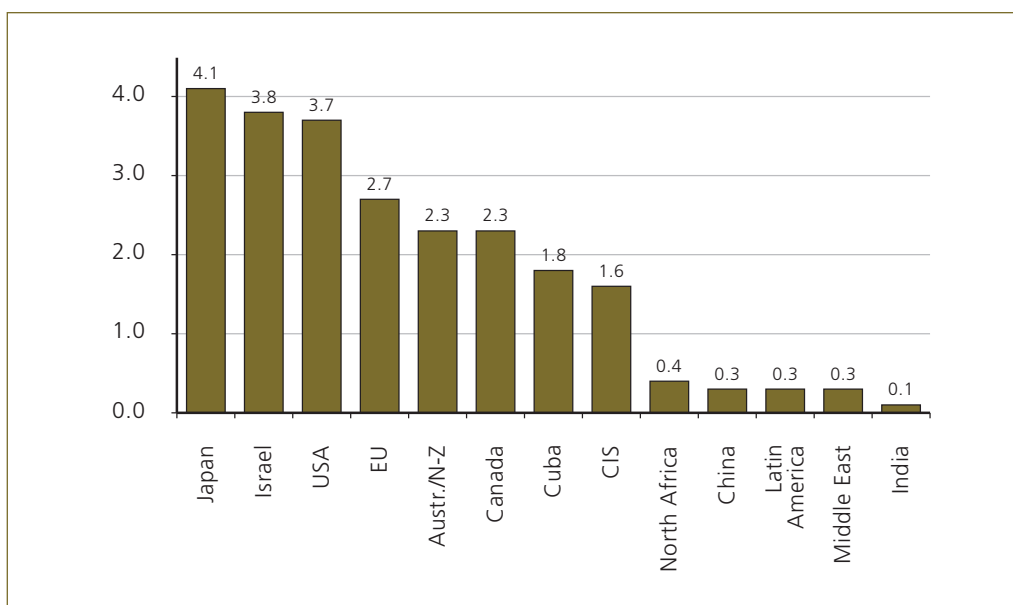


Table 1 Scientific potential in Cuba, 2008

	Science sector	Science and innovation system
Total employees	33 875 (49.3% women)	74 068 (53% women)
Higher level	12 737 (37.6% women)	44 827 (60.5% women)
Researchers	5 141 (47% women)	5 491 (49.6% women)
Higher and intermediate level	24 085 (71% of employees)	63 923 (86% of employees)

Figure 3 Number of scientists and engineers per 1 000 inhabitants



Note: USA = United States of America; EU = European Union; CIS = Common Wealth of Independent States

Scientific research in Cuba is a very important strategic element for the future, not only from a political and economic point of view but also from the perspective of defence and for the country's social development. Thus, research, innovation and the generalization of results are essential for increasing economic efficiency and a basic prerequisite for development. In light of this, it is essential to make progress in the optimization of skills

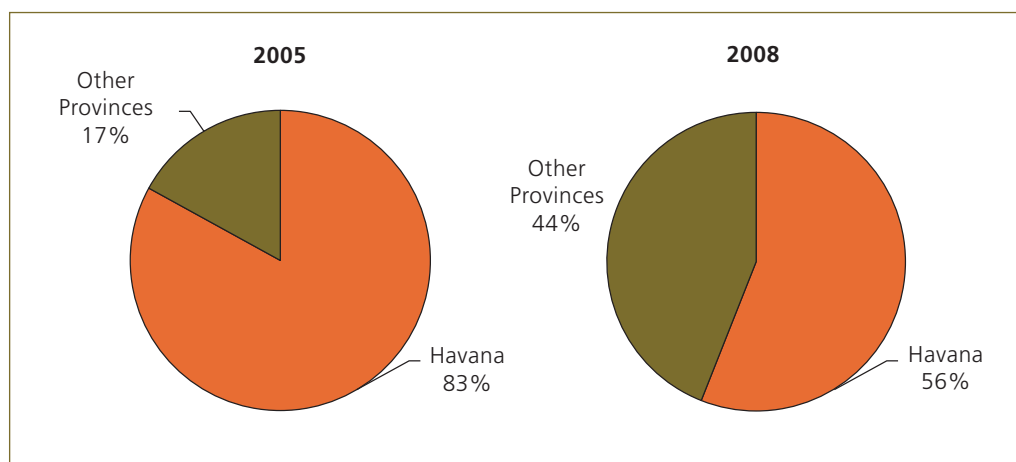
and the resources allocated to research (Álvarez Blanco, 2008).

MINSAP already has 1634 classified researchers. Their geographical distribution has varied considerably, as illustrated in Figure 4. In 2005, 83% were based in the capital, while at the end of 2008, this figure had fallen to 56% due to the regional increase in organizations of science and technological innovation in health.

Table 2 MINSAP researchers by classification, 2008

Tenured	Assistant	Aggregate	Candidate	Total
191	394	669	380	1634

Figure 4 MINSAP researchers by geographical location, 2005–2008

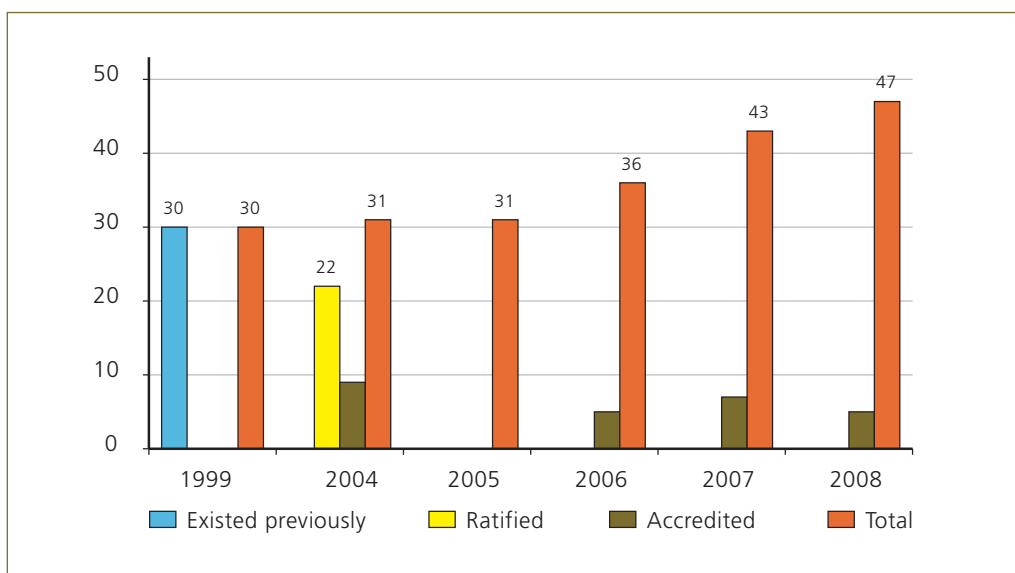


Source: Science and Technical Directorate, MINSAP.

Research and innovation in and for health are also regarded as a need and an investment, not only for understanding but also for pinpointing – at national, provincial, municipal and institutional levels – existing health needs, setting priorities, obtaining local responses to our own health problems by the use of technical intervention strategies

(Álvarez Blanco, 2004), and developing a series of scientific, technological, organizational, financial and commercial activities with the aim of obtaining new and improved products, technological processes, methodologies or services, and applying them to social practice or using them in specific production processes or services (OECD, 1992).

Figure 5 Accredited organizations of science and technological innovation in health, 1999–2008



Source: Science and Technical Directorate, MINSAP.

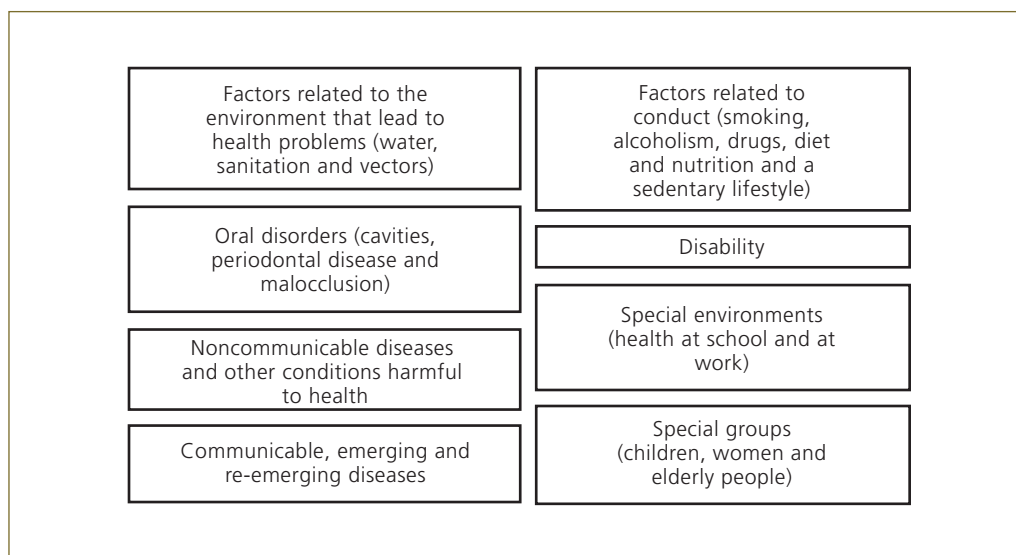
MINSAP, as the body to which the SNS reports, guides research activities in and for health and is able to call on other state bodies and institutions to take part in any science and technological innovation activity relating to the health of Cubans.

The main aim of the National Policy of Science and Technological Innovation in Cuba is to enhance the efficiency, efficacy and excellence of Cuban science and technology by maintaining the generation of new knowledge and promoting technology. The lines of this policy seek to raise the well-being of the population of Cuba and to develop the national economy on the basis of interaction, cooperation and integration between science units, the production sector and the services industry, as well as through the performance of national and international interinstitutional and bilateral actions. March 2006

saw the approval of the Public Health Projections in Cuba for the Year 2015 (PSP-2015)(MINSAP, 2006), divided into the eight priority areas of the SNS (Figure 6), together with their priorities, goals and indicators. This 10-year period was preceded by two similar projects: the Health Situation Analysis (1980) (MINSAP, 1980) and the Objectives, Aims and Guidelines in Cuban Health for 2000 (1992) (MINSAP, 1992).

After the drafting and passing of the Public Health Projections in Cuba for the Year 2015, the Strategic Projection in Science and Technological Innovation in Health for the Period 2008–2010 (PE-CITS) (MINSAP, 2007) was drawn up with the participation of the same actors (management figures and civil servants from the ministry, provincial and municipal health directorates, national specialty groups, scientific societies for health, primary care specialists and

Figure 6 Priority areas for public health projects in Cuba up to 2015



managers, other central government administration organizations, and popular organizations from the health community). Following consultation and identification of the technical and scientific actions, the national, branch-based and regional scientific and technical programmes were designed, together with their aims and priorities. In addition, annual competitions were set up and the “Manual of procedures for the management of programmes and projects in the national health system” was drawn up and approved (Álvarez Blanco et al., 2008).

Under the methodological management of the Science and Technology Directorate (DirCyT) of MINSAP, the research priorities for the country’s 498 health areas, 169 municipalities and 14 provinces were defined. The strategies were categorized by scientific and technical intervention, on the basis of the priorities set in March 2006, and through performance of regional

exercises on science and technology management in health in each province (MINSAP, 2009), whose analysis, discussion and consensus led to PE-CITS.

Cuba’s strong public health research institutions and the lack of private participation, laid the foundations for the Western Scientific Pole of Havana, the scientific institutions of other central government organizations carrying out health projects, and for the country’s regional poles (Figure 7). This amounts to an initiative, stimulating, cross-sector integration producing quality results and raising the international prestige of Cuban science.

One of the features of current scientific development in Cuba is the merger between different fields of science. This means that research projects can be successful only if several disciplines take part in them, and continuation of the project is guaranteed up to the

Figure 7 National and regional scientific poles



production phase, if applicable. This situation has been accomplished in Cuba through integration and the concept of the “full-cycle project”, whereby research centres are transformed into complexes for research, development, services, production and marketing, becoming a considerable productive force in which several institutions from the sector take part (Cabrera Cruz).

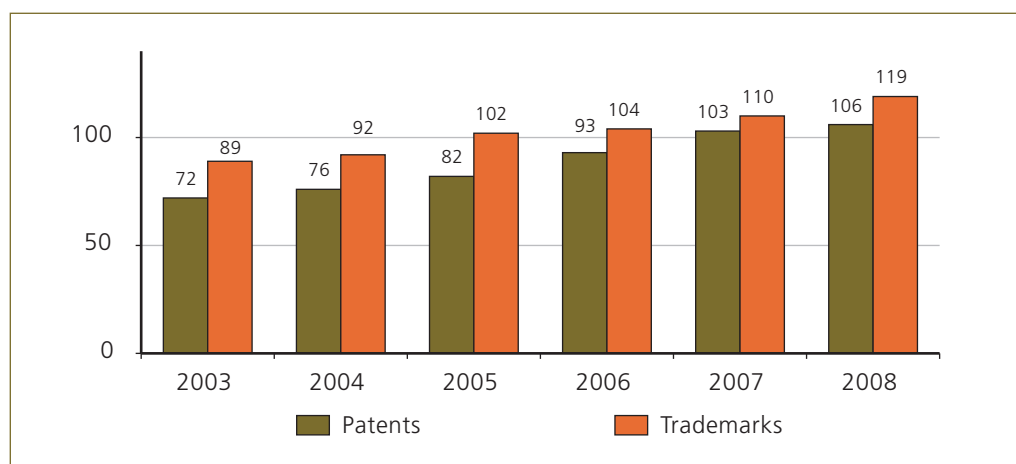
Health research in Cuba has also been stimulated by the possibility of funding from Cuba’s own centres of medical technology production. Both medicinal products and medical equipment contribute to the state budget – in this case, for the health sector – with part of the income from their sales. There is no private national financing in the country (Cabrera Cruz).

There is no private industry in Cuba. The national biotechnology system and medical pharmaceutical industry are

state-owned and produce and export vaccines, medicines, biomaterials, medical equipment, diagnostic and therapeutic procedures, high value-added scientific and technical services and other specialist health products to the region and to other countries around the world that order them through commercial companies, often in the form of associate companies. The industry has its own regulations.

The country regulates and registers patents on medicinal products and medical devices and on trademarks and copyright through the Cuban Intellectual Property Office (OCPI) and the National Copyright Centre (CENDA). Between 2003 and the end of 2008, 106 patents and 119 trademarks were registered (Figure 8). The figures for copyright were also considerable – Cuba has applied the safeguards in the WTO intellectual property agreement (TRIPS) and the Doha Declaration.

Figure 8 Registration of patents and trademarks by MINSAP



Source: Cuban Intellectual Property Office.

2 Capital flow analysis

Gross domestic product (GDP) increased during the country's recovery in the 1990s, initially at a slow pace and then more quickly, reaching an average annual growth rate of 5.1% in 2007, taking 1997 as the base year. In 2008, GDP reached a growth rate of 4.3%

compared with 2007. The SNS budget of 1.3 billion pesos in 1996 had risen to 4.01 billion pesos by 2007, an increase of 25% on 2005 figures. In 2008, the percentage of GDP allocated to health was 10.6%, while 1.9% was allocated to research and development (R&D).

Table 3 Structure of state budget expenditure, 2007

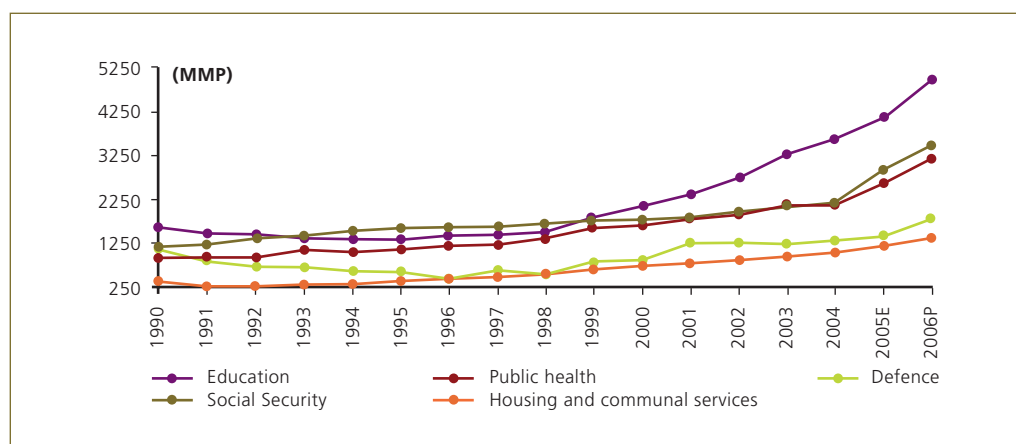
Current expenditure	%
Education	63.1
Public health	17.5
Social Security	10.4
Welfare	3.3
Business activity	17.7
Other expenditure	31.8

Over 60% of current budget expenditure has been specifically allocated to the areas of health, education, safety and welfare (Table 3). In the 2007 budget, education expenditure totalled 7.1096 billion pesos while spending on health amounted to 5.7919 billion pesos.

The Plans for Science and Technological Innovation in Health and their financial

requirements are submitted in June each year by the municipal and provincial health units to the municipal and provincial health and finance directorates, respectively, and are simultaneously sent to the higher bodies, which in turn send them to the National Science and Technology Directorate and the Finance and Prices Directorate of MINSAP. The

Figure 9 Historical expenditure by sector, 1990–2006



Source: Juan Triana Cordoví.

latter review, balance and consolidate the plans with those of the technological innovation and science bodies (EnCIT), medical universities and other national dependent units. Following this, the National Plan is presented and reconciled with the Ministry of Finance and Prices and the Ministry of Science, Technology and the Environment before its approval by the Cuban Parliament in December.

In 2008, MINSAP approved a total of 152.1 billion pesos for research (100% of the

requested funds) from the national budget allocated to the ministry. Of this amount, 128.3 billion pesos was for scientific and technical research and 23.8 billion pesos was allocated to other scientific and technical activities; this sum accounts for 40% of funding allocated to scientific and technical activities for all organizations of the central government administration.

In recent years, technical cooperation has been established with the United Nations system. A Pan-American

Table 4 Budgeted expenditure by activity, 1999–2009*

Year	Country MMP total	MINSAP MMP total
1999	128.1	42.5
2000	154.3	42.5
2001	163.6	55.2
2002	168.4	55.2
2003	227.8	65.5
2004	210.7	65.5
2005	247.5	62.8
2006	292.2	72.4
2007	473.3	92.8
2008	570.3	119.3
2009	612.7	152.1

Note: *Based on reports on settlement of the budgets in 1999–2007 and 2009 draft budget report (estimated). Budget itemized by OACEs and OLPPs for 2009. For its part, the Western Scientific Pole has received an annual average of 4 million pesos from state financing.
Source: Programming and Evaluation Directorate, Ministry of Finance and Prices.

Health Organization/World Health Organization cooperation project is in place that consists of seven subprojects for each of the priorities of the SNS. Projects with various UN agencies, including the United Nations Population Fund (UNFPA), the United Nations Children's Fund (UNICEF), the World Fund, the United Nations Joint Programme on HIV/AIDS (UNAIDS) and the United Nations World Food Programme (WFP), have covered issues such as sexual and reproductive health, the prevention and control of anaemia, acquired immunodeficiency syndrome (AIDS), care for people living with human immunodeficiency virus (HIV) and tuberculosis control among others. The total amount for these projects between 2006 and 2008 was \$13.6 million per year. They have also encouraged academic and scientific exchange, which has had an impact on certain programmes.

In addition, numerous investments have been made in the SNS in recent years (Juan Triana Cordoví) including in the construction of rehabilitation wards; basic repair of polyclinics; refurbishment, extension and refitting of hospitals and wards; and equipment purchase (e.g. electrocardiogram (ECG), ultrasound and X-ray machines, endoscopy equipment, computers, Internet connections and dental equipment).

All of this has been achieved despite the difficult times affecting the country. Spiralling speculation led to a 53%

increase in food prices, although export lines brought the prices back down. Cuba was hit by the catastrophic impact of three powerful hurricanes, with an approximate cost of \$ 10 billion, and witnessed the almost simultaneous outbreak of the biggest global financial crisis since the 1930s. The economic blockade that has cost the country more than \$93 billion was also kept in place. In response, the Subsystem for the Mobilization of External Funds was set up, through which a total of 5.9 million Cuban convertible pesos (CUC\$) from 15 countries was mobilized at the end of 2008 by means of 65 research and innovation in health projects through scientific and technical collaboration.

The establishment of projects or agreements with international organizations is always related closely to the country's interests, for which three priority areas are set: political, scientific and economic.

The global financing of the SNS includes four means of guaranteeing basic funding: (i) funds from the national budget requested through the Annual Plan for Science and Technological Innovation; (ii) financing from other state sources for projects of priority and relevance for MINSAP and the Scientific Pole; (iii) financing obtained from technical and scientific collaboration through research or technical cooperation projects; and (iv) financing obtained through the mobilization of external funds (Table 5 and Figure 10).

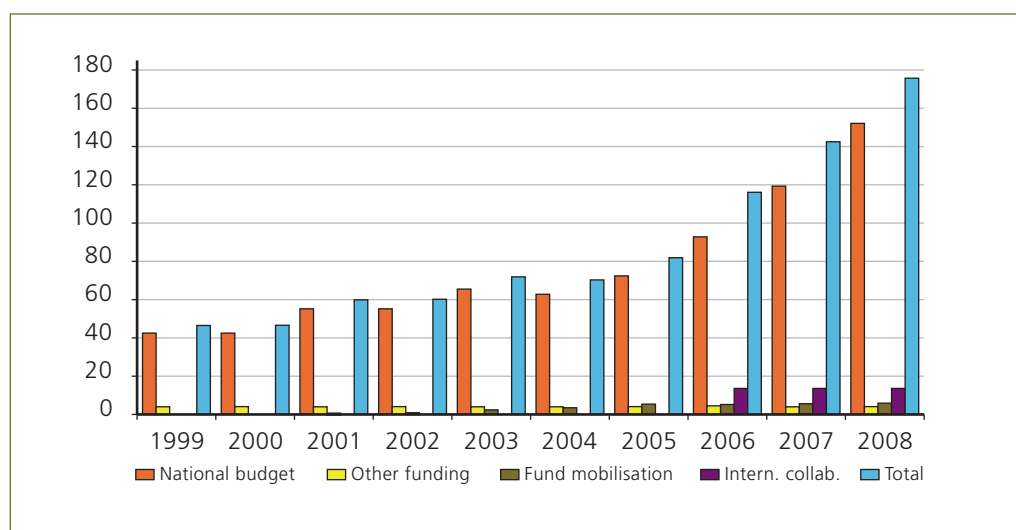
Table 5 Financing of the Cuban National Health System by source (millions of pesos)

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
National budget	42.5	42.5	55.2	55.2	65.5	62.8	72.4	92.8	119.3	152.1
Other funding	4.0	4.1	4.0	4.1	4.0	4.0	4.1	4.5	4.0	4.1
Fund mobilisation			0.7	0.9	2.4	3.5	5.4	5.2	5.6	5.9
Intern. collaboration								13.6	13.6	13.6
Total	46.5	46.6	59.9	60.2	71.9	70.3	81.9	116.1	142.5	175.7

Sources:

- ^a Expenditure on Science and Technology, MINSAP historical series, Programming and Evaluation Directorate, Ministry of Finance and Prices.
- ^b Other sources of state financing to MINSAP and the Scientific Pole.
- ^c Technical cooperation projects with the United Nations. International Bodies Department of the International Relations Directorate of MINSAP.
- ^d National Unit of Projects and Donations of the International Relations Directorate of MINSAP.

Figure 10 Budget allocated to projects (millions of pesos), 1999–2008



Source: Science and Technical Directorate, MINSAP.

3 Conclusions

The main aim of this work was to collect, process, analyse and consolidate the information available on financial resources for scientific research and innovation for health in Cuba between 1999 and the end of December 2008.

Between 1996 and 2007, the SNS budget increased by 1.3 billion pesos to

over 4 billion pesos, representing a 25% increase on 2005 figures. In 2008, the percentage of GDP allocated to health was 10.6% while 1.9% was allocated to R&D.

In the 2007 budget, education expenditure amounted to 7.1096 billion pesos while that of health totalled

5.7919 billion pesos. These figures indicate the priority status afforded to these two citizens' rights by the Cuban government.

In 2008, the MINSAP national budget for research was approved for a total of 152.1 million pesos, of which 128.3 million pesos was allocated to scientific and technical research and 23.8 million pesos to other scientific and technical activities.

The financing obtained from other state sources for projects of priority and relevance both for MINSAP and the Scientific Pole has amounted to more than \$4 million a year for the past 10 years. Moreover, technical cooperation has been set up with the United Nations system. The total sum for this cooperation between 2006 and 2008 amounted to \$13.6 million a year. The Subsystem for the Mobilization of External Funds has increased substantially. By the end of 2008, a total of CUC \$5.9 million had been mobilized. By the end of 2008, the total sum invested in science and innovation in Cuba had reached 175.7 million pesos.

The figures above do not include the numerous investments made in the SNS in recent years, with state funding for construction and renovation of hospitals, and equipment purchases.

All of this has been achieved in spite of more than five decades of economic, commercial and financial blockade to which Cuba has been subject, along with the direct economic damage that this has caused. The value of this economic damage is estimated to be in excess of \$93 billion dollars, which, taking into account the effect of the devaluation of the dollar and fluctuations in its value over time, is equivalent to \$224.6 billion at current prices. The situation has been made worse by speculation on food prices, the impact of three hurricanes, and the outbreak of the global financial crisis.

Nonetheless, the establishment of projects and agreements with international organizations has always been related closely to Cuba's interests, for which three priority areas are set – political, scientific and economic priorities, in this order.

Notes

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- 2 Niviola J Cabrera Cruz is a physician specializing in epidemiology. He is director of the Science and Technical Directorate of the Ministry of Public Health.

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Chapter 10

The 2009 Report Card on financing research and development for health

Stephen A Matlin, Erik Landriault and Jean-Jacques Monot

1 Introduction

Evidence over the past two decades has reinforced the conclusions of the Commission on Health Research for Development (1990) that more research is urgently needed to address the health problems of low- and middle-income countries (LMICs) – research that especially focuses on the poor, marginalized and disadvantaged. At present, the resources for this research come from three domains:

- Research for health is located in the broader domain of research of all kinds, receiving financing through a combination of public and private channels that operate within and across countries.
- Research also receives some of its resources directly from the health sector, through national allocations made within health sector budgets and within international health initiatives.
- Development assistance also contributes to funding of research for health, either explicitly through direct funding of health research and research capacity building or as an included component of funding for the overall health sector.

Box 1 Report Card for research and development (R&D) for health

A All countries

- A1 National R&D total investment as a percentage of GDP
- A2 National R&D for health as a percentage of GDP
- A3 National R&D for health as a percentage of national health investments
- A4 National R&D for health as a percentage of total R&D

B High-income countries

- B1 Gap between actual ODA investments and commitment to invest 0.7% of GNI on ODA
- B2 Gap between actual annual increase in ODA and commitment to double aid between 2005 and 2010 – an extra US\$ 50 billion worldwide and US\$ 25 billion for Africa
- B3 Gap between actual ODA investments in R&D for health and target to invest 5% of health ODA in R&D for health

C Low- and middle-income countries

- C1 Gap between actual investments in health and target to spend 15% of domestic public spending on health
- C2 Gap between actual investments in R&D for health and target to spend 2% of national health budgets on health research

D Global health initiatives and development agencies

- D1 Gap between actual investments and commitment to invest 5% of overall health investment portfolios of global health initiatives and development agencies to support research capacity of countries, dissemination of research findings, and management of knowledge.

Note: GDP = gross domestic product; GNI = gross national income; ODA = official development aid.

In 2008, the Global Forum for Health Research began publication of an annual Report Card, selecting 10 indicators or elements grouped in four clusters (Box 1) to track progress towards the goal of ensuring adequate attention to research for the health of the poor, marginalized and disadvantaged (Burke & Matlin, 2008).

The extent to which the relevant actors have made firm and time-bound financial commitments concerning each of these indicators is extremely variable. In some cases, there are clear and precise commitments to specific targets, while in others the targets may have little more status than being aspirations (sometimes aspirations for what the actors themselves should do; in other cases aspirations of

one group of actors for what they would like another group to do).

In some cases, the Report Card applies targets to countries that have not necessarily agreed to them. This exercise is nonetheless productive, since it provides a valid benchmark to compare countries within regions and with similar levels of development. For example, although the European Union (EU) agreed that 3% of GDP should be allocated to R&D, this target has most recently been adopted by the new US administration.

The 2009 Report Card is set out below. As before, for each indicator under review the data is provided for the most recent year available.

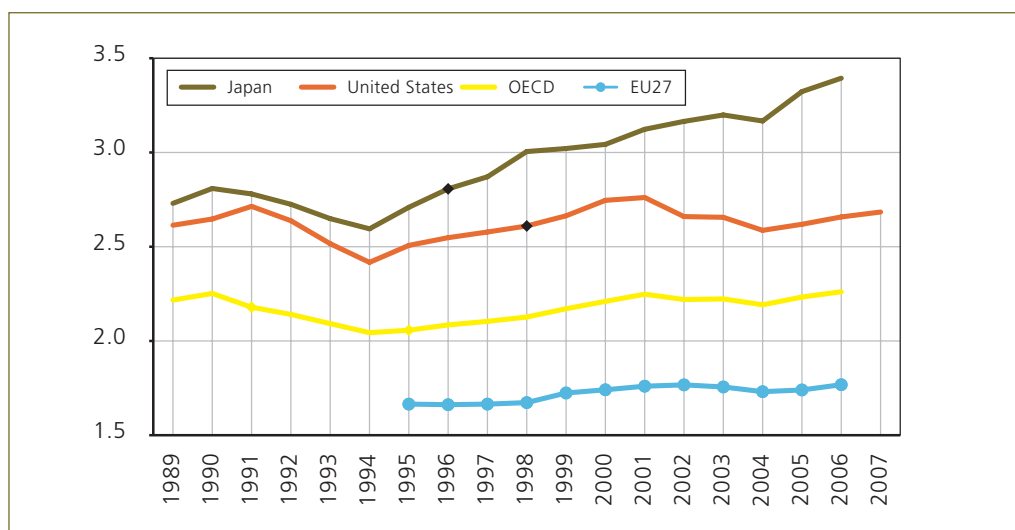
2 A: All countries

A1 National R&D total investment as a percentage of GDP

European Union target

In 2002, the European Council agreed that **overall spending on R&D and innovation in the EU should be increased with the aim of approaching 3% of GDP by 2010**, up from 1.9%

Figure 1 Gross expenditure on R&D as a percentage of GDP 1989–2007

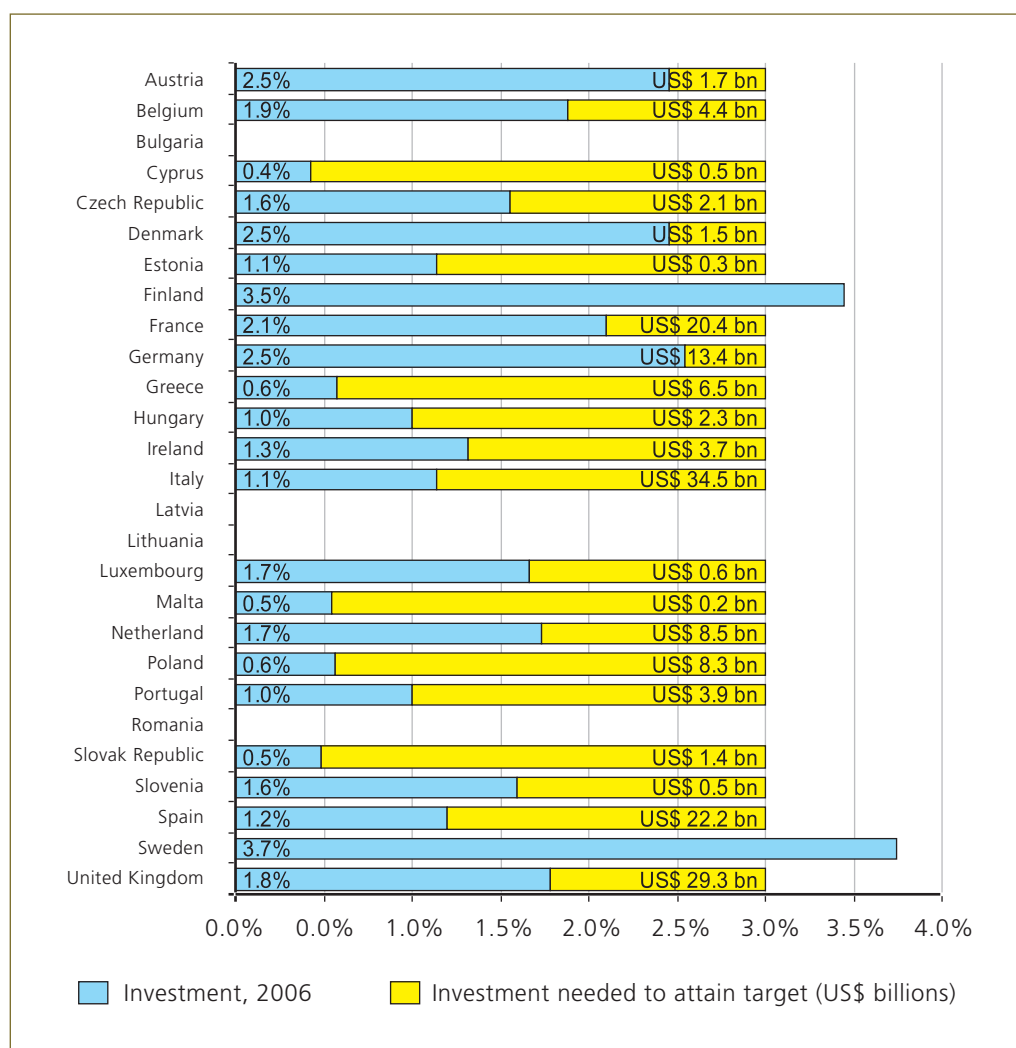


Source: OECD, 2008a.

in 2000. This is an ambitious overall target for the EU (OECD, 2008a) (Figure 1) and achieving it will require the collective effort of the member countries. It is therefore interesting to see how closely the 27 individual EU members are approaching to this target.

OECD data published in 2009 (OECD, 2009c) reports gross domestic expenditure on R&D (GERD)¹ as a percentage of GDP for 2006. Additional data was obtained from the United Nations Educational, Scientific and Cultural Organization (UNESCO)

Figure 2 Gross domestic expenditure on R&D (GERD) as a percentage of GDP by EU countries (2006)



Notes: Bulgaria, Latvia, Lithuania and Romania do not collect information on R&D investments as a per cent of GDP.

Sources:

1 Most data on GERD taken from OECD (2009c).

2 For Cyprus and Malta, UNESCO data on R&D was used, UNESCO (2009).

3 GDP in current US\$, 2006 from World Bank.

(2009) and the World Bank (2009). Bulgaria, Latvia, Lithuania and Romania do not collect information on R&D investments as a percentage of GDP. The expenditures by country are illustrated in Figure 2, together with the additional amounts that would need to be invested at the 2006 GDP level to reach 3%.

Compared with 2006 when the total EU-27 investment in R&D was 1.87% of GDP, if they remained at the same GDP level these countries would together need to invest a further US\$ 166.2 billion in overall R&D to achieve the 3% target for 2010.

Individually, the only two countries that have exceeded the target set by the EU are Finland and Sweden, with 3.5% and 3.7% of GDP invested in R&D, respectively. Four countries (Austria, Denmark, France and Germany) invested 2–2.5% of GDP in R&D in 2006, while 16 countries (Cyprus, Czech Republic, Estonia, Greece, Hungary, Ireland, Italy, Luxembourg, Malta, the Netherlands, Poland, Portugal, Slovak Republic, Slovenia, Spain and the United Kingdom) remain well below 2%.

Strategies to achieve the EU R&D target are particularly crucial at a time of severe economic pressure. The UK Prime Minister, Gordon Brown, said, “We will not allow science to become a victim of the recession, but rather focus on developing it as a key element of our path to recovery” (Drayson, 2009). While the UK economy was expected to contract by 3.5%, the April 2009 UK budget maintained investment in science, with an increased focus on areas expected to yield economic benefit (Wilkinson, 2009).

Other high-income countries

OECD data for 2006 also covers other, non-EU high-income countries (HICs), including OECD members and non-members (Table 1). Within this group, Israel, Japan and Korea all invest more than 3% of GDP in R&D. Recognizing the strategic economic importance of investing in R&D, in April 2009, US President Barack Obama announced that the USA will devote more than 3% of its GDP to research and development, with policies that invest in basic and applied research, create new incentives

Table 1 GERD for non-EU OECD countries and HICs (2006 or latest available year)

Country	GERD as % of GDP
Australia	2.01
Canada	1.94
Israel	4.53
Japan	3.39
Korea	3.22
Mexico	0.46 ^a
New Zealand	1.16 ^a
United States of America	2.66
OECD total	2.26

Note: ^a 2005 data.

for private innovation, promote science (see Box 2). This represents breakthroughs in energy and medicine, the largest commitment to scientific and improve education in maths and research and innovation in US history.

Box 2 US President Barack Obama: The vital role of science

At such a difficult moment, there are those who say we cannot afford to invest in science, that support for research is somehow a luxury at moments defined by necessities. I fundamentally disagree. Science is more essential for our prosperity, our security, our health, our environment, and our quality of life than it has ever been before.

We are closely monitoring the emerging cases of swine flu in the United States.... But one thing is clear – our capacity to deal with a public health challenge of this sort rests heavily on the work of our scientific and medical community. And this is one more example of why we can't allow our nation to fall behind. Unfortunately, that's exactly what's happened.

So, I'm here today to set this goal: We will devote more than 3% of our GDP to research and development. We will not just meet, but we will exceed the level achieved at the height of the space race, through policies that invest in basic and applied research, create new incentives for private innovation, promote breakthroughs in energy and medicine, and improve education in math and science.

This represents the largest commitment to scientific research and innovation in American history.

The fact is an investigation into a particular physical, chemical, or biological process might not pay off for a year, or a decade, or at all. And when it does, the rewards are often broadly shared, enjoyed by those who bore its costs but also by those who did not. And that's why the private sector generally under-invests in basic science, and why the public sector must invest in this kind of research – because while the risks may be large, so are the rewards for our economy and our society.

But the renewed commitment of our nation will not be driven by government investment alone. It's a commitment that extends from the laboratory to the marketplace. And that's why my budget makes the research and experimentation tax credit permanent. This is a tax credit that returns two dollars to the economy for every dollar we spend, by helping companies afford the often high costs of developing new ideas, new technologies, and new products. Yet, at times, we've allowed it to lapse or only renewed it year to year. I've heard this time and again from entrepreneurs across this country: By making this credit permanent we make it possible for businesses to plan the kinds of projects that create jobs and economic growth.

Extracts from speech by President Barack Obama to US National Academy of Sciences, 27 April 2009 (Obama, 2009).

President Obama stressed the importance of the private sector in contributing to the national effort in R&D. Similarly, the EU target of overall expenditure of 3% of GDP on R&D is expected to include 2% investment by industry.

Policy implication

- Compared with 2006, overall the EU needs to invest a further US\$ 166.2 billion in R&D to achieve the 3% of GDP target for 2010.
- Most EU countries – with the exception of Finland and Sweden – need to increase the proportion of GDP they spend on R&D if they are individually to meet the overall EU 3% target by 2010. For Austria, Denmark, France and Germany this would require an additional investment of 0.5–1.0 % of GDP in R&D from their 2006 levels, while for the other EU countries increases

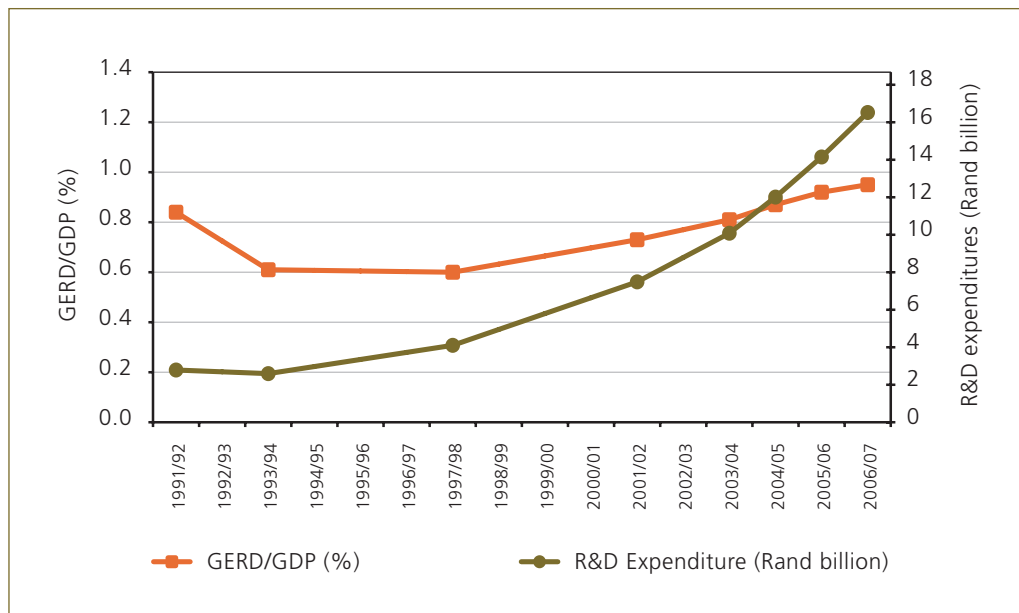
of more than 1.0 % of GDP would be required.

- Country strategies to reach the target are needed. The UK has announced a policy of strong investment in science and technology in response to the economic crisis and, beyond the EU, the USA has announced it will also devote more than 3% of its GDP to research and development – the largest commitment to scientific research and innovation in US history.

African Union target

The New Partnership for Africa's Development (NEPAD) spearheads the efforts of the African Union (AU) to improve Africa's performance across a range of development fields, including R&D. At the first NEPAD Ministerial Conference on Science and Technology in **November 2003, ministers of science and technology of 20 AU countries**

Figure 3 South African R&D investments and intensity 1991–2007



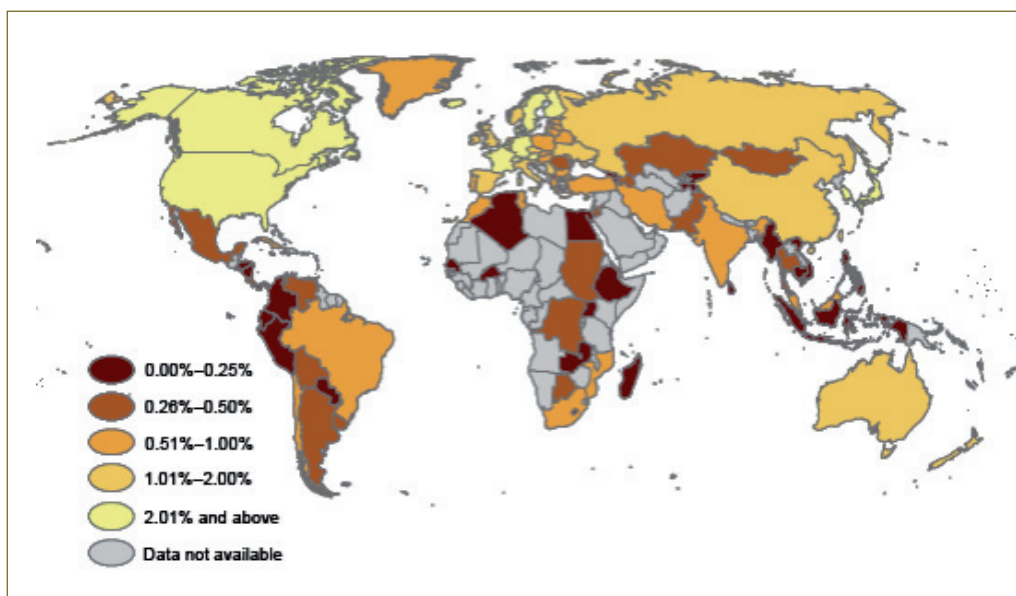
Source: NACI, 2008.

reaffirmed their commitment to increasing public spending on R&D to at least 1% of GDP within five years and the AU commitment to this 1% target has been reiterated on a number of occasions.

Unfortunately, there is almost no data on R&D investments by African countries. The only country in the region that regularly tracks and reports its R&D performance is South Africa, which had reached a GERD of 0.95% of GDP by 2007 (Figure 3), albeit with 56% of this coming from the business enterprise sector (NACI, 2008).

Data on R&D investments in other African countries appears only sporadically. The Global Forum is currently supporting a pilot study with Afristat (2009) to build capacity for health research related data in francophone Africa. UNESCO has provided a snapshot of available data globally on gross expenditures on R&D as a percentage of GDP for many countries, (Figure 4), from its 2006 global survey on statistics of science and technology (Fahmi, 2009; UNESCO, 2007). It is notable how little data was obtained on countries in Africa.

Figure 4 GERD as a percentage of GDP (2005 or latest available year)



Source: Fahmi, 2009.

A survey of R&D intensity by the Organization of the Islamic Conference (OIC) in 2009 included information (“data on the most recent year available between 2000 and 2006”) on Tunisia (1.03%) and Morocco (0.66%) in North Africa, and Mozambique (0.5%) in sub-

Saharan Africa (OIC, 2009). Other countries mentioned in the OIC report included Sudan (c. 0.3%), Egypt (c. 0.2%), Uganda (c. 0.2%), Burkina Faso (c. 0.2%) and Algeria (c. <0.1%). It was also noted that, while all Burkina Faso’s R&D was government financed, most

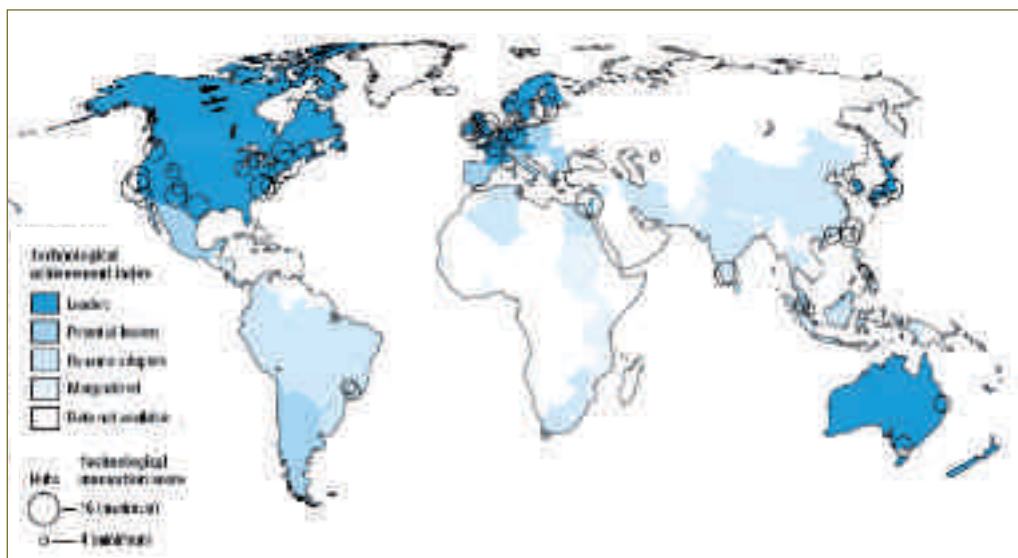
of the R&D funding in Mozambique (63.5%) and Uganda (56.9%) actually came from abroad.

As discussed by the Global Forum in a recent review of innovation for health (Matlin, 2008), the United Nations Development Programme (UNDP) has developed a Technology Achievement Index, with indicators selected for their relevance to important technology policy objectives for all countries, regardless of their level of development. The 2001 results for 72 countries for which data were available and of acceptable quality (Figure 5) highlighted the paucity of data and the weakness of technological achievement in Africa (UNDP, 2001).

While science and innovation in much of Africa has long lagged behind other regions, new approaches are now being seen, as reflected in the Tshwane

Consensus (Science in Africa, 2005). Africa's Science and Technology Consolidated Plan of Action 2006–2010 was first elaborated in 2005 by the African Union/NEPAD and is being implemented with assistance from UNESCO. It has adopted three flagship projects: i) capacity building in science and technology (S&T) and innovation policy; ii) enhancing science and technology education; and iii) the African Virtual Campus. The plan of action acknowledges Africa's low investment in science and technology and seeks to improve policy conditions and innovation mechanisms. It notes that science, technology and innovation indicators are crucial for monitoring Africa's scientific progress and acknowledges the value of indicators such as the target of a ratio of R&D spending to GDP of 1% for African countries (AU/NEPAD, 2005).

**Figure 5 Technology Achievement Index:
The geography of technological innovation and achievement**



Source: UNDP, 2001.

In recognition of the weakness of S&T in Africa (Pouris & Pouris 2009), the dearth of S&T indicators (UNECA, 2005), the challenges of producing reliable and internationally comparable data (Kahn, 2008), and the key importance of tracking efforts to improve the poor state of S&T in most of the continent, NEPAD has instituted the African Science, Technology and Innovation Indicators Initiative (ASTII) and the establishment of the African Observatory for Science, Technology and Innovation (AOSTI). ASTII aims at the development and adoption of

African common science, technology and innovation indicators, while AOSTI will ensure that the indicators and information gathering, as well as collation, compilation and validation are standardized (NEPAD, 2008).

Beyond these technical measures, the UN Economic Commission for Africa (ECA) has stressed the importance of policy measures and political commitment to move S&T to the centre of the development process (UNECA, 2005) (Box 3).

Box 3 Policy and political imperatives for science, technology and innovation in Africa

The new and strengthened technological regime requires strong political leadership and a better integration of science and technology and innovation policies – which are cutting across many sectors – with overall development policies, including economic, financial, budgetary, fiscal, labour, agriculture, industry, micro-enterprise development and others. This has far-reaching consequences for policy-making, as it implies that science and technology should move from the periphery to the centre of development policy processes and pervades all relevant policy areas impacting on the development and utilization of science and technology. Success in this realignment and ‘re-centring’ requires strong political commitment vis-à-vis science and technology and the full engagement of the science and technology community...

This ‘re-centring’ may be facilitated by the setting up or strengthening of Parliamentary Committees on Science and Technology (PCST) – already in existence in a few African countries – such as South Africa, Uganda, Nigeria and Kenya. It may also be facilitated by the appointment of high profile and highly credible and respected science and technology advisors to the President. The creation of Interdepartmental Science and Technology Fora (ISTF), comprising science and technology focal points of various ministries and governmental institutions dealing with issues related to science and technology may also be useful in ‘demonopolizing’ science and technology responsibilities and in bringing science and technology issues to the centre of the development policy process. ECA is encouraging the diffusion of these best practices throughout the continent.

UN Economic Commission for Africa, 2005

Policy implication

With the exception of South Africa, only sporadic and incomplete information is available on R&D intensity in African states. From the limited information available, the vast majority of AU countries are far from attaining the AU target of investing 1% of GDP in R&D. Two essential requirements need to be met urgently:

- 1 AU countries need to institute national policies and strategies to strengthen their investments in R&D.
- 2 Tracking systems, using standardized definitions and methodologies, need to be instituted and implemented to provide annual assessments of R&D intensity in each country.

In this regard, the current programmes of AU/NEPAD, UNESCO and the UN Commission for Africa have a vital role to play and should be strongly supported by AU member countries and development partners.

Other regions

In a comparative study (Satti & Nour, 2005) of S&T development indicators, it was concluded that Arab Gulf and

Mediterranean countries also lacked adequate investment in the financial and human resources necessary to promote S&T for development. As a consequence, they have lagged behind the rapidly advancing Asian countries in terms of S&T input and output indicators. In both regions most R&D and S&T activities are allocated within the public and university sectors, with very small contribution from the private sector.

The 2009 OIC report surveying R&D intensity in member states of the Organization of the Islamic Conference cited a number of non-African countries, including Azerbaijan, Brunei, Indonesia, Jordan, Kazakhstan, Kuwait, Kyrgyz Republic, Pakistan and Tajikistan, as all having R&D investments well below the OIC average of 0.47% of GDP, Brunei (0.02%) being the lowest of all.

The BRICSA group of countries (Brazil, Russian Federation, India, China and South Africa) are becoming key drivers of innovation among LMICs. Within this group, China has made both the largest investments and has also shown the greatest rate of increase in R&D as a proportion of GDP in the last few years (Table 2).

Table 2 GERD for BRICSA countries

Country	GERD as % of GDP	
	2003	2006 or latest available year
Brazil	0.88	1.02
Russian Federation	1.28	1.07
India	0.74	0.71 ^a
China	1.13	1.42 (1.49) ^b
South Africa	0.80	0.95

Note: ^a 2004 data; ^b 2007 data.

Source: OECD, 2009a.

Table 3 Expenditure on S&T as a percentage of GDP, Latin American and Caribbean countries

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Argentina							0.42	0.42	0.41	0.45	0.44	0.42	0.39	0.41	0.44	0.46	0.49
Bolivia		0.37	0.40	0.40	0.40	0.36	0.33	0.32	0.29	0.29	0.28	0.27	0.26				
Brazil	0.78	0.88	0.76	0.91	0.92	0.87	0.72			0.94	0.96	0.91	0.88	0.83	0.97	1.02	
Chile	0.51	0.53	0.58	0.63	0.62	0.62	0.53	0.49	0.50	0.51	0.53	0.53	0.68	0.67	0.67		
Colombia					0.29	0.30	0.27	0.27	0.21	0.20	0.14	0.14	0.15	0.18	0.18	0.18	0.18
Costa Rica					0.33	0.33	0.32	0.32	0.28	0.36	0.43			0.39	0.41		
Cuba	0.70	0.68	1.13	0.78	0.55	0.47	0.38	0.43	0.54	0.50	0.45	0.53	0.53	0.54	0.56	0.51	0.41
Ecuador					0.08	0.08	0.10	0.09	0.09			0.06	0.06	0.06			0.15
El Salvador									0.08								
Guatemala								0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.05
Honduras										0.06	0.05	0.05	0.06	0.06	0.06		
Jamaica												0.05	0.07				
Mexico			0.22	0.29	0.29	0.31	0.31	0.34	0.38	0.43	0.37	0.39	0.42	0.45	0.44	0.46	
Nicaragua							0.08						0.05				
Panama	0.38	0.38	0.34	0.36	0.37	0.38	0.38	0.37	0.34	0.35	0.40	0.40	0.36	0.34	0.24	0.25	
Paraguay												0.09	0.11	0.08	0.08	0.09	
Peru								0.08	0.10	0.10	0.11	0.11	0.10	0.10	0.15		
Trinidad & Tobago							0.10	0.11	0.13	0.12	0.11	0.10	0.14	0.12	0.12	0.12	0.09
Uruguay	0.25	0.15	0.19	0.07	0.14	0.28	0.28	0.39	0.22	0.26	0.24		0.26				0.36
Latin America & Caribbean	0.53	0.53	0.48	0.50	0.55	0.58	0.51	0.52	0.55	0.55	0.55	0.54	0.53	0.54	0.53	0.60	0.63

Source: RICYT, 2009.

For the region of the Americas, trends from 1990 to 2006 have been compiled by RICYT (2009). By 2006, the Latin American and Caribbean region had reached an average R&D intensity of 0.63% of GDP, overall representing a modest increase from 0.53% in

1990 (Table 3).

The importance of a long-term perspective for developing science, technology and innovation capacity has been stressed (Peng, 2009) (Box 4).

Box 4 Taking a long-term perspective for developing science, technology and innovation capacity

“A long-term perspective can help planners think together about the future, and get away from immediate constraints. Such visionary work is rarely the basis for immediate policy.”

– Geoff Oldham, former chairman of the United Nations Advisory Committee on Science and Technology for Development

China has taken such a long-term approach (Peng, 2009) with the release by the Chinese Academy of Sciences of a 50-year science strategy. This ‘roadmap’ for science and technology development is an extension of the Mid-to-Long-Term Plan for Development of Science and Technology (2006–2020), issued by the State Council of China, which highlights the importance of research in basic sciences and frontier technologies. The human health component projects that China will aim to transform from treating disease to preventing it. To do this it aims to combine insights from a variety of research areas including biology, environment, psychology and society.

annual assessments is an important step to support evidence-informed policy-making – coupled, as appropriate, with the adoption of national policies and strategies for R&D investment.

Among the BRICSA group of countries, China is investing strongly in R&D and has developed a very long-term strategy for science and technology, while Brazil, the Russian Federation and South Africa are investing close to or above the level of 1% of GDP. India lags significantly behind in this group and needs to increase its R&D investment significantly from the level of 0.71% reported for 2004.

Policy implication

The AU target of investing 1% of GDP in R&D provides a useful benchmark for assessing commitment to R&D in LMICs generally. The majority of LMICs do not assess or report their own R&D intensity, and instituting such

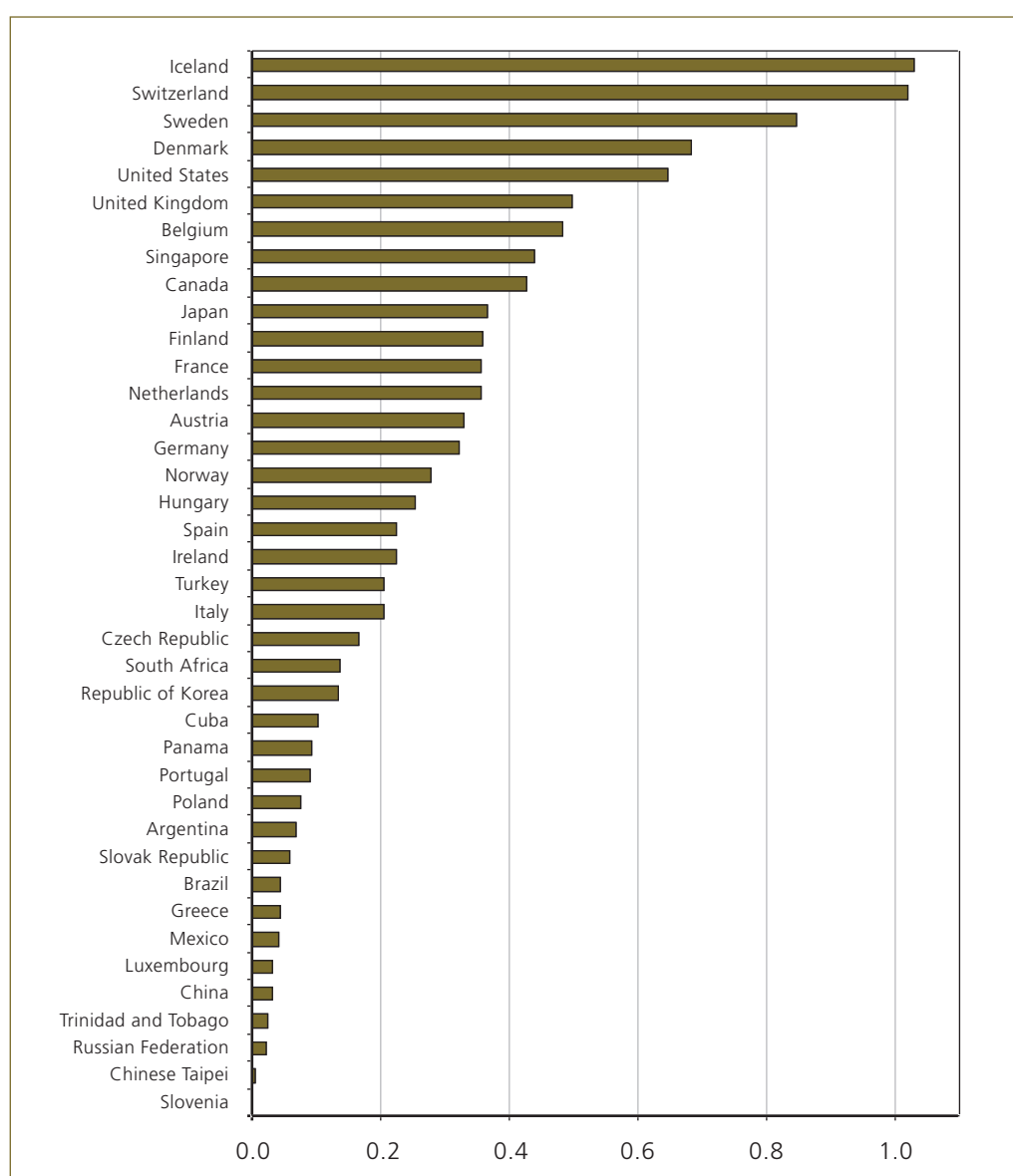
In the Latin American and Caribbean region, apart from Brazil, no country has reached the level of 1% expenditure of GDP on R&D and Cuba was the only other country that had reached the 0.5% level. Most countries in the region need to develop policies and strategies for increasing their investments in R&D.

A2 National R&D for health as a percentage of GDP;

A3 National R&D for health as a percentage of national health investments

The most recent (2005) data available (Global Forum, 2008) on national investments in R&D for health as a percentage of GDP is illustrated in Figure 6. There is an extremely wide variation in how much is invested, even among high-income countries.

Figure 6 Total investments in health R&D as percentage of GDP



Source: Global Forum, 2008.

There is no formal target for investments in R&D for health as a percentage of GDP. However, at the beginning of 2009 the Global Strategy and Plan of Action on Public Health, Innovation and Intellectual Property, which was agreed by intergovernmental negotiations (WHA, 2008), estimated that implementing the Plan would require US\$ 147 billion over the seven years between 2009 and 2015, or roughly US\$ 16 billion more per year, on average, in addition to the roughly US\$ 5 billion per year currently invested in health problems of LMICs (WHO, 2009a). As shown in Figure 6, several countries (Denmark, Iceland, Sweden, Switzerland, UK and the USA) invested 0.5% of GDP or more in R&D for health in 2005. If the other large economies with 2005 GDPs of US\$ 1 trillion or more were to increase their investments in R&D for health to 0.5% of their 2005 GDP, this would raise the net annual level of financing for R&D for health by US\$ 23 billion and a significant fraction of this increase could be devoted to problems relevant to the health needs of LMICs.

The latest (2005) data available (Global Forum, 2008) on national R&D for

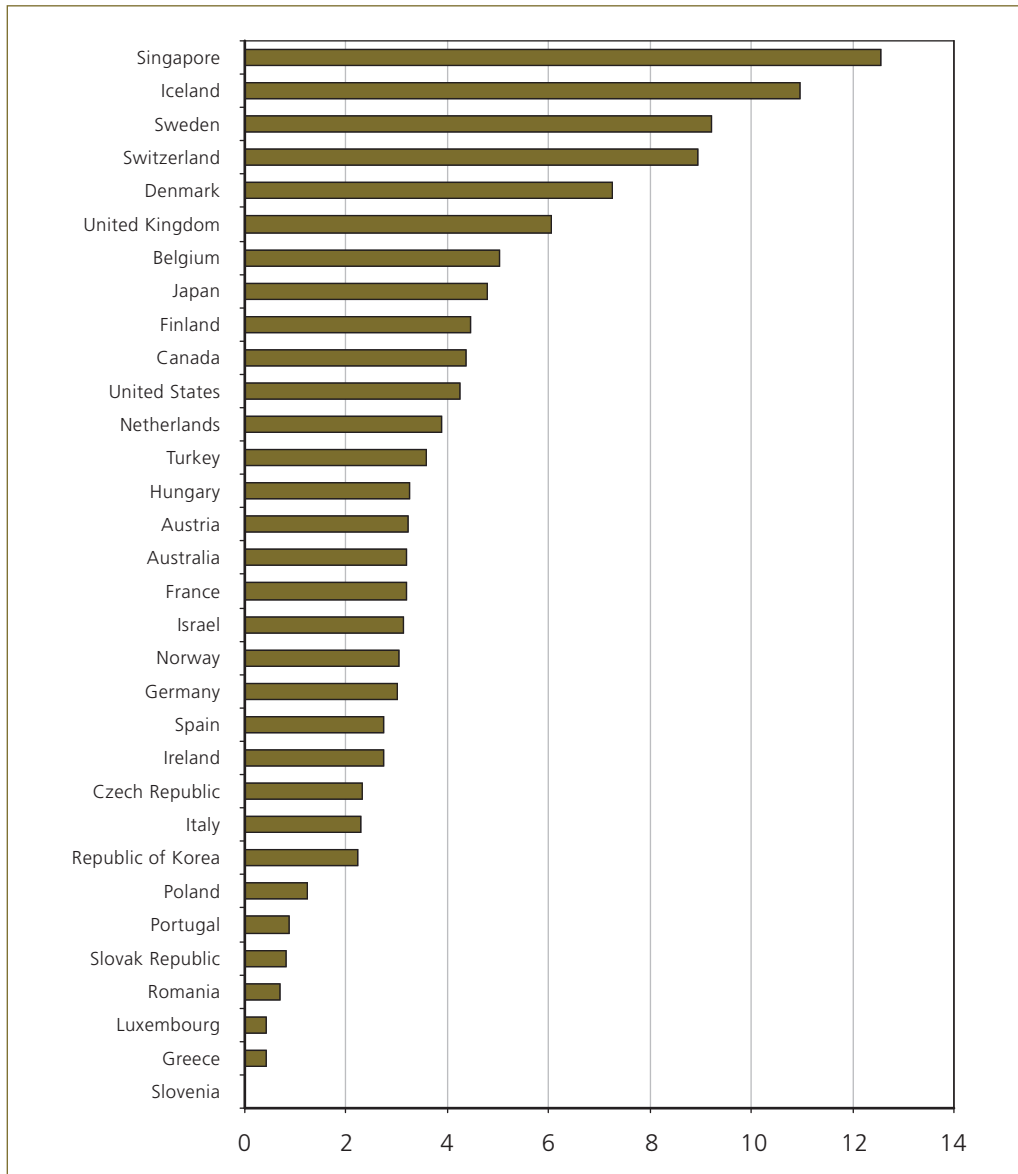
health as a percentage of national health investments is illustrated in Figure 7 for OECD countries. These countries mostly invest amounts equivalent to more than 2% of their health budgets in R&D for health, with several investing more than 4% and two (Iceland, Singapore) more than 10%.

Data on national R&D for health as a percentage of national health investments for LMICs is covered under element C2 below.

Policy implication

Investments in R&D for health are vital to improving global health and health equity. To meet the needs of financing the Global Strategy and Plan of Action on Public Health, Innovation and Intellectual Property, a greater level of global investment in R&D for health is required and a substantial portion of this could be met by high-income countries raising the proportion of their GDP devoted to R&D for health, to a level of 0.5%. This is target has already been surpassed by Denmark, Iceland, Sweden, Switzerland, the UK and the USA.

Figure 7 Total investments in health R&D as percentage of total national health investments (2005)



Source: Global Forum, 2008.

A4 National R&D for health as a percentage of total R&D

There is no agreed target for this element. The latest (2005) available data on national R&D for health as a

percentage of total investments in R&D (GERD) is illustrated in Figure 8 for OECD countries, which show a wide variation from 37% for Iceland to just 2% for Luxembourg, with an average for the countries shown of 17.3%.

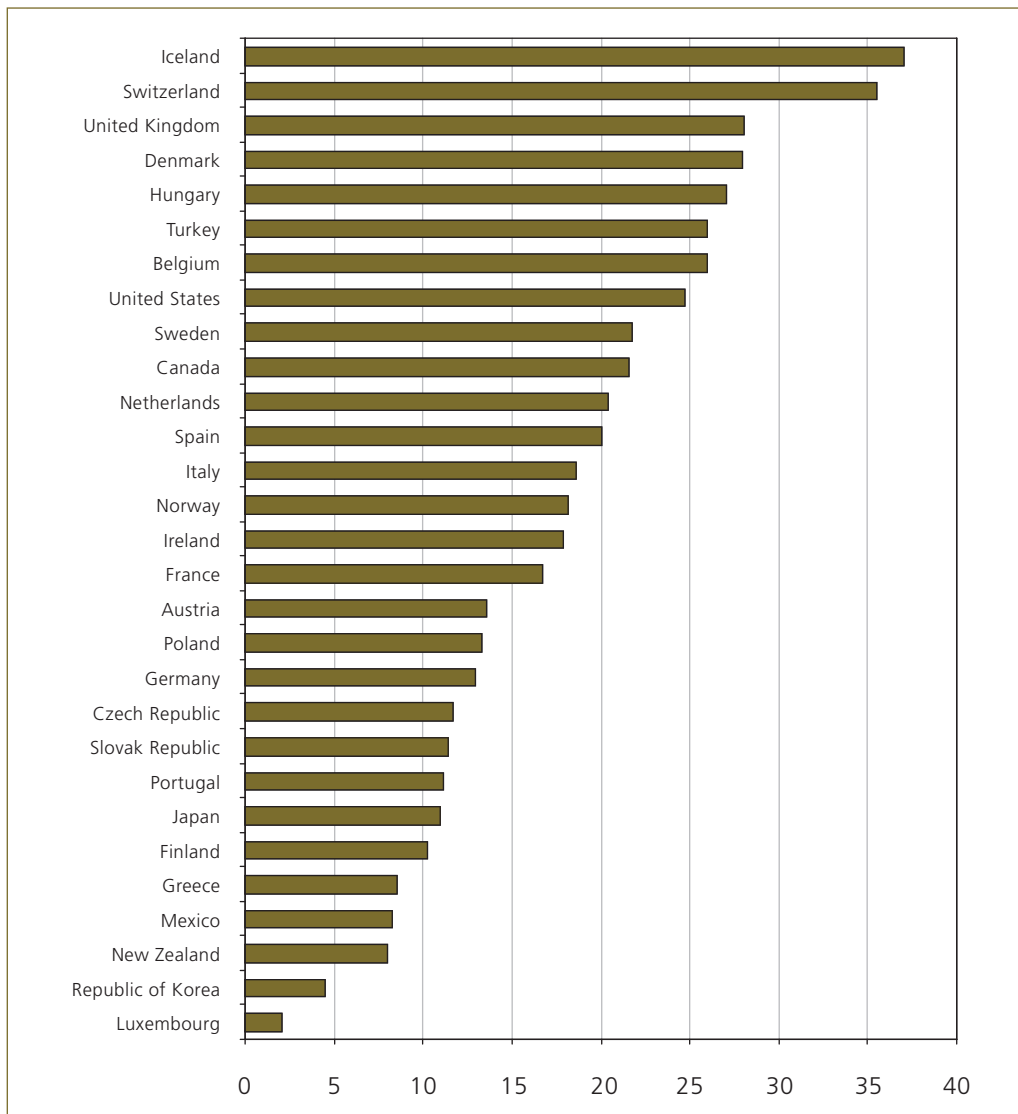
Figure 9 illustrates the percentages of total R&D invested in R&D for health in a range of non-OECD countries. Among the BRICS countries, South Africa's relative investment in health R&D (14.8%) comes closest to the average OECD level, while the other members of this group spend substantially less on health compared with R&D in other

sectors (Brazil 5.3%, India 4.3%, China 2.3%, Russian Federation 2.1%).

Policy implication

As a fundamental human right, health needs to be given a high priority in the policies of all countries, with the promotion and maintenance of good

Figure 8 National R&D for health as a percentage of total R&D: OECD countries

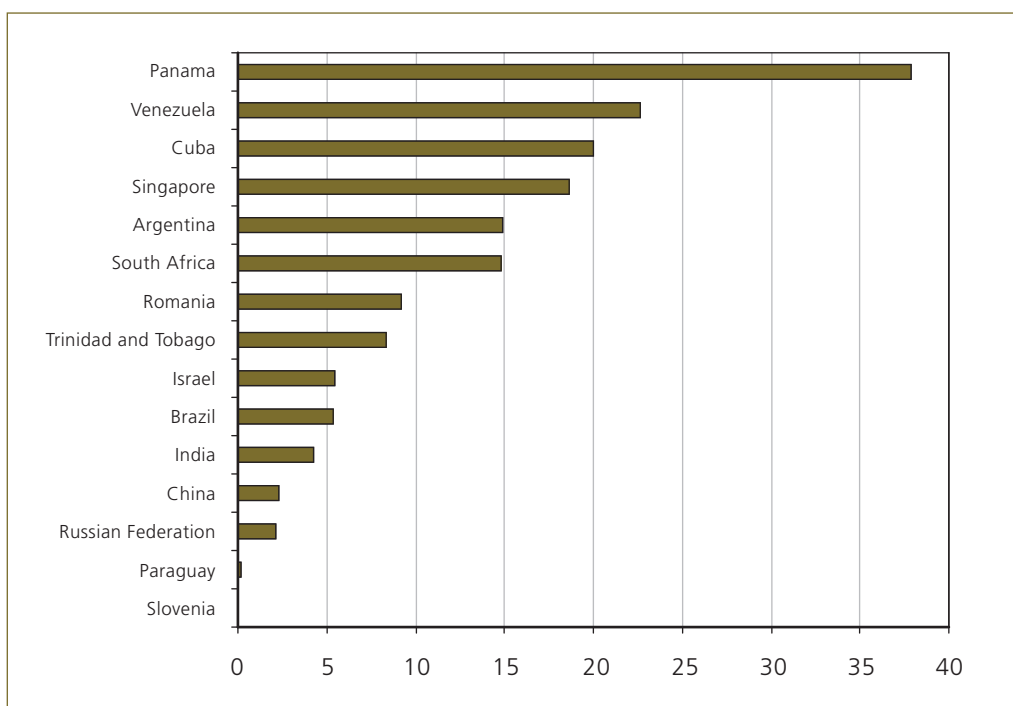


Source: Global Forum, 2008.

health and health equity being supported by adequate research capacity. Financing of R&D for health in most LMICs and

some HICs needs to be increased as a proportion of overall research spending, to reflect this priority.

Figure 9 National R&D for health as a percentage of total R&D: non-OECD countries



3 B: High-income countries

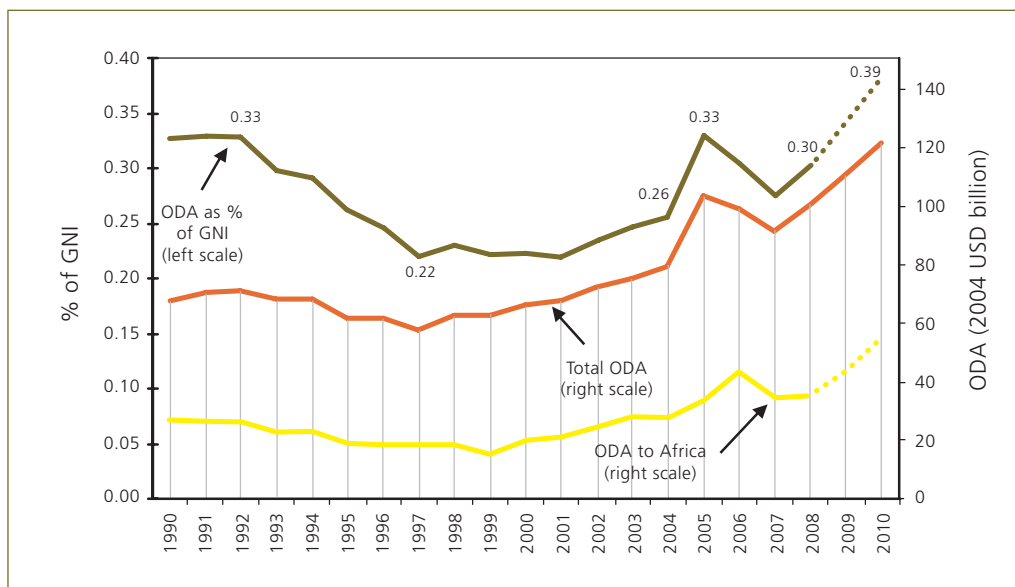
B1 Gap between actual ODA investments and commitment to invest 0.7% of GNI in ODA

The UN General Assembly adopted a resolution in 1970 stating, “**Each economically advanced country will progressively increase its official development assistance to the developing countries and will exert its best efforts to reach a minimum net amount of 0.7 per cent of its gross national product at market prices by the middle of the Decade**”. Although only a handful of countries (notably Denmark,

Luxembourg, Netherlands, Norway and Sweden,) paid attention to this target for many years, since the 2002 Monterrey Consensus on Financing for Development many EU countries have recommitted to reaching the target not later than 2015.

After falling significantly during the 1990s, net ODA by members of the OECD Development Assistance Committee (DAC)² is still recovering towards the levels seen in the early 1990s (0.33%) and is projected to reach 0.39% in 2010 based on current commitments (OECD, 2009a) (Figure 10).

Figure 10 DAC members' net ODA 1990–2008 and DAC Secretariat simulations of net ODA to 2009 and 2010

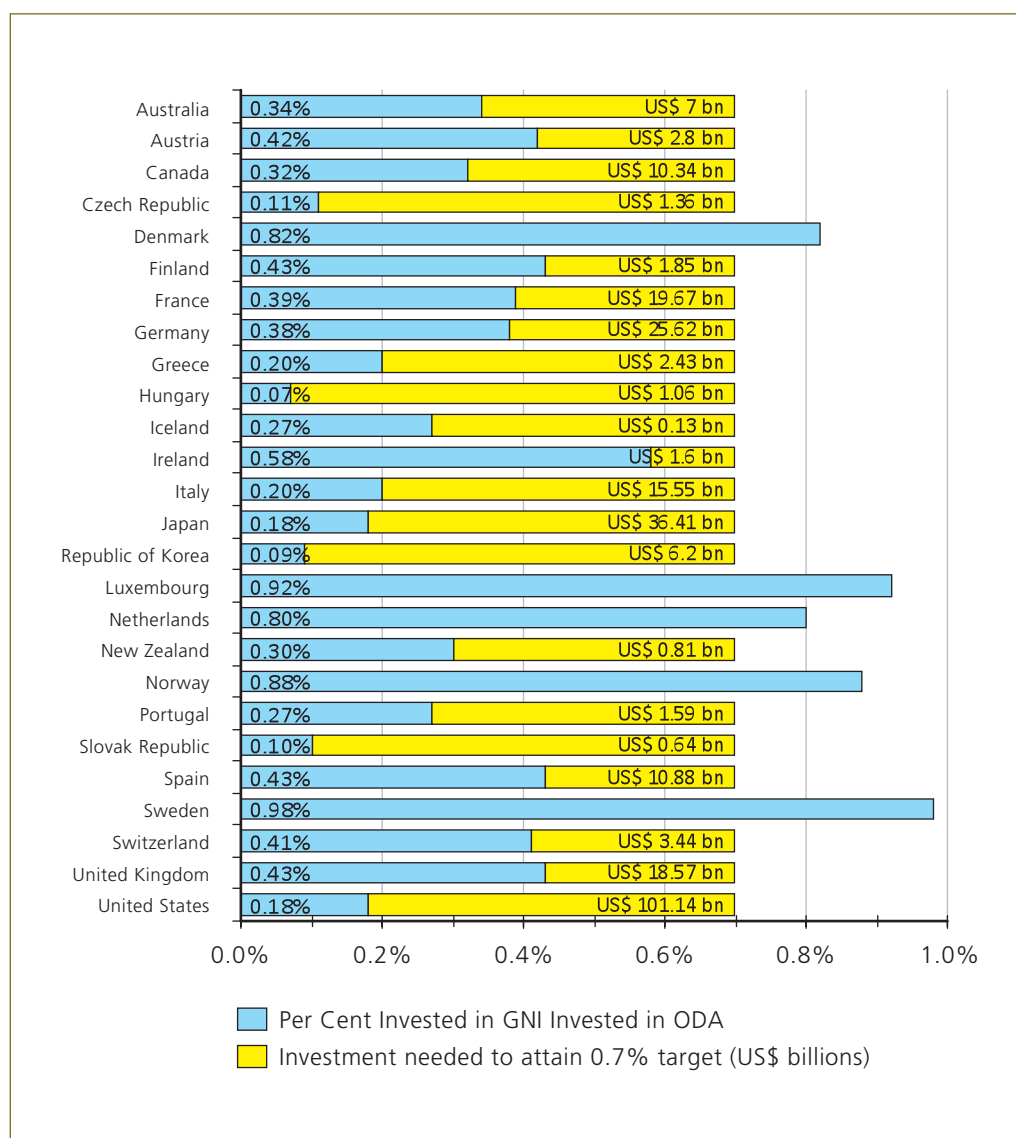


Source: OECD, 2009a.

In 2008, the World Bank's classification³ of 'high-income countries' (those having a 2008 GNI per capita of US\$ 11 906 or greater) included 66 countries. OECD data for 2008 ODA investments (OECDb, 2008) is available for only

26 countries⁴ (Figure 11). Only five of these countries have so far met the 0.7% UN target and the remaining countries illustrated would need to increase their combined ODA by US\$ 268.61 billion to reach the target.

Figure 11 Percentage of GNI invested in ODA by high-income countries (2008)

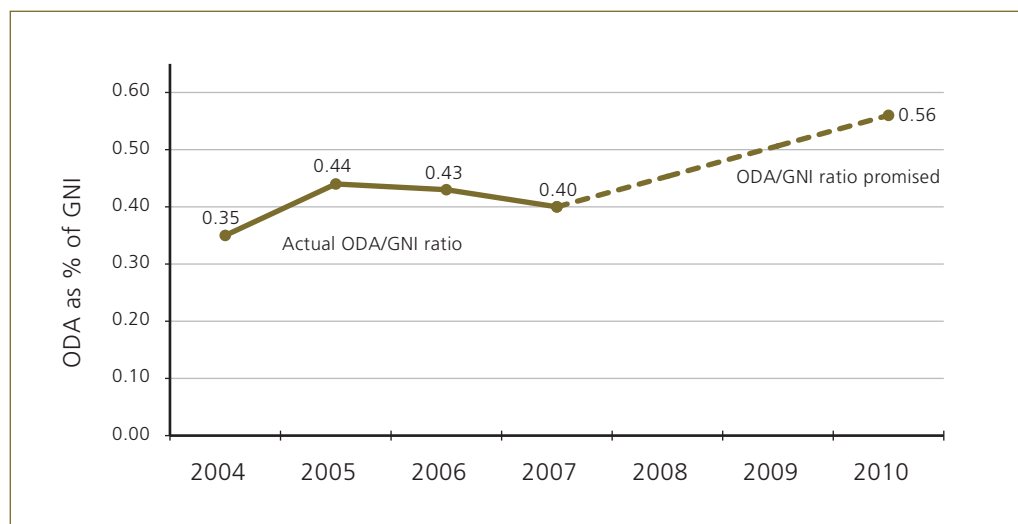


Note: 2007 data was used for Iceland.
Source: OECD, 2008b.

The G8 Gleneagles Summit reported: **“The EU has pledged to reach 0.7 per cent ODA/GNI by 2015 with a new interim collective target of 0.56 per cent ODA/GNI by 2010. The EU will nearly double its ODA between 2004**

and 2010 from € 34.5 billion to € 67 billion”. OECD data on the extent to which the EU had progressed towards these targets by the end of 2007 is shown in Figure 11 (OECD, 2008).

Figure 12 EU ODA as a percentage of GNI



Source: OECD, *Aid targets slipping out of reach?*

The financial crisis and ODA

Against the background of widely articulated fears of cutbacks, early responses to the 2008 financial crisis by some donors provided a mixed picture. For example:

- Ireland, which had aimed to increase its ODA to 0.6 % of GNI by 2010 and to 0.7% by 2012, made a series of cuts over a 10-month period from July 2008 which amounted to an overall reduction of 22% (€255 million) in its 2009 ODA budget (Concern, 2009).
- Italy announced in Dec 2008 that the 2009 ODA budget would be cut by 56% (AidWatch, 2009).
- Latvia, one of the newest contributors to ODA, announced in Jan 2009 that the year's ODA budget was being cut by 100% (Concern, 2009).
- Norway is continuing to increase its ODA, which will reach 1% of GNI in 2009 (NORAD, 2009).

- The UK's ODA will also continue to rise in 2009 (DFID, 2009).
- The new Obama administration in the USA announced its intention to double its foreign assistance by 2015 (US Department of Statistics, 2009).
- Despite the fact that its asset value decreased by 20% in 2008, the Bill and Melinda Gates Foundation announced that it would increase its spending from US\$ 3.3 billion in 2008 to US\$ 3.8 billion (7% of assets) in 2009 (BMGF, 2009).

A further, complicating factor is that major shifts have been occurring in exchange rates of many currencies since the financial crisis began, sometimes adversely impacting on the value of ODA contributions. For example, the value of the British pound fell significantly against the US dollar during 2008.

At a high-level meeting in Paris on 27–28 May 2009, DAC and non-DAC

OECD donors adopted an Action Plan “in response to the development challenges raised by the global economic and financial crisis”. The Action Plan was intended to feed into other major international forums, such as the OECD Ministerial Council Meeting, G8 Summit, UN Conference on the World Financial and Economic Crisis, the G20 Summit and the UN General Assembly (OECD, 2009b). While reaffirming existing ODA commitments, especially for Africa, the Action Plan recognized that the wide range of policies being deployed by development partners in response to the crisis would have major development impact. The Action Plan therefore stressed the need for:

- integrating crisis management with long-term growth and the MDGs;
- embedding the Paris Declaration and the Accra Agenda for Action into the crisis response;
- signalling greater predictability in the international response;
- ensuring complementarity between ODA and other development flows;
- monitoring and accounting for responses to the crisis.

Policy implication

To reach the ODA targets to which they have made commitments, the G8, the EU and other DAC member countries need to increase their ODA substantially during the next few years, collectively contributing an additional US\$ 268.61 billion per year if they are to reach the UN 0.7% target.

B2 Gap between actual annual increase in ODA and commitment to double aid between 2005 and 2010 – an extra US\$ 50 billion worldwide and US\$ 25 billion for Africa

Paragraph 28 of the G8 Gleneagles Summit Statement on Africa stated: “On the basis of donor commitments and other relevant factors, the **OECD estimates that official development assistance from the G8 and other donors to all developing countries will now increase by around \$50 billion a year by 2010, compared to 2004.**”

G7 contributions to ODA since 2004, including OECD estimates for 2008, are shown in Figure 13. In 2004, the G7 collectively committed US\$ 57.6 billion to ODA and by 2008 this had risen to US\$ 80.8bn, which represents an increase of US\$ 23.2 billion (or 46% towards the attainment of the goal).

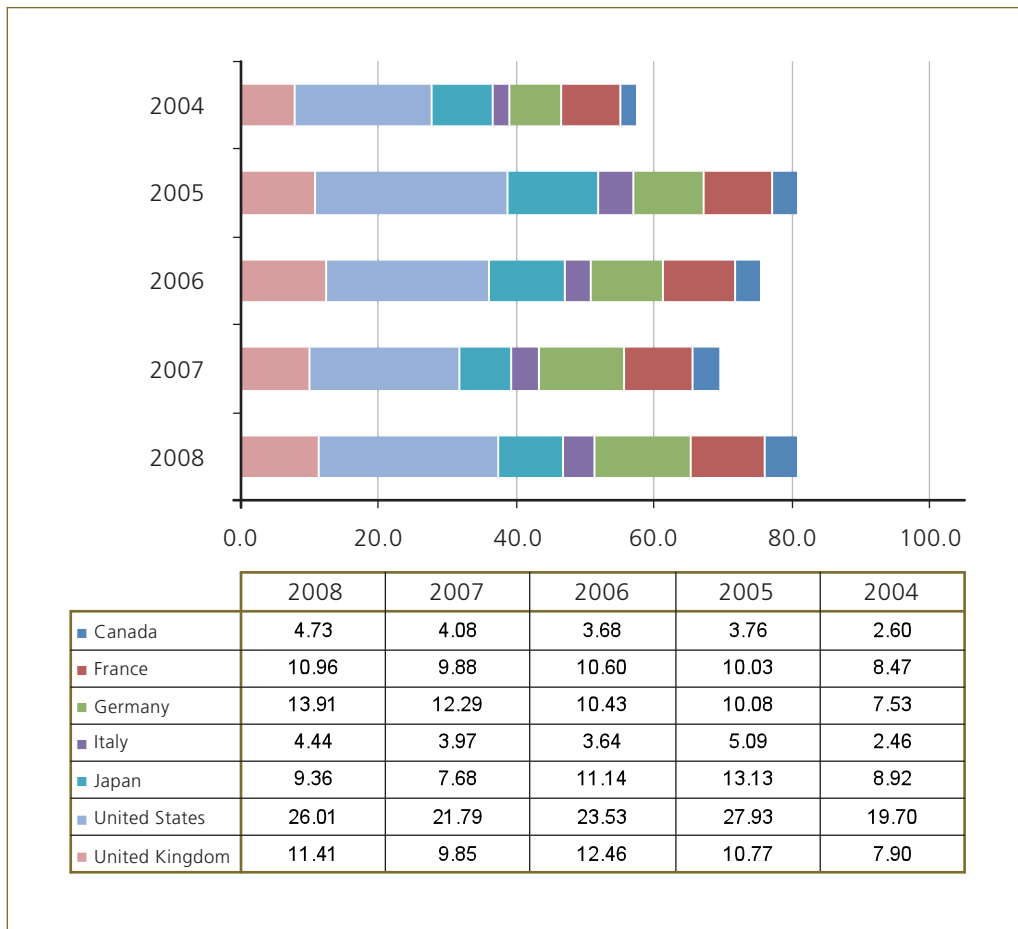
In 2007, total Russian ODA was US\$ 210 million, or 0.02% of GNI. This level reflected an increase from US\$ 100 million in 2006 (One, 2008).

As shown in Figure 10, net ODA to Africa increased substantially from 2004 (US\$ 29.5 billion) to 2006, but a large part of this was due to exceptional debt relief, especially for Nigeria. Excluding debt relief grants, underlying ODA to Africa rose by 12% in real terms from 2004 to 2006. In 2007, net ODA to Africa amounted to US\$ 38.7 billion. The Gleneagles G8 summit estimate that donors’ total commitments would amount to “an increase in ODA to Africa of US\$ 25 billion a year by 2010, more

than doubling aid to Africa compared to 2004” is generally interpreted as meaning an increase in ODA of US\$ 25 billion at 2004 prices and exchange rates. Thus, for the promise to be fulfilled, ODA to Africa would need

to be at least \$54.5 billion in 2010, at 2004 prices and exchange rates. To achieve this target, donors will need to boost their aid to Africa between 2007 and 2010 by over 17% annually (OECD, 2008; One, 2008).

Figure 13 ODA commitments by G7 countries in US\$ billions, 2004–2008



Note: The data for 2008 are preliminary, pending detailed final data to be published in December 2009. The data are standardized on a calendar year basis for all donors, and so may differ from fiscal year data available in countries' budget documents.

Source: OECD, 2009a

Policy implication

To fulfil the Gleneagles commitments for general increases in ODA and for specific ODA increases for Africa, the G7 will need to increase their ODA by about US\$ 30 billion between 2007 and 2010 and total DAC contributions of ODA for Africa will need to rise by over 17% annually in that period.

B3 Gap between actual ODA investments in R&D for health and target to invest 5% of health ODA in R&D for health

The Commission on Health Research for Development (1990) recommended that **5% of development assistance to health should be allocated to health research and research capacity strengthening.**

As noted in last year's Report Card, a study by the Kaiser Family Foundation (Kates et al., 2008) published in 2008 showed that ODA to health has been rising steeply during recent years. An important new initiative by the Institute for Health Metrics and Evaluation (IHME) at the University of Washington has now provided detailed documentation of development assistance for health from 1990–2007 and IHME will produce annual reports in future (Ravishankar, 2009; IHME, 2009). Key findings of the IHME study included:

- Development assistance for health (measured in real 2007 US\$) quadrupled from US\$ 5.6 billion in 1990 to US\$ 21.8 billion in 2007, with the most dramatic gains having occurred in the period 2002–2007.

- Contributions from donor governments over the period 1990–2007 averaged nearly two thirds of total development assistance for health flowing to LMICs (lowest 60%, highest 76%).
- The proportion of health aid via bilateral agencies fluctuated considerably, being highest in 1990 (46.8%), lowest in 2001 (27.1%) and rising again to reach 34% in 2007; while overseas health aid from nongovernmental organizations (NGOs) provided a quarter of the total in 2007 (Figure 14)
- Private sources of funding accounted for a growing share of total health assistance, up from 19% in 1998 to 26.7% in 2007.
- Private sector in-kind contributions, in the form of technical assistance and drug donations, constitute a significant share of total health aid, estimated at US\$ 8.7 billion (40%) out of US\$ 21.8 billion in 2007 (although the current methods being used to assign values to those contributions may mean that the figures could be inflated).

Of the US\$ 21.8 billion provided by all development assistance partners in 2007 to support health in LMICs, if 5% of this were allocated to R&D and research capacity strengthening this would amount to US\$ 1.1 billion. More specifically, support to health in LMICs through bilateral channels in 2007 amounted to US\$ 7.4 billion and 5% of this would provide US\$ 370 million of financing for R&D and research capacity strengthening.

The IHME study does not cover the proportion of health assistance from

bilateral sources that is allocated to R&D and comprehensive data on this is not available at present. The Global Forum is initiating work during 2009 to estimate these investments.

Policy implication

- To reach the target, HICs should continue increasing the proportion of health ODA devoted to the broad field

of research for health – including, but not limited to, health R&D and research capacity strengthening.

- Development assistance partners should systematically track and report on the proportions of their health ODA that is allocated to health R&D and research capacity strengthening and should use the information in steering aid towards meeting the 5% target.

4 C: Low- and middle-income countries

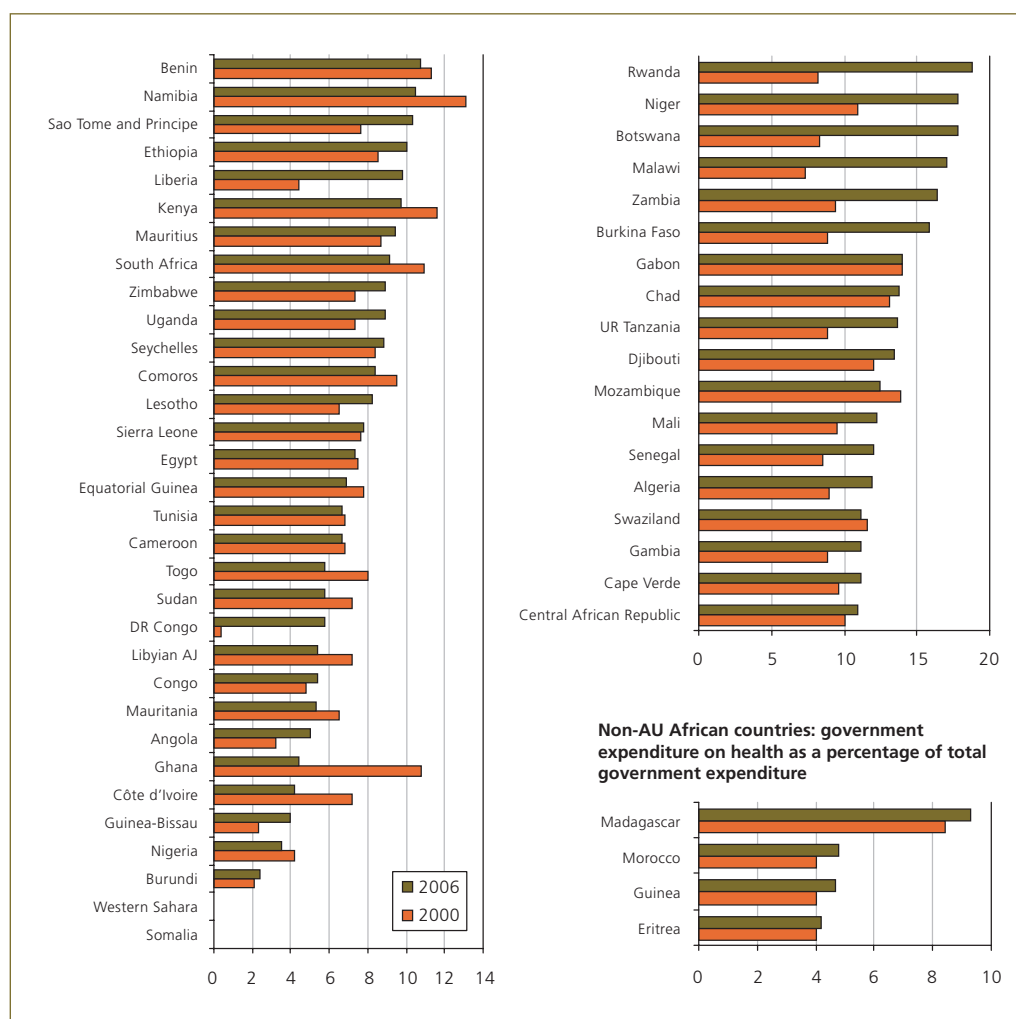
C1 Gap between actual investments in health and target to spend 15% of domestic public spending on health

In the 2001 Abuja Declaration, Heads of State and Government of the Organization of African Unity (OAU) pledged “**to set a target of allocating at least 15% of our annual budget to the improvement of the health sector**”. While this 15% commitment only applied to members of the OAU (now called the African Union), it is similar to government spending levels on health seen in HICs and provides a useful benchmark for assessing the levels of health spending by LMICs³ generally.

Africa

African Union: Government expenditure on health as a percentage of total government expenditure in African Union (AU) countries⁵ is illustrated in Figure 15 (WHO, 2009b). By 2006, six members of the AU (Botswana, Burkina Faso, Malawi, Niger, Rwanda and Zambia) had met the commitment made in the 2001 Abuja Declaration and these countries showed among the largest increases in government health spending since 2000. At the other end of the scale, five countries (Burundi, Côte d’Ivoire, Ghana, Guinea-Bissau and Nigeria) were still spending less than 5% of the government budget on health in 2006 (no data was available for Somalia and Western Sahara).

Figure 14 AU and non-AU African government expenditure on health as a percentage of total government expenditure 2000–2006



Source: WHO, 2009b.

Non-AU African countries: Other regions

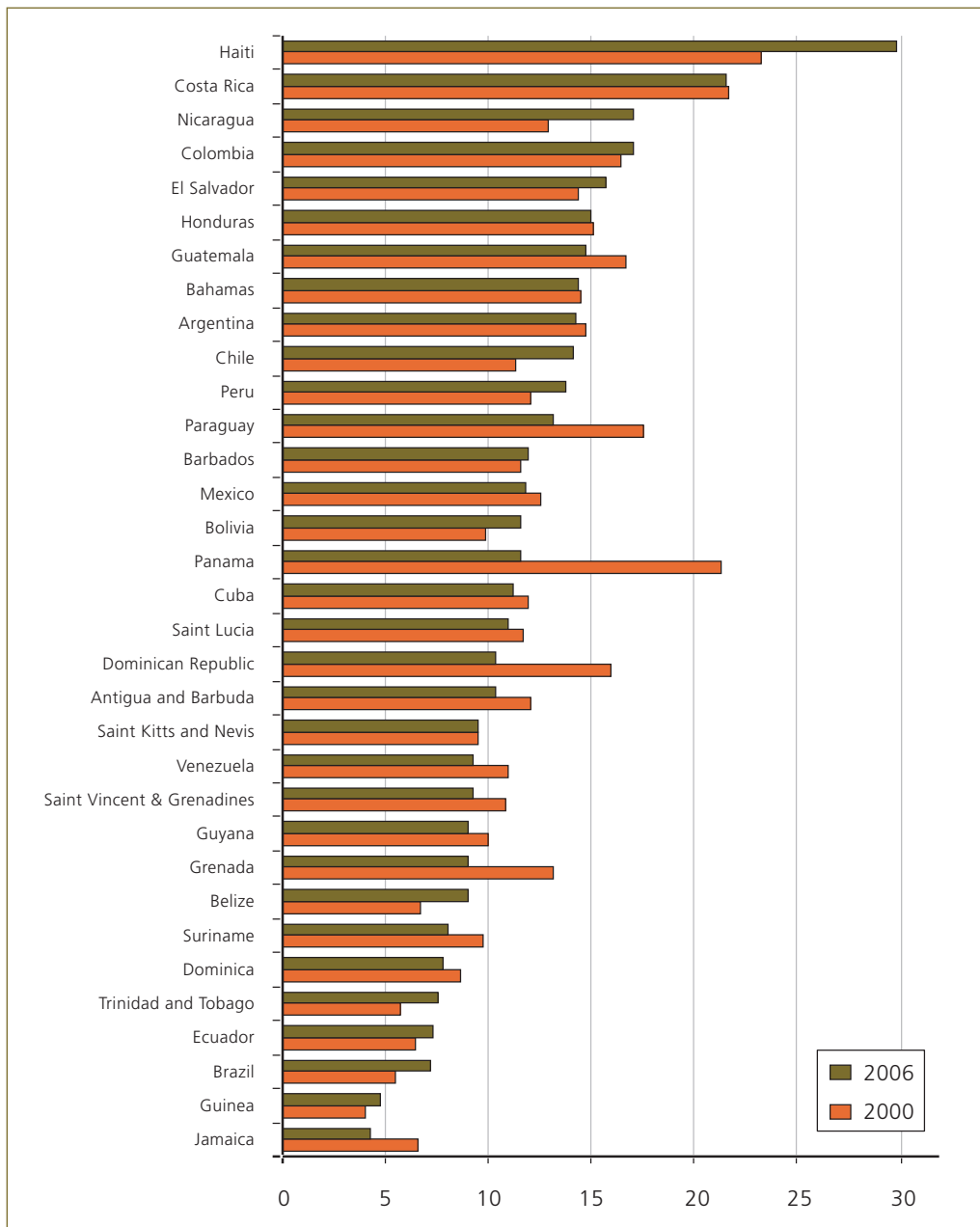
Government expenditure on health as a percentage of total government expenditure in the four non-AU African countries is also illustrated in Figure 14. Eritrea, Guinea and Morocco all increased their government health expenditure to above 4% of total government expenditure between 2000 and 2006, while Madagascar increased from 8.4% to 9.3% in this period.

In its 2009 statistical report, the World Health Organization (WHO) notes that, in 2006, global expenditure on health was about 8.7% of GDP. This translates to about US\$ 716 per capita on average, but with tremendous variation ranging from US\$ 31 per capita in the South-East Asia region to US\$ 2636 per capita in the Americas. The government share

in health spending varies from 76% in Europe to 34% in South-East Asia, where government expenditure in health is low. The shortfall is made up in low-income countries by private spending, about

85% of which is out-of-pocket, which leads to a high probability of catastrophic payments that can result in poverty for the household. External resources are becoming a major source of health funding

Figure 15 Latin America and Caribbean government expenditure on health as a percentage of total government expenditure 2000–2006



Source: WHO, 2009b.

in low-income countries. From a share of 12% of total health expenditure in 2000, external resources represented 17% of low-income country health expenditure in 2006. Some low-income countries have two thirds of their total health expenditure funded by external resources. In these situations, predictability of aid is an important concern.

Among the Latin American and Caribbean countries, Colombia, Costa Rica, El Salvador, Haiti, Honduras and Nicaragua spent more than 15% of the government budget on health in 2006, with Argentina, Bahamas, Chile and Guatemala coming close with more than 14% expenditure (Figure 15).

In the Asia-Pacific region, LMICs that spent more than 15% of the government budget on health in 2006 were the Federated States of Micronesia, Nauru, Timor-Leste and Tuvalu, which spent a massive 38.1%. These were also among the countries that showed the greatest improvements since 2000. The Marshall Islands, Solomon Islands and Turkmenistan all invested between 14% and 15% of government expenditure in health. Countries with extremely low levels of investment in health (<5% of government expenditure) were India, Iraq, the Lao People's Democratic Republic, Myanmar and Pakistan. Almost a third of the countries in this region showed no increase or an actual decrease in government investment in health in the 2000–2006 period (Figure 16).

Policy implication

- The commitment by AU countries to invest 15% of the government

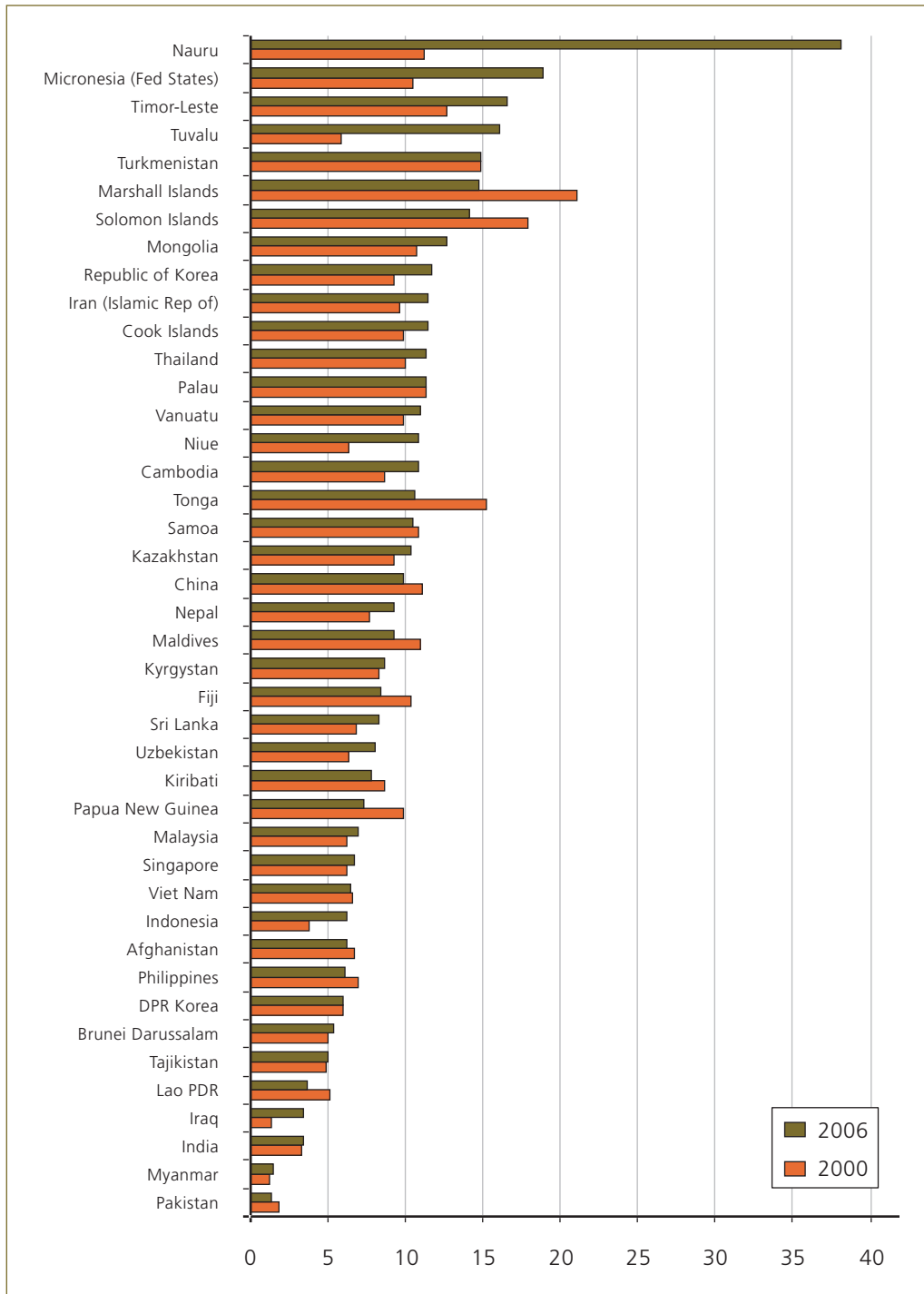
budget in health was being met in 2006 by Botswana, Burkina Faso, Niger, Malawi, Rwanda and Zambia. Other AU members need to make greater efforts to reach this target – in particular Burundi, Côte d'Ivoire, Nigeria, Ghana and Guinea-Bissau, all of which were still spending less than 5% of the government budget on health in 2006.

- Investment of 15% of the government budget in health is a valuable benchmark of the commitment to health by LMIC governments generally. Outside the AU, in the Latin American and Caribbean region Colombia, Costa Rica, El Salvador, Haiti, Honduras and Nicaragua exceeded this level of health spending in 2006, as did the Federated States of Micronesia, Timor-Leste, Tuvalu and Nauru in the Asia-Pacific region. Countries spending less than 5% of the government budget on health in 2006 included Guinea and Jamaica in the Latin American and Caribbean region and India, Iraq, the Lao People's Democratic Republic, Myanmar and Pakistan in the Asia-Pacific region.

C2 Gap between actual investments in R&D for health and target to spend 2% of national health budgets on health research

In its 1990 report, the Commission on Health Research for Development recommended that **LMICs should aim to spend 2% of their government health budgets on health research and research capacity strengthening.** As yet, few LMICs report their investments in health research so only

Figure 16 Asian and Pacific government expenditure on health as a percentage of total government expenditure 2000–2006



Source: WHO, 2009b.

a limited picture is available at present and in 2005 no LMIC had attained the 2% target. Figure 17 illustrates the data for two groups of countries:

- Within the **BRICSA group**, according to OECD data, South Africa was making the biggest investment in health R&D as a proportion of health spending in 2005, while Brazil, China, India and the Russian Federation were all investing well below 1%.
- In **Latin America and the Caribbean**, Cuba, Panama and Venezuela were making the largest investments in health R&D as a proportion of health spending in 2005.

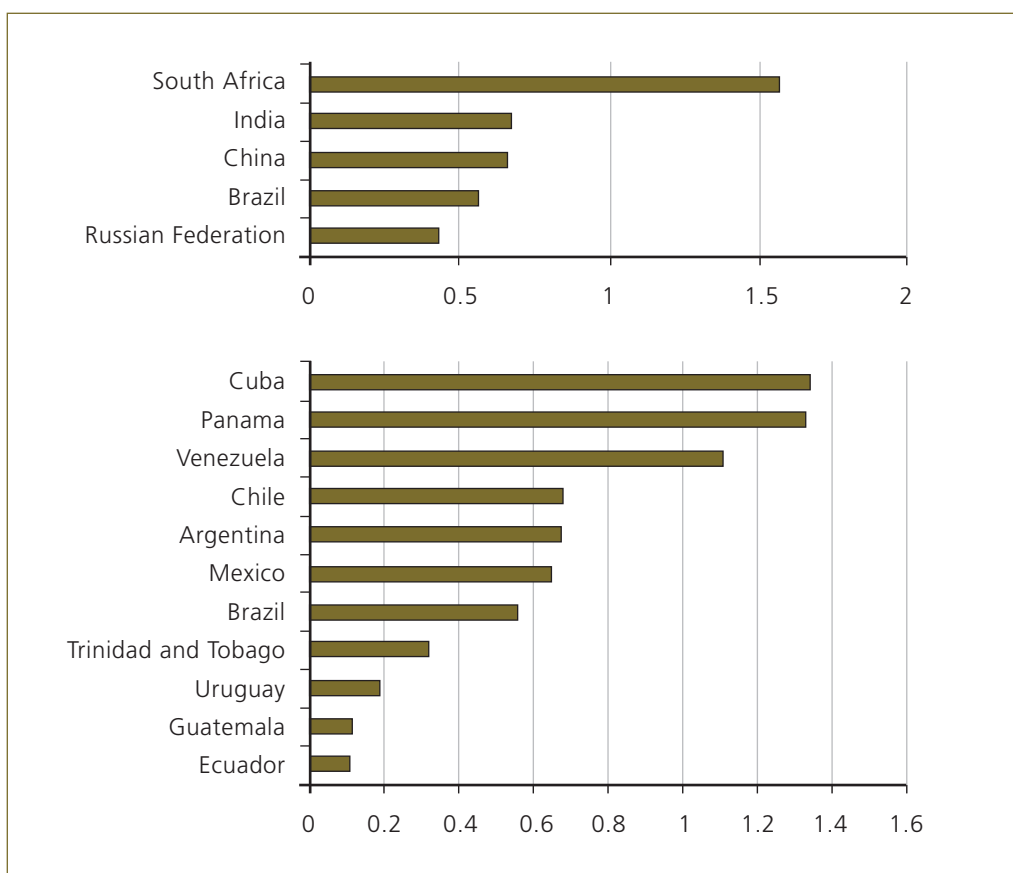
The 2% target has most recently been re-endorsed by the Global Ministerial Forum on Research for Health in Bamako in November 2008. WHO has developed a systematic approach to national health research systems analysis (Sadana & Pang, 2004) and the WHO Regional Office for Africa is undertaking a major programme to survey national health research systems

in the region (WHO-AFRO, 2008), while the new Health Research Web being launched by the Council on Health Research for Development (COHRED, 2009) will accumulate data on country health research systems. It is hoped that these initiatives, together with the efforts that the Global Forum is making to encourage LMICs to adopt regular, systematic resource tracking, will lead to much greater availability of annual and internationally comparable data on expenditures on R&D for health.

Policy implication

- Following recent re-affirmations of the target that LMICs should aim to spend 2% of their government health budgets on health research and research capacity strengthening, all LMICs need to put in place policies and strategies to reach this target.
- For most LMICs there is also a need to institute national systems for tracking and reporting health R&D investments if the commitment to the 2% target is to have any meaning.

Figure 17 Total expenditure on health R&D as a percentage of total national health expenditure 2005



Source: Global Forum, 2008

5 D: Global health initiatives and development agencies

D.1 Global health initiatives and development agencies

The general target that **5% of development assistance to health should be allocated to health research and research capacity strengthening** was first recommended in 1990 by the Commission on Health Research for Development. The extent to which bilateral donors are meeting this target is discussed above under element B3.

Since 1990, the role of other actors in global health has increased enormously – in particular, intergovernmental agencies and the private not-for-profit sector. In the 2006 Accra Communiqué, ministers of health and heads of delegation of 14 African countries urged **global health initiatives and development agencies to devote at least 5% of their overall health investment portfolio to support research capacity of countries, dissemination of research findings and management of knowledge.**

A new tracking study by the Institute for Health Metrics and Evaluation (IHME) (2009) demonstrated the greatly increased role of new actors over the last two decades as providers of development assistance to health. For example, from 1990 to 2007 development assistance for health rose from US\$ 5.59 billion to US\$ 21.79 billion. In particular, apart from bilateral development agencies, major health contributions are now being provided by a range of international development agencies and global health initiatives, including development banks, foundations, multilateral organizations and NGOs. This section examines the information currently available about the contributions these actors are making to research.

Development Banks

World Bank: As highlighted in the 2008 Report Card (Global Forum, 2008), the World Bank is not a donor agency but acts almost exclusively as a lender to the economies of LMICs, including to the health sector, through the International Development Association (IDA) and the International Bank for Reconstruction and Development (IBRD).

- The World Bank does not have a formal policy commitment to include a specific research allocation in its lending. However, it does encourage countries to allocate up to an initial 1% of the total operations budget in loans to ‘analytical work’ (a term commonly used in the Bank to cover research) in support of the programmes funded. Insufficient use is made of this facility by countries. The World Bank announced in February 2009 that it expected

to triple its lending for health programs to US\$ 3 billion this year to mitigate the impact of the global credit crisis in poor countries. If LMICs took full advantage of the opportunity to allocate 1% of these loans to ‘analytical work’, this could generate US\$ 30 million of funding for country-based research, activities in 2009.

- In the financial year to June 2008, the World Bank’s Development Grant Facility (DGF) disbursed US\$ 178.52 million in grants to 55 programmes, of which 10 were in the Bank’s Health, Nutrition and Population sector. This health funding amounted to US\$ 21.1 million, of which US\$ 9.4 million (44.5%) was allocated to health R&D.

Regional development banks: The Asian Development Bank (ADB), the African Development Bank (AfDB) and the Inter-American Development Bank (IDB) provide targeted financial and technical assistance to LMICs within their region of focus. The IHME tracking study (2009) has reported that the combined contributions by ADB, AfDB and IDB to the health sector in 2007 amounted to about US\$ 0.4 billion. No information is currently available about the use of any portion of this health funding for research.

Foundations and NGOs

Bill and Melinda Gates Foundation (BMGF): The BMGF committed close to US\$ 2 billion per year in 2006 and 2007 to global health, although actual disbursements were substantially lower according to the IHME study (2009).

Out of about US\$ 1.2 billion dispersed in 2007, one third was allocated to universities, research institutions and product development partnerships for health R&D activities.

Other foundations and NGOs: The USA is by far the largest source of private giving, including to the health sector. Compared with the BMGF, contributions to global health by other US-based foundations are relatively small, collectively amounting to less than US\$ 300 million in 2007. Non-US based NGOs contributed over US\$ 230 million in 2006 (IHME, 2009). As yet, information on the proportion of this global health funding allocated to research is not available.

Multilateral organizations

European Commission (EC): Despite the overall importance of the Europe Union as the world's largest source of development assistance, the EC is a relatively modest contributor to the health sector in LMICs, having accounted for less than US\$ 0.5 billion per year in recent years (IHME, 2009). There is no specific policy regarding allocation of EC health sector support to research.

United Nations agencies: The IHME study (2009) has estimated contributions to development assistance for health in 2007 to be in the region of US\$ 1.7 billion for WHO and US\$ 0.7 billion for the United Nations Children's Fund (UNICEF), with smaller amounts for the United Nations Population Fund (UNFPA) and the Joint United Nations Programme on HIV/AIDS (UNAIDS).

Of these agencies, WHO is the only one with a research mandate built into its constitution, but it does not have an overall policy on the fraction of its funding spent on research centrally or at regional or country levels. However the WHO Regional Office for the Eastern Mediterranean has adopted a 2% target for the proportion of its health sector assistance spent on research.

WHO's regular income has remained relatively constant for the last two decades at around US\$ 0.5 billion per year and represents less than a fifth of the total income, which is mainly derived from extra-budgetary sources. Recent estimates conducted in connection with the development of the first WHO Research Strategy indicate that aggregate spending on research from regular and extra-budgetary sources amounted to US\$ 232 million for the biennium 2006–7, or around 4% per year of the total annual income, mainly in the form of targeted funding for specific research activities such as the co-sponsored special programmes for research in tropical diseases and human reproduction and the International Agency for Research on Cancer (van de Rijt & Terry, 2008). The proportion of the regular budget allocated for research is unclear but is also certainly less than 4%.

Global health initiatives (GHIs): Two very large global health initiatives account for most of the support to health in LMICs coming from this group of actors:

1) Global Fund to Fight AIDS, Tuberculosis and Malaria (GFATM): GFATM was created in 2002 to support

country programmes to combat AIDS, TB and Malaria, especially focusing on the purchase of drugs. By 2009, GFATM was providing 57% of international resources for tuberculosis control, 50% for the global response to malaria and 23% of international financing for AIDS (GFATM, 2009).

Recently it has begun allocating a portion of its funding to support the development of health systems more broadly. In 2007, it disbursed US\$ 2.5 billion in grants. The Global Fund has encouraged recipient programmes to spend 5–10% of grant budget on monitoring and evaluation, including operational research, but in funding rounds 1–5, only a fifth of proposals included operational research (Korenromp et al., 2007). This has subsequently increased and, over the total Global Fund portfolio to 2008, the budget allocated to operational research increased from 0.4% to 3%.

2) Global Alliance for Vaccines and Immunization (GAVI): The GAVI Alliance has been providing support to the world's poorest countries since 2000 so that they can increase their access to immunisation. GAVI's total programme disbursements reached close to US\$ 900 million in 2007, with US\$ 400 million being allocated to country programmes and the remainder to support to GAVI partners for new initiatives such as

Global Polio Eradication and funding for Pentavalent vaccine procurement (IHME, 2009; GAVI, 2008). In aggregate, by August 2008 GAVI had approved a total of US\$ 3.7 billion to countries for the period 2000 to 2015. The 'Window 3' mechanism introduced in 2002 permits the use of GAVI funds for a range of activities including R&D and GAVI's 2007 revised guidelines for this area stressed the opportunity for countries to use some of their GAVI funds for health systems operational research that better informs decisions and processes for overcoming health systems barriers to deliver immunization (GAVI, 2007).

Policy implication

Global health initiatives and multilateral agencies providing health assistance to LMICs need to:

1. Formally adopt policies of contributing a portion of their health support to research (and research capacity strengthening) and move towards a target of raising this level of research support towards the target of 5% of their health contributions.
2. Regularly track and report on their contributions to research and research capacity strengthening.
3. Encourage countries to take up and fully utilize the provisions available for research, including capacity building.

6 Conclusions

The Report Card on R&D for health tracks financial flows in the domains of development, health and research. All three of these domains contribute to the global financing of R&D for health, including R&D relevant to the health needs of poor and marginalized populations in LMICs. The Report Card examines these financial flows by tracking 10 elements clustered in four groups, comparing actual investments with targets that have been agreed internationally or proposed as benchmarks and indicators of progress.

Since the 2008 Report Card was published, a substantial amount of new data has become available relating to financial flows in the domains of development, health and research (Moran et al. 2009; Ravishankar, 2009; Families USA, 2008). Owing to variations in collecting and reporting cycles, the data available relating to the 10 elements of the Report Card covers the period 2005 to 2008. Year on year, the Report Card therefore provides both a snapshot of the most recent information and a picture of the evolving situation over time. It represents a mechanism by which progress can be assessed and the commitments or aspirations of different actors compared with their actual performance.

The period 2008–2009 has seen enormous challenges being recognized and unprecedented changes taking place in the world. With limited resources to invest in health research, policy-makers need to ensure that research provides both economic and social returns on

investments. To do this, investments needs to be more transparent, so as to draw attention to inequities, provide accountability, and inform health research. Assessments of progress at the mid-point towards the 2015 MDG targets have revealed that the health goals are among the least likely to be attained, especially in sub-Saharan Africa. As the greatest global financial crisis since the 1930s has unfolded, there have been many calls for investments in development generally and health in particular to be sustained and for research to be supported strongly as a vital component of protecting health and ensuring the most efficient use of current and future health resources. A series of massive mergers and acquisitions in the pharmaceutical industry has been accompanied by a growing recognition of the need for new models that will drive innovation generally, and address the health needs of poorer countries.

Against this background, the 2009 Report Card reveals a mixed picture of performance globally in relation to financial flows in the domains contributing to R&D for health:

- Globally, investments in the domains of development, health and research have been rising significantly in recent years, but few countries are meeting the targets that have been set and the pace of increases is often too slow.
- Relatively few countries have instituted policies and strategies for achieving the targets.
- Systems for regularly tracking and reporting on financial flows in the

domains of development, health and research are often weak or non-existent – especially in LMICs but also in some major development partners including bilateral and multilateral development agencies and global health initiatives.

Health is a fundamental human right, but continuing large health disparities between and within populations across the world demonstrate the limited extent to which the protection of this human right has been given priority. Research has vital roles to play in supporting the achievement of health equity, including through identifying the nature, extent and root causes of ill-health, identifying and testing solutions and monitoring and evaluating the effectiveness and impact of interventions. Ignorance – the lack of the knowledge, products and tools that research provides – is truly a fatal disease.

Although the benefits of health research are difficult to quantify, it is evident that it has produced both positive

changes in health and quality of life, while substantially contributing to economic development (Cyril, 2009). Technical progress has contributed to longer life expectancy globally, yet the poorest still have significantly shorter life expectancies than the wealthiest. It is in this context that the Global Forum advocates for greater application of the knowledge, processes and products of research as well as research for the needs of the poor.

Tracking resources for R&D for health provides one important approach to examining the extent of efforts being undertaken to improve health and health equity. The Global Forum for Health Research will continue its efforts to monitor the flows of resources that feed into R&D. It will especially focus attention on the gaps in resources needed to support research to address the priority health needs of the poorest and most disadvantaged people in the world and to ensure that they do not remain the victims of ignorance.

Notes

- 1 Gross domestic expenditure on research and development as a percentage of gross domestic product (GERD): definition (www.un.org/esa/sustdev/natlinfo/indicators/methodology_sheets/econ_development/research_development_expenditure.pdf, accessed 20 August 2009).
- 2 There are 23 members of the DAC: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Italy, Ireland, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom, the United States of America, European Commission. (www.oecd.org/document/32/0,3343,en_2649_33721_42632800_1_1_1_1,00.html#DAC, accessed 20 August 2009).
- 3 The World Bank Country Classification for 2008 lists 43 countries as 'low income' (GNI per capita US\$ 975 or less), 55 'lower middle income' (US\$ 976 to 3855), and 46 'upper middle income' (US\$ 3856 to 11 905). (<http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS/0,,contentMDK:20420458~menuPK:64133156~pagePK:64133150~piPK:64133175~theSitePK:239419,00.html>, accessed 20 August 2009).
- 4 Data are not available for the following 40 of the 66 HICs: Andorra, Antigua and Barbuda, Aruba, Bahamas, Bahrain, Barbados, Belgium, Bermuda, Brunei Darussalam, Cayman Islands, Channel Islands, Croatia, Cyprus, Estonia, Equatorial Guinea, Faeroe Islands, French Polynesia, Greenland, Guam, Hong Kong, Isle of Man, Israel, Kuwait, Liechtenstein, Macao, Malta, Monaco, Netherlands Antilles, New Caledonia, Northern Mariana Islands, Oman, Puerto Rico, Qatar, San Marino, Saudi Arabia, Singapore, Slovenia, Trinidad and Tobago, United Arab Emirates, Virgin Islands (US).
- 5 The African Union includes all countries on the African continent, except for Eritrea, Guinea, Madagascar and Morocco. Western Sahara is a member of the African Union, although it is only recognised as a territory.

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