Ministry of Health – Brazil

Secretariat for Science, Technology and Strategic Inputs,
Department of Science and Technology

Flows of Financial Resources for Health Research and Development in Brazil 2000-2002

Series C. Projects, Programs and Reports

Brasilia – DF
2006

ACRONYMS AND ABBREVIATIONS

ANS– National Agency for Supplementary Health
ANVISA– National Agency for Health Surveillance
CAPES–Coordinating Body for Upgrading of Higher Level Personnel, MEC
CEMPRE–Central Company Registry, IBGE
CENEPI– National Center for Epidemiology
CEPESQ – Center for Studies and Research in Collective Health
CEPR – Center for Economic Policy Research
CICT– Center for Scientific and Technological Information
CNPq–National Council for Scientific and Technological Development
COHRED – Council on Health Research for Development
CPD – Data Processing Center
DECIT– Department of Science and Technology
DENSP– Department of Health Engineering, FUNASA
ENHR– Essential National Health Research
FAP– State Research Foundation
FAPESP – The State of São Paulo Research Foundation
FAPERJ – The State of Rio de Janeiro Research Foundation
FAPEMIG–State of Minas Gerais Research Foundation
FEBRAFARMA– Brazilian Pharmaceutical Industry Federation
FIOCRUZ Foundation– Oswaldo Cruz Foundation
FINEP–Financing Agency for Studies and Projects
FJB– José Bonifácio Foundation
FNS– National Health Fund
FORD– Ford Foundation
FUNASA– National Health Foundation
GDP– Gross Domestic Product
GESCON– Information System for Management of Finances and Agreements
GFHR – Global Forum for Health Research
GNP– Gross National Product
GRUPEMEF– Group of Executive Professionals in the Pharmaceutical Market
Health R&D–Health Research and Development
Health ST&I– Science, Technology and Innovation in Health
IBRD– World Bank
IBGE– Brazilian Institute of Geography and Statistics
IDB– Inter-American Development Bank
IMS–Institute of Social Medicine, Rio de Janeiro State University
IES – Higher Education Institutions
INCa– National Cancer Institute
KELLOGG– W. K. Kellogg Foundation
LILACS–Latin American and Caribbean Literature in the Health Sciences
MCT– Ministry of Science and Technology
MEC– Ministry of Education
MS– Ministry of Health
NGO–Nongovernmental Organization

NIC– Newly industrialized country
OECD– Organization for Economic Cooperation and Development
PAHO– Pan American Health Organization
R&D–Research and Development
PINTEC– Industrial Research and Technological Innovation
PROF.– Program for Promotion of Postgraduate Education
REFORSUS– Strengthening the Reorganization of the Unified Health System
RICYT – Ibero-American and Inter-American Network on Science and Technology Indicators
S&T– Science and Technology
SciELO–Scientific Electronic Library Online
UERJ– Rio de Janeiro State University
UNESCO– United Nations Educational, Scientific, and Cultural Organization
UNODC– United Nations Office on Drugs and Crime
WHO– World Health Organization

TABLE OF CONTENTS

LIST OF TABLES

LIST OF CHARTS

LIST OF FIGURES

LIST OF GRAPHS

FOREWORD

The Ministry of Health, through the Department of Science and Technology of the Secretariat for Science, Technology and Strategic Inputs, contracted the Center for Research and Studies in Collective Health (CEPESC) of the Institute of Social Medicine (IMS) of Rio de Janeiro State University to gather information on expenditures for health research and development operations (health R&D) in Brazil, for the period 2000-2002. The purpose of this work was to allow for more coordinated action by the ministry, based on a prioritized agenda, to protect the interests of the State and of Brazilian society.

The starting point for the project is the imbalance between the amount of public and private financial resources devoted to health R&D and the portion of these resources that are directed at the elimination of health problems affecting the majority of the world's population.

In order to change this highly complex pattern, it is necessary to have systematic monitoring of global expenditures on health R&D. There is no continuous, reliable and accessible set of information on world expenditures on health R&D and consequently there are no accurate estimates of total expenditures or of the quantity of resources allocated for research on the principal diseases or risk factors that affect the population.

Naturally, it is important to know the size of flows from the various actors in the health system (financing agencies, research institutes, etc.), but what is of fundamental importance is the use of these resources according to national health priorities and the principal national health problems.

International organizations involved in the health area, especially the World Health Organization (WHO) and the Pan American Health Organization (PAHO), play an important role in the effort to systematize the approaches for setting priorities, with the goal of more informed decision-making, taking into account the global dimension of health problems.

This study focuses on the preparation of a systematic framework for application of the methodology developed by the Center for Economic Policy Research[1] (CEPR) and the Council on Health Research for Development (COHRED), in order to make it possible to map and measure the flows of financial resources for health R&D in Brazil, as well as the quantification of how well the national expenditures in health R&D match the agenda of priorities set by the Ministry of Health.

In order to do this, the investigation was organized in the following stages: collection of data and information on sources, expenditures and uses of health R&D resources; data analysis and creation of indicators; and the proposal of a system for monitoring financial resources invested in health R&D in Brazil.

For the purposes of this research, health R&D was defined as any systematic and creative work undertaken with the intention of increasing the stock of knowledge in health and the use of such knowledge to develop new applications for the improvement of groups' and individuals' health.

The central criterion for the definition of health R&D included in this study is that the sector of

[1] The Center for Economic Policy Research is an organization that carries out research in the area of public policies on the economy and international macroeconomics, among other issues. It brings together researchers and institutions from member countries such as the Philippines that, together with Malaysia and Thailand and with support from COHRED, have worked out methodology for measuring financial flows of health R&D.

activity or application is in the health area, not that it fits in the health knowledge area. Health R&D thus includes all R&D work within the domain of medical and natural sciences, as well as studies in health economics and sociological studies, such as practical surveys on knowledge, attitudes and practices of individuals related to health programs and interventions. Health R&D also includes work that aims at new applications to improve the health of groups and individuals, even if it does not start from areas of knowledge conventionally linked to health.

In the research, the sources of health R&D resources considered were the primary financing agents for health research, both public and private, regardless of the existence of intermediary agents between the source agency and the end user of the resources. Users of resources were considered to include those institutions that receive financial resources from third parties to carry out activities of health R&D.

Adapting the methodology developed by the Center for Economic Policy Research, mapping and measurement of the flows of financial resources in health R&D were carried out using a twofold categorization, by the field of activity and by the nature of the research activity. By the nature of the activity, activities were classified into basic research, applied research and experimental development. The classification into fields of activity was into natural sciences, medical sciences, social and economic health sciences, and other R&D fields with application to the health area.

The research also adopted a classification of institutions, valid for the source institutions and for users of financial resources. The classification included the following types: Ministry of Health (MS); other ministries (Other Min); State Research Foundations (FAPs); other state and municipal organs (Other S&M); nongovernmental organizations (NGOs); councils and professional associations (Prof. Councils); universities, research institutes, and associated foundations (Univ,Inst,Foun.); international organizations (IO); other private institutions (Other Priv).

Through identification and classification in the information collection phase, it was possible to pick out and select several "key institutions or actors."

In addition to measuring the financial resources devoted to health R&D, the results of this research permitted: a) filling in gaps in national information on health R&D; b) identification of flows of financial resources devoted to health R&D in Brazil; c) designing a system for monitoring the flows of resources applied to this research sector, to make possible increased effectiveness of actions for development, based on selective introduction of knowledge production, material goods, and processes in priority areas for health of the Brazilian population; and d) testing and adaptation of the proposed methodology, leading to generation of internationally comparable information.

This book is a summary of the research work carried out. The annual average amount of the total resources dedicated to health R&D from 2000 to 2002 was in the order of US$ 573 million. The public sector as a whole invested US$ 417 million (72.8%) and the Ministry of Health US$ 32 million (5.6%).

Brazil spends nearly 7.5% of the value of its Gross Domestic Product (GDP) (US$ 515.7 billion in 2002) on health, leading to the conclusion that, in the period under review, expenditures on health research were equivalent to 1.48% of national health expenditures, therefore below the 2% level recommended in 1990 by the Commission on Health research for Development. The public sector invested in health R&D each year almost 4.15% of the budget of the Ministry of Health. However, the Ministry of Health itself contributes only 0.33% of its budget in the total of investments in health research in health in the country, predominantly directed to its own institutions.

Since 2003, the year after the period covered by this research, the ministry has been changing its science and technology policy in the direction of orienting its development actions outside the ministry. This should increase the impact of these investments on the national system of health R&D.

The principal users of resources in health R&D in Brazil are universities and research institutes that receive 92.5% of public expenditures, approximately US$ 382 million per year. It is worth noting that the private sector receives only a small fraction of these resources, about 0.69% of the total.

The first part of this work, after the introduction, discusses the methodology used, the concepts and definitions, as well as some of the problems and difficulties encountered and the solutions adopted by the principal institutions providing resources for health R&D.

The second part presents the quantitative data on investments in health R&D in Brazil for the period 2000–2002. For better visualization, data were divided by source institutions and resource users for the three years covered by the survey. Starting from the average for the three years studied, financial flow charts by source institutions and resource users and source-user matrices were constructed to allow a more detailed understanding of how health R&D resources were invested. In this section calculations were also made of the relation between total spending on health R&D and some of the principal national aggregates such as the Gross Domestic Product (GDP), the budget for social security, and the budget of the Ministry of Health.

Finally, recommendations are presented for a monitoring system coordinated by the Ministry of Health, and operational functions to be carried out by partner institutions.

Cid Manso de Mello Vianna, PhD
Research Coordinator on Financial Resource Flows in Health R&D

Suzanne Jacob Serruya, MD, PhD
Director, Department of Science and Technology
Secretariat for Science, Technology and Strategic Inputs
Ministry of Health of Brazil

1. INTRODUCTION

Research in health is essential for preparation and implementation of national health policies, for planning health actions and health services delivery. The subject of financing is critical for this entire process. Each year, more than US$ 100 billion is spent on health research and development (R&D) by the public and private sectors of the economy, which makes this type of research the one that spends the largest quantity of world resources, except for military research (Global Forum for Health Research, 2004).

It is estimated that, in 2001, US$ 105.9 billion were invested in health worldwide. Of this amount, 44% came from public funds in the rich countries and in transition economies (Eastern Europe) and the Asian Newly Industrialized Countries (NICs); 48% came from private resources (predominantly the pharmaceutical industry), and 8% from private resources of non-profit entities[2]. With regard to the public sector, US$ 44.1 billion were invested by rich countries and US$ 2.5 billion by the developing world, including Brazil (Global Forum for Health Research, 2004).

Despite this investment, deficiencies in the process of establishing and carrying out a set of priorities for health R&D have led to a situation in which less than 10% of the public and private financial resources destined to research is devoted to 90% of the health problems that affect the world's population, an imbalance known as the "10/90 gap." Moreover, this gap has a high economic and social cost, aggravated because even the 10% available are not being used in areas where the greatest impact on health can be assured.

In the specific case of Latin America, the actual expenditures on health R&D are relatively low, taking into account the countries' populations and their Gross National Product (GNP). Although there has been a growth of 57% in expenditures on health R&D in this region between 1990 and 1996, per capita expenditures in Latin American countries remain much lower than in other more developed nations. The USA spends near 10 times more per capita and Canada approximately 12 times more. Latin American countries spend on average 0.5% of GNP on health R&D. Countries above this average are Costa Rica (1.13%), Brazil (0.76%), and Chile (0.64%). Moreover, total expenditures on health R&D are highly concentrated. In 1996, Brazil accounted for nearly 60% of the total, followed by Argentina (12.5%) and Mexico (10%) (Pelegrini Filho, 2000).

According to the same author, the State is the principal source of financing in this region, contributing more than 70% of resources invested in health R&D. This is the reverse of the North American situation, where nearly 70% of financing comes from the private sector. The locations where research is carried out are also different. While in Latin America, health R&D is primarily a function of the universities, in the USA and Canada private companies play the predominant role.

Estimates from the Global Forum (2001) showed that total spending on health R&D in Latin America in 1998 was US$ 1.4 billion (nearly 8.5% of total investments in R&D). Of this amount, Argentina (nearly US$ 235 million), Brazil (nearly US$ 715 million)[3] and Mexico (nearly US$ 180 million) accounted for more than 80.8% of this total (RICYT, 2001 in Global Forum, 2001). According to this organization, the proportion of expenditure on health R&D

[2] Global Forum for Health Research, available at: http://www.globalforumhealth.org/site/003__The%2010%2090%20gap/001__Now.php

[3] As will be seen in this study, the estimate given by RICYT differs from the estimates of this study due to methodological differences.

Table 1: Total Expenditure on Science and Technology and on Research and Development and Estimated Expenditure on Health Research and Development in Latin America

		S&T	R&D	Estimated Health R&D			
Country	Year	US$ million		% GDP	US$ million	% total R&D	% GPD
Brazil	1996	9355	6574	0.91	715.6	10.9	0.092
Mexico	1997	1690	1382	0.34	180.3	13.0	0.045
Argentina	1998	1530	1263	0.42	234.8	18.6	0.079
Chile	1998		455	0.62	9.6	2.1	0.013
Colombia	1997	632	398	0.41	40.0	10.0	0.041
Venezuela	1997	293	200	0.23	20.0	10.0	0.023
Cuba	1998	220	129	0.87	13.0	10.0	0.088
Costa Rica	1996		108	1.13	11.0	10.0	0.115
Uruguay	1998		84	0.23	3.5	4.2	0.017
Peru	1997	424	39	0.06	7.3	18.8	0.012
Panama	1998	81	31	0.33	7.6	24.6	0.081
Bolivia	1998	46	25	0.29	2.5	10.0	0.029
Ecuador	1998	43	15	0.08	1.0	6.6	0.005
Salvador	1998	99	10	0.08	0.9	8.7	0.007
Trinidad	1997	21	8	0.14	0.2	3.0	0.004
Total	**1998**	**15330**	**10781**	**0.58**	**1400**	**8.5**	**0.065**

Source: RICYT (2001) in Global Forum (2001: 20). Note: Estimates of spending on health R&D for Colombia, Venezuela, Cuba and Costa Rica are based on limited information.

out of total spending on R&D ranges from more than 20% in Panama to less than 5% in Chile and Uruguay, as shown in Table 1.

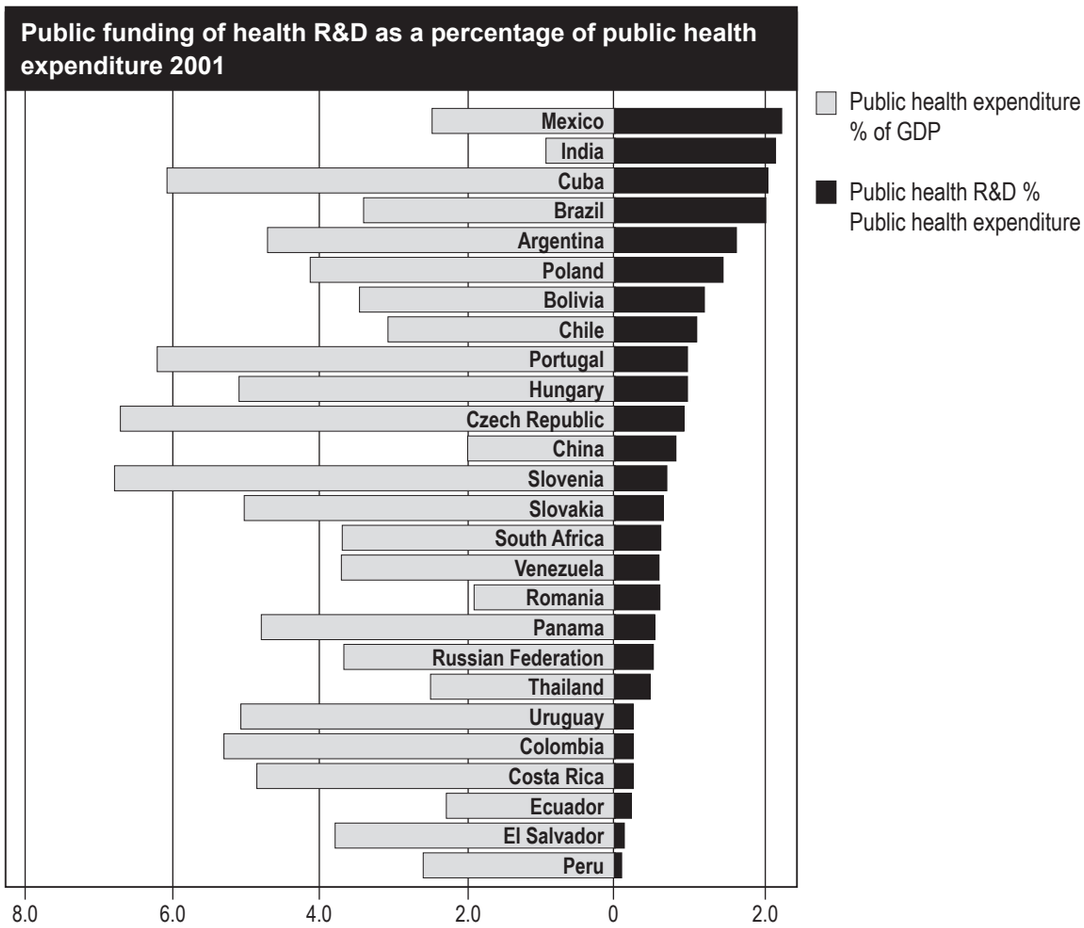
As a general reference, the 1990 Commission of Health Research for Development and the World Health Organization recommend that governments of the developing countries apply at least 2% of national health expenditures to promotion of health R&D. In 1998, no developing country had implemented this recommendation, but by 2001 four countries – Brazil, Cuba, India and Mexico – came close to this level. Graph 1 provides a proxy for this indicator, showing public spending on health research in relation to total public spending on health.

It is also recommended that these resources be applied according to strategic and managerial principles aimed at reduction of social inequalities. With this commitment of investments and establishment of research priorities that are more consistent with the pattern of illnesses and injuries that affect the world, it will be possible to reduce the "10/90 gap."

One issue that is important for a full appraisal of the imbalance between the financial resources allocated to health R&D and the part that is aimed at overcoming priority health problems is the absence of systematic monitoring of global spending on this type of research. There is no continuous, reliable and accessible set of information on world expenditures on health R&D. Consequently, there are no verified quantitative estimates of resources allocated for research on the principal diseases or risk factors. There is also no consolidated set of information on results, products and impact of these investments on health status. Accordingly, the development of a broad base of quantitative information on health R&D activities has been a common concern on the agenda of different countries and organizations. Considerable effort has been devoted to the development of methodologies and studies to produce information and indicators, with those carried out by WHO and by the Global Forum for Health Research being particularly noteworthy.

Since the 1980s, there have been efforts to structure and strengthen coordination among coun-

Graph 1: Public Funding of Health R&D as a Percentage of Public Health Expenditure, Selected Countries



Source: Global Forum for Health Research, Monitoring Financial Flows for Health Research (2004: 10).

tries on the proposition that health research is an important tool for decision-making in defining health policy and plans, contributing to the improvement of health care and to decrease health inequalities in developing countries. International organizations involved in the health area, particularly WHO and the Pan American Health Organization (PAHO), are playing an important role in this movement, making efforts to systematize approaches for establishing priorities, making the process more transparent and decision-making better informed, and taking into account a more global approach to health problems.

The following are efforts to strengthen coordination among countries on health research: establishment of Essential National Health Research (ENHR) by the Commission on Health Research for Development (1990) and by the Task Force on Health Research for Development (1991); the Five-Step Process from the Ad Hoc Committee on Health Research (1996); the Visual Health Information Profile from the Advisory Committee on Health Research (1997); and the Combined Approach from the Global Forum for Health Research (1999-2000).

Since 1997, WHO, the Council on Health Research for Development (COHRED) and the Global Forum for Health Research recommended that countries not only make a commitment to the strategy of ENHR but also create mechanisms for exchange of information and experiences on the improvement of the "10/90 gap." In

order to ensure that these objectives are reached, they recommended monitoring of financial flows channeled to health R&D in each country and in the world.

A more detailed mapping of global resource flows can help decision-making, both in developed and developing countries, for better selection and allocation of resources for financing health R&D. This mapping can also help in reallocation of resources for the most important health conditions and determinants of health, by identifying areas that do not attract sufficient investment and avoiding duplication of research efforts. These steps, in turn, can have a significant impact on reduction of the burden of disease and injuries in developing countries, particularly in the poorest countries.

In developing countries, this pattern and the difficulties already mentioned are even more critical due to problems of information that are of common knowledge. For these countries, the challenge is not only to expand the coverage and scope of information on expenditures and flows of health R&D, maintaining international comparability, but also to improve the quality and the representative character of primary information through investments in data collection and processing. Furthermore, the development of national studies is needed, for gaining greater knowledge of the characteristics of the structures for science and technology (S&T) and health R&D in particular national contexts, and for refining the methodologies used in production of quantitative information on resources and research results, as well as comparison with health research priorities.

In the case of Brazil, it is not easy to gauge the scale of efforts put into health research, given that there is not sufficient information for a precise estimate of the amount or the flows of financial resources devoted to health research and development in health. Some studies carried out in the country, such as that of the National Council for Scientific and Technological Development–CNPq (2000), were limited to data from public institutions. Other studies, for example, those by Eduardo Albuquerque and José Cassiolato (2000), and by Barjas Negri and Geraldo di Giovani (2001), evaluated important aspects of scientific and technological advance in the health sector, but did not aim at investigating, in detail, private investments applied to health R&D. The effort coordinated by Francisco Landi (1998) collected data for the State of São Paulo. Even more comprehensive works seeking information at the national level, such as the "Green Book" coordinated by Cylon Silva (2001), presented only partial data on R&D spending from private enterprises (MS/UNESCO, 2003).

The objective of these works were not collecting and evaluating total expenditures, including private expenditures, nor investigating the origin of resources invested in health R&D in the country. Similarly, the relationship between the resources spent on health R&D and their correspondence with the sector priorities identified by the state were not evaluated.

An initial difficulty for such an investigation is that research investments are carried out by a myriad of institutions and agents, and data on the amounts and on the breakdown by the nature of the research or by the field of activity[4] are not easily accessible.

Another limitation to be considered is that data generated by studies on investments in health R&D in Brazil cannot, in most of the cases, be compared to that of developed or developing countries because methodological differences make international comparisons difficult.

In Brazil, the body responsible for official statistics and science and technology indicators is

[4] For definitions of the nature of research and fields of activity of research see the section on methodology. .

the Ministry of Science and Technology. In spite of the great progress observed in recent years in improvement of coverage and accuracy of data, there are still problems, mainly concerning less aggregated sectoral data. In the area of the federal government, the principal source of official data is the Integrated System of Financial Administration (Siafi), which has the objective of tracking expenses by governmental bodies. At the state level, the sources are the general ledgers for the states or surveys carried out by the secretariats of Science and Technology. Siafi and the state ledgers are systems that were not constructed for tracking the objective or final destination of financial resources. Therefore their results are quite imprecise for tracking the appropriation of expenditures by activity sectors, as is the case of the expenditures on health research. As a result, estimated sectoral data tends to be overestimated. For example, the annual expenses of the Ministry of Health on health R&D for 2000, 2001 and 2002 found in our research correspond to about 15% of values given in the official statistics.

In terms of expenditures on health R&D, Guimarães (2002), taking into account only the federal government and without counting personnel costs, estimated that spending on health research was between US$ 190 million and US$ 215 million in 2001, with nearly 45% of this total spent on fellowships. Only between 20% and 25% of these expenses would have been carried out by the Ministry of Health. Difficulties in establishing more precise and comprehensive amounts come from the fact that there are no consolidated estimates on the expenditure on health research in the country, particularly due to the fragility of the sectoral databases related to spending by private companies. With regard to academic research, carried out in universities and research institutes, the availability of information is somewhat better, although still far from providing a precise picture. Only data from governmental agencies, particularly at the federal level, are somewhat better systematized and known. But even these are frequently presented as aggregates, without a more detailed breakdown by the nature of the activity and/or the field of activity within health R&D where the resources were used.

This is the context for the present research that has the general purpose of mapping and measuring the flows of financial resources for health R&D in Brazil for the years 2000 through 2002. The specific objectives were: (a) Identify the sources and users of resources allocated in health R&D in health by the nature and field of health research activity; (b) Estimate the amount of national spending on health R&D in Brazil for the years 2000-2002; (c) Trace the financial flows of health R&D by the principal agents involved in the system; (d) Categorize and evaluate the distribution of national investment in health R&D by sector: public, private and nongovernmental organizations, and external financing agencies; (e) Propose a system for monitoring the flows of financial resources for health R&D in Brazil.

In addition, the process of development of this work made it possible to establish some bases for designing a system for monitoring information related to financing of health R&D, a necessary tool for evaluating the potentialities of the scientific and technological base in the country, for identifying the most promising activities and projects for the future, and for strategic decisions by managers of scientific and technological health policies, with a view to obtaining the most cost-effective results from resources used.

This text is organized in the following way. After this introduction, the methodology adopted and the results by sources of financing are presented. Then, the summary of the data collected and the profiles of resources involved and of the flows among the different agents are presented in the form of source-user matrixes and flow charts. Included in the same section are the principal summary indicators related to expenditures on health R&D in Brazil in the period under examination. Finally, the bases for the organization of a system of regular monitoring of flows of health R&D in the country are presented in a proposal.

2. METHODOLOGY

The methodology selected for obtaining data on spending on health R&D in Brazil was to start with the identification and collection of data from the **source** financing institutions rather than the **users** of the resources. This option was dictated by characteristics of the Brazilian system of science, technology and innovation, for which the structure is basically determined by federal and state public development agencies and by sectoral organs that promote research on the basis of their policies.

Examples that stand out are the National Council for Scientific and Technological Development (CNPq), that finances health research projects and provides productivity fellowships directly to researchers, and maintains an accounting system for the projects it finances. Also, at the federal level, the Financing Agency for Studies and Projects tracks expenditures and knows the volume of resources provided to the institutions and companies carrying out the projects financed. At state level, there are the state research foundations, such as the State of São Paulo Research Foundation which has a data-processing centre with a system for administrative-financial tracking of research projects it finances.

The sectoral bodies, such as the Ministry of Health, consolidate general data on supported projects, and the Ministry of Education records information on resources allocated to fellowship grants for doctorate and master's programmes, through the Coordinating Body for Upgrading of Higher Level Personnel (CAPES), an agency linked to the ministry that also has information on salaries of researchers in federal universities.

The users of health R&D resources are widely dispersed, and normally they do not have accounting systems that make it possible for them to identify the origin of resources for financing research. Therefore, the principal strategy was to target data collection efforts on the financing institutions.

2.1. General Concepts and Definitions Used

Development of the study demanded spelling out a number of concepts and operational requirements, principally in order to (1) identify the relevant actors involved in health R&D in the country, according to the basic categorization into sources of resources, intermediaries, and end users of financial resources in health R&D; (2) single out and classify research activities according to the nature and the field of health R&D; (3) map out and quantify the principal financial flows associated with health R&D activities; and (4) synthesize the results obtained, including the use of indicators, for the purposes of analysis and construction of a monitoring system.

These requirements shaped the need to characterize and spell out a process within which to situate the flows of resources, components and end results of health R&D, as suggested in the diagram below.

The starting point for an operational definition of research and development in health (health R&D) was the definition of research and development (R&D) in the *Frascati Manual*.

According to this Manual, R&D

> "[...] *comprises creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge in the search of new applications*." (OECD, *Frascati Manual*, 1993: 29).

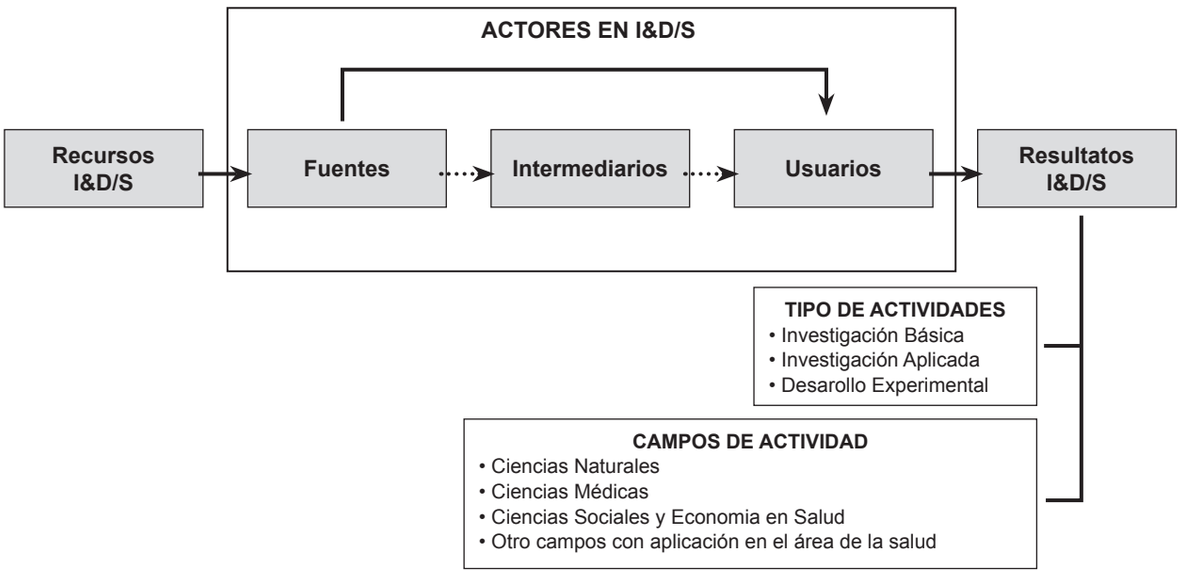
R&D is an important part of the set of activities of science and technology (S&T). In turn, scientific and technological activities correspond

> *"[...] to systematic effort, directly related to the generation, advance, dissemination, and application of scientific and technical knowledge in all fields of Science and Technology. They include activities of research and development (R&D), training and technical and scientific education[5], as well as scientific and technological services[6]"* (SILVA & MELO, 2001:16).

As it happens, several of the statistical series for Brazil before 1999, in particular those dedicated to resources applied to S&T, divided expenditures into two categories: R&D[7] and so-called related scientific and technical activities. The latter comprises activities that directly support R&D, including the collection and dissemination of scientific and technological information, the transfer of laboratory results to industrial production, and actions for quality control, protection of intellectual property, industrial promotion, licensing and assimilation of technology, and other similar services[8]. Beginning in 2000, this distinction was dropped, making it impossible to disaggregate subsequent data in this way.

Taking the OECD definition as the basis, health R&D was understood, for purposes of this study, as

Figure 1: Graphic Representation of Actors and Financial Flows Involved with Health R&D



[5] Technical and scientific training and education correspond to all activities related to training and all specialized non-university higher education, to higher education and training for university degrees, to graduate and subsequent training, in addition to continued training for scientists and engineers (Silva & Melo, 2001).

[6] Scientific and technological services include activities relating to research and experimental development, as well as those contributing to to the generation, dissemination and application of scientific and technological knowledge. These services can be grouped into nine subclasses: (1) S&T activities in libraries and similar institutions; (2) S&T activities in museums and similar institutions; (3) translation and publishing of scientific literature; (4) geological, hydrological and related research, (5) prospecting; (6) data collection on socioeconomic phenomena; (7) tests, standardizations, quality control, etc.; (8) consulting services for clients, including public services for agriculture and industry; and (9) activities of patenting and licensing by public institutions. (Silva & Melo, 2001)

[7] R&D activities include all creative work done systematically to expand the stock of scientific and technological knowledge. In terms of the MCT classification of functions and programming, until 1999, the following categories were included in these activities, with their respective codes: (a) basic research (54); (b) applied research (55); (c) experimental development (56); (d) graduate teaching (206); (e) other services included in the Science and Technology Program (10), the training of human resources (217); and fellowships (235).

[8] In terms of the MCT classification of functions and programmes, until 1999, the following subprogrammes were included in related scientific and technical activities, with their respective codes: (a) scientific and technological information (57); (b) tests and quality analysis (58); (c) environmental research (59); (d) geological surveys (292); (e) hydrological studies and surveys (296); (f) trademarks and patents (374); and (g) measurement (375). In http://www.mct.gov.br/estat/ascavpp/portugues/menu1page.hmtl, accessed on 30/08/2003.

> "[...] *any systematic creative work undertaken with a view to increasing the stock of knowledge in health and the use of such knowledge for finding new applications that improve the health of groups and individuals*" (OECD, 1994).

A preliminary task for this study was, therefore, to delimit precisely what were regarded as health research activities, that is, how to define the meaning of "health" in health R&D.

Even among specialists and experts in the field, health research is frequently limited to biomedical research. This lack of conceptual precision, according to Guimarães (2002), leads to a methodological complication and an empirical accommodation. The complication is to regard "health" as an area of knowledge, when in fact it is a sector for implementation or action. The consequent accommodation in practice consists in measuring the health research effort by the total of health research in the broad areas of the health and biological sciences, leaving outside of health R&D all the research activities devoted to health in other areas, such as the humanities, the natural sciences and agricultural sciences, for example.

According to another study by the same author, taking into account a sectoral approach, these other areas outside the health and biological sciences would include about 25% of the research groups working on health R&D in Brazil (Guimarães, Lourenço & Cosac, 2001).

The alternative for overcoming that limitation and the option chosen in this study was to use a concept based on a teleological perspective, that is, the objective of the research, as laid out by Pellegrini, among others:

> "*We use the term 'scientific activity for health development' instead of 'scientific activity in health', in order to stress that our focus seeks to emphasize the essential character of science for improvement of health conditions.*" (Pellegrini, 1991 in Guimarães, Lourenço & Cosac, 2001:324).

This definition derives from an understanding of scientific activity in health as "*the set of processes through which scientific knowledge is obtained, transferred or used, and the objective and subjective conditions in which these processes are developed*" (Garcia, 1982 in Pellegrini, 2000). Thus, scientific activity in health corresponds to a field of social activity understood as

> "[...] *the set of processes and actors that intervene so that a particular kind of result is produced, circulated and used in society. This field has its own laws; it shares in the totality of the social structure, but is governed by a specific way of functioning*" (Canelini, 1990 in Pellegrini, 2000:2).

It is therefore worth pointing out that, in the case of health, research goes beyond the boundaries of the traditional **health sciences**[9], incorporating knowledge from fields originally far from those sciences, such as engineering, the exact sciences and the human and social sciences. In this way, considered in its complexity, health research goes beyond the perspective of disciplines, with the limits established by a much more inclusive sectoral perspective[10].

---

[9] The following are included in the health sciences knowledge area, according to the Coordinating Body for Upgrading of Higher Level Personnel (CAPES), in the Ministry of Education: pharmacy; medicine; endemic diseases; nutrition; collective health; physical education; nursing; physiotherapy; speech therapy; and dentistry.

[10] The impact of this sectoral perspective that is more inclusive than a disciplinary perspective can be seen using the CNPq Directory of Research Groups database, that includes 11,760 groups in all knowledge areas (49,956 researchers). According to this database, 1,832 groups belong to the large area of health sciences and 1,720 groups to the area of biological sciences. The same directory shows that 960 groups whose primary knowledge areas are not in the health or biological sciences have at least one research line associated with the "health" activity sector. In addition, of the 827 groups having their primary area of activity in the biological sciences do not have any research line linked to the "health" activity sector (Guimarães, Lourenço e Cosac, 2001).

Likewise, this research does not include in the health research sector those research activities by groups in the area of biological sciences that do not have ties with human health. There are many groups that are examples of this in the areas of botany, zoology, etc.

Therefore, the central criterion for the definition of health R&D to be included in this study was that of **sector of activity or application** in the health area rather than the area of knowledge within health. Health R&D thus included all R&D work within the domains of the medical and natural sciences, as well as studies in health economy and sociological studies (such as surveys on knowledge, attitudes and practices of individuals related to health programmes and interventions). But it was not restricted to that, including also work that, not starting from knowledge areas conventionally linked to health, aimed at new applications for improving the health of groups and individuals.

According to this understanding, for defining the research groups working in the sector of human health, it was necessary to examine the CNPq Directory of Research Groups in Brazil database using specific filters allowing additions needed for an approach with a sectoral focus, to include research groups and activities beyond those in the traditional selection.

This showed the existence of 4,914 groups reporting at least one research line associated with the **human health** application sector, in the 2002 census carried our for this directory, These groups correspond to 32.4% of the total number of groups registered in that census, as shown in Table 2.

The 4,914 research groups included more than 13,000 research lines and 17,700 researchers, of whom nearly 60% which have doctoral degrees (Table 3).

The methodology developed by the Center for Economic Policy Research (Alano Jr et al, 2000) foresees mapping and measurement of the flows of the financial resources in health R&D by a twofold categorization: nature and field of the research activity.

In accordance with their **nature,** health R&D activities were classified into three types, as defined below:

1. **basic research:** any experimental or theoretical work carried out primarily to acquire new knowledge about the fundamentals or phenomena and observable facts, with no purpose of any particular or specific application or use[11].

2. **applied research:** any original research, carried out with a view to acquiring new knowledge, but directed primarily to a practical and specific objective or purpose[12].

3. **experimental development:** any systematic work, supported by existing knowledge obtained through research and/or practical experience, that is directed towards the production of new materials, products or tools, installation of new processes, systems or services, or substantially for improving products or systems that are already produced or installed[13].

Following the manual of the Center for Economic Policy Research, health R&D was also subdivided by **field of activity**, according to the following classification:

---

[11] As examples of health R&D projects found in this research, one can cite the following: *Ultrastructural and biochemical study of expressive proteins in antigenic extracts of infective larvae (L3) of Wuchereria bancrofiti* and *Identification of membrane proteins, secreted and excreted (M/S) by Schistosoma mansoni*.

[12] See as examples found in this research: *Mapping of antigen epitopes candidates for a vaccine against Toxoplasma gondii*, *Non-clinical appraisal of drug and bio-insecticide safety* and *Production of drinking water through natural solar distillation*.

[13] Examples of this type of research are: *Development of a bivalent anti-helminthic vaccine against Schistosomiasis and fascioliasis, based on the recombinant antigen Sm14e* and *Vaccine against malaria: prime-boost protocols with recombinant Adenovirus and plasmidian DNA*.

Table 2: Groups Involved in Health and Total Number of Research Groups Registered in the 2002 Census for the Research Group Directory, by Principal Area of Knowledge in the Group Activities.

Principal Area of Knowledge[1]	Groups involved with health activities[2] (H)	Total groups registered (T)	% (H) / (T)
Health Sciences	2,507	2,513	99.8
Biological Sciences	1,129	2,126	53.1
Human Sciences	430	2,399	17.9
Exact Sciences and Earth Sciences	319	2,051	15.6
Agricultural Sciences	216	1,653	13.1
Engineering and Computer Sciences	199	2,243	8.9
Applied Social Sciences	91	1,429	6.4
Linguistics, Letters, and Arts	23	744	3.1
Total	**4,914**	**15,158**	**32.4**

Source: Guimarães (2004: 376). Notes: [1]Principal area of knowledge in the activities of the research groups; [2]Groups with at least one research line related to the broad area of Health Sciences or in the Human Health activity sector.

Table 3: Number of Groups, Research Lines and Researchers Involved in Health, by Principal Area of Knowledge in the Activities of the Group

Principal Area of Knowledge	Groups	Research Lines (L)	Researchers (R)	Researchers with Doctorates (D)	Researchers (P^1)	Researchers with Doctorates (D^2)
Health Sciences	2,507	7,958	13,371	8,277	10,302	5,886
Biological Sciences	1,129	3,261	5,054	4,064	3,983	3,081
Human Sciences	430	864	2,003	1,113	1,825	979
Exact Sciences and Earth Sciences	319	544	1,210	957	1,142	896
Agricultural Sciences	216	479	1,025	710	725	463
Engineering and Computer Sciences	199	410	782	596	727	547
Applied Social Sciences	91	131	352	175	339	165
Linguistics, Letters and Arts	23	41	110	58	108	56
Total	**4,914**	**13,688**	**23,907**	**15,950**	**19,151**	**12,073**
All knowledge areas without double counting of researchers					**17,773**	**10,938**

Source: Guimarães (2004: 376). Note: P^1 researchers without double count; D^2 doctors without double count.

1. **natural sciences:** focused on natural phenomena and including research in biology, botany, physics, chemistry, etc. applied to the field of health (for example, studies of bacteriology, molecular biology, chemistry of drugs and medicines, etc.)[14]

2. **medical sciences:** include epidemiological[15], clinical[16] and biomedical[17] research in the following fields of study: anatomy, dentistry, medicine, nursing, obstetrics, optometry, osteopathy, pharmacy, physiotherapy, public health, and other related subjects[18].

3. **social sciences and health economics:** include research related to health in the social sciences such as health economics, research on knowledge, attitudes, and practices of individuals related to health programs or interventions[19].

4. **other fields of health R&D with application in the area of health:** research that does not fit in the above categories (for example, research in new technologies of sanitation, new materials, etc.)[20].

It should be noted that classification of activities of health R&D, whether by nature or by field of activity, is not a trivial task and requires a certain degree of arbitrary judgment.

The classification of R&D activities by nature is generic and applicable to multiple areas of scientific and technological activity, including the health area. In this classification, the boundaries between basic, applied and experimental research are recognized to be unclear, as pointed out even by the *Frascati Manual* itself. That is because, in addition to practical issues, this classification should not be understood as an arbitrary separation between activities aimed at expansion of knowledge and activities aimed at solving specific problems. Not only are there patterns of sequencing, causality and complementarity among them, but, and perhaps even more important, there are communities of actors that are more associated with one than the other, whose interests and objectives need to be harmonized within a perspective of strengthening strategic research in health[21].

Similar problems also were found in the classification of health R&D by field of activity, in particular in distinguishing between clinical and

---

[14] Two examples of this type of research are: *Functional studies of small unstable chromosomes of Leishmania braziliensise* and *Studies on cellular joints in the thymic epithelium*.

[15] Epidemiological research is directed to the study of the distribution and determinants of states of health and events in specific populations and to applications of these studies for control of health problems (for example, study of the long-term effects of exposure to heavy metals, the relationship between exposure to tobacco and incidence of neoplasms, etc.).

[16] Clinical research includes studies, tests and/or experiments on diseases or health problems carried out for the benefit of and using specific patients (for example, the comparative effects of two or more drugs in reduction of blood pressure in hypertensives or of ocular pressure in patients with glaucoma and other types of intraocular hypertension).

[17] Biomedical research includes studies on live organisms with medical purposes, including diagnosis, treatment and rehabilitation such as biochemistry, chemistry, pharmacology, etc. (for example, therapeutic properties of phytotherapeutical drugs).

[18] As examples of research in the area of medical sciences the following can be cited: *Cognitive changes in patients with HIV infection*, *Performance appraisal of the Determine HbSAge rapid test* and *Epidemiological surveillance of acute febrile diseases/dengue*.

[19] Included as examples of research in the field of social sciences and health economics are the following: *Studies for development of the Supplementary Health Market*, *Managerial Modernization in Large Health Facilities* and *Evaluation of the National Programme for Control of Hospital Infections*.

[20] Examples of this kind of research include: *Influence of environmental and climatic changes on epidemiology of snake bites and the distribution of poisonous serpents of medical importance* and *Development of alternative methodologies for secondary data analysis*.

[21] In the last decade in particular, the idea of the existence of rigid boundaries and structural tensions between basic research and applied research has been the subject of intense debate and criticism, just as there has been questioning of the linear conception based on the view that technological innovations are the culmination of a continuous process, beginning with a set of basic research findings. Some matrix models, such as the one suggested by Stokes (1997), try to overcome this false dichotomy between basic research and applied research, proposing a new taxonomy of R&D activities. In a very synthetic approach, this author suggests that two coordinates be applied to research: one that measures progress in knowledge and another that measures the application of knowledge. These two coordinates would serve to group research into three well-defined categories: (1) the Bohr

biomedical research. This led to opting for a combined classification – medical sciences – that could lessen this problem.

With a view to reducing the heterogeneity of the classifications effectively applied, it was opted to categorize the health R&D projects with the classification by nature and field of activity being carried out by the members of the research team. However, more often than not, information obtained on health R&D projects was limited to the title or, at most, to one very summary description of the objectives of the research, making categorization extremely difficult.

Similarly, classification into these categories was possible using data from the public sector and international organizations, corresponding to approximately 60% of the total financial resources for health R&D provided by these sectors. Only 22% of the number of projects in these sectors could be classified. For all the projects included in this research, the corresponding percentage was 17%. For this reason, the data referring to the nature and the field of activity should be analysed with great caution.

2.2. Sources and Users of Health R&D Resources in Brazil: Definitions and Mapping

The activities of health R&D involve the existence of relationships of multiple agents, with distinct characteristics and functions, and the investigation of the financial resources involved in these activities was based on categorization of the distinct agents involved in the process. Thus, data on health R&D spending were collected according to whether the unit or institution financed research, directly or indirectly (**financer** or **source**) or received the resources and carried out the research work (**implementer/user**).

The methodology developed by the Center for Economic Policy Research proposes that agents in both these two large categories be subdivided into sectors: public, private, and international. Applying this matrix to Brazil gives the following general chart of sources and users of resources:

For purposes of this research, **sources** of health R&D were considered to be the primary financing agents for health research, both public and private, regardless of the existence of intermediary agents linking them to the end user of the resources. **Users** of resources were considered to be those institutions that receive financial resources from third parties to carry out health R&D activities.

There are organizations, in both public and private spheres, that are both sources and users of financial resources for health R&D, to the extent that they finance research with their own resources, at the same time that they also receive resources from other institutions to carry out their health research activities.

The investigation of the **source** financing institutions sought to identify governmental actors at various levels of government, private agents (including nonprofit nongovernmental organizations/NGOs) and international organizations involved with financing health R&D in the country.

The first category included federal ministries and state and municipal governments among others. Private financing agents included companies producing inputs related to the health sector (drugs,

quadrant – includes basic research or research that promotes progress in knowledge without any identification of an immediate application; (2) the Edison quadrant – includes applied research or that for which the most important objective is application of knowedge for the development of technology; and (3) the Pasteur quadrant–corresponds to basic research or research aimed at progress in knowledge but which, from the beginning, has defined prospects for application. For greater details on this model, see Stokes (1997). In the present research study, however, it was opted to work with the classification by nature laid out in the *Frascati Manual* and with the Global Forum methodology for guidance on conceptual terms.

Chart 1: General Classification of Sources and Users of Health R&D Resources in Brazil

Sector	Sources	Users
Public Sector	Federal government organizations/agencies	Federal government organizations/agencies
	State government organizations/agencies	State government organizations/agencies
	Municipal government organizations/agencies	Municipal government organizations/agencies
		Academic institutions and research institutes
		Hospitals and laboratories
		Others
Private Sector	Pharmaceutical companies	Pharmaceutical companies
	Medical and surgical equipment companies	Medical and surgical equipment companies
	National private nonprofit organizations	Academic and research institutes
		Hospitals and laboratories
		Nongovernmental organizations
		Others
International	Multilateral agencies	Governmental organizations
	Bilateral agencies	Nongovernmental organizations
	Foreign private nonprofit organizations	Others

vaccines, blood derivatives, equipment, medical, hospital, and odontological products); sectoral associations; universities and private research centres; providers of health services; and nonprofit nongovernmental organizations. Finally, the last group referred to bilateral and multilateral external financing agencies, to international development banks (IDB and IBRD), to agencies of the United Nations system, to private foundations (Kellogg, Ford, etc.), to nongovernmental organizations, etc.

It should be emphasized that there are institutions that function as **intermediaries** in the flow of financial resources for health R&D, that is, institutions that, although they are not the primary sources of financial resources, receive these resources and serve as sources of financing for other agents, end users and implementers of health research activities. Thus, for example, MCT finances implementation of health research by public and private universities and research institutions, through federal development agencies linked to it, such as the National Council for Scientific and Technology Development and the Financing Agency for Studies and Projects (FINEP). In such a case, this study considers the primary source of the resources, with the finance agencies mentioned as intermediaries or redistributors of the resources.

The **users** of financing could be governmental or private and include governmental bodies, academic institutions, research institutions, NGOs and foundations, companies producing goods (drugs, medical equipment, etc.) and health services providers, among others.

In some cases, when a public or private institution financed health R&D with resources originally from an external source, these amounts were not attributed to that institution, but rather to the original international source, if that was identified. When such identification was not possible, these amounts were allocated to the national institution.

Chart 2: Sources of Health R&D Financing

- Federal ministries: ministries of health, science and technology and education (*)
- Regulatory agencies linked to the Ministry of Health: National Agency for Supplementary Health (ANS) and National Agency for Health Surveillance (ANVISA)
- State research foundations (FAPs)
- State Education secretariats
- State and municipal health secretariats
- State and municipal secretariats for S&T
- Private industrial health complex: industrial companies producing medical inputs (pharmaceutical industry and medical and hospital equipment industry).
- National and international nongovernmental organizations (NGOs)
- Bilateral/multilateral financing agencies
- Development banks (IDB and IBRD)
- International foundations (Ford, Kellogg, etc.)

(*) Responsible for nearly 80% of federal spending on R&D in all areas. (www.mct.gov.br/estat/ascavpp/default.htm)

Chart 3: Intermediaries in the Flow of Health R&D Resources

- Governmental institutions and associated foundations
- National Council for Scientific and Technological Development (CNPq)
- Coordinating Body for Upgrading of Higher Level Personnel (Capes/MEC)
- Financing Agency for Studies and Projects (FINEP)
- State research foundations (FAPs)
- Industrial companies producing medical inputs (pharmaceutical industry and medical and hospital equipment industry)
- National and international nongovernmental organizations (NGOs)
- Bilateral/multilateral financing agencies

When possible, spending on health R&D was grouped by the type of beneficiary or user of the financial resources, using the categorization shown in Chart 5.

2.2.1. Users of Financial Resources for Health R&D

The users of financial resources for health R&D were identified from two principal sources: 1) the CNPq Directory of Research Groups – Census 2002; and 2) a survey of source institutions for health R&D financing, in particular that coming from federal and state development agencies.

The Lattes Platform and the CNPq Directory of Research Groups

The Lattes Platform is the CNPq's principal management information system, the key instrument not only for development activities carried out by the agency, but also for

processing and dissemination of information necessary for policy formulation and management of science and technology. This system is composed of four distinct, but integrated, projects. The first is an Electronic System for Curricula. This registry of the past and present careers of researchers is a fundamental element for analysis of their merit and competence. In this area, Brazil has developed a standard format for collection of data on career information, adopted not only by CNPq, but also by most of the development agencies of the country. On this basis, there are now more than 500 thousand curricula registered.

Chart 4: Users of Health R&D Resources in Brazil

- Federal organizations
- State and municipal health secretariats
- Research institutes
- Universities and other institutions of higher education
- Public laboratories
- Industrial companies producing health inputs
- Public and private providers of health services
- NGOs

Chart 5: Aggregate Institutional Categories of Users of Health R&D Resources

Institutional Categories
Organs and entities of the Ministry of Health and related foundations
Organs and related foundations of other ministries
State research foundations
Other state and municipal organs
NGOs
Professional councils and specialist associations
Universities, research institutes and related foundations
Other private sector Institutions
International organizations

Source: Adapted from DECIT/MS (2003).

The second system is the Directory of Research Groups in Brazil**.** This directory is a database that contains the research groups working in the country. Information contained in the database includes the human resources engaged in the group, the lines of research being pursued, the knowledge specialties, the application sectors, the master's and doctoral level courses with which the groups interact, and the scientific and technological output, taken from the electronic system for curricula.

The third system is the Directory of Institutions. The accurate registry of institutions that request support from CNPq, or that have members participating in the research groups, or that offer graduate or postgraduate courses, is fundamental so that not only CNPq but also Brazilian development agencies and organs in charge of planning and monitoring the development of science and technology in Brazil can have a precise map of the distribution of resources and the location of research and development competencies in the country and abroad.

The fourth system is called Management System for Development. This system is indispensable for strategic management and for improving the quality of CNPq development activities.

These four integrated information systems, articulated with other databases located outside CNPq, such as the Scientific Electronic Library Online (SciELO), Latin American and Caribbean Health Sciences Literature (LILACS), the patent database of the National Institute of Industrial Property, and the records of dissertations and theses from the universities, constitute the Lattes Platform.

In addition, on the basis of the Lattes Platform, CNPq supports the initiative led by the Pan American Health Organization (PAHO) to establish, in the area of Latin America and the Caribbean, a standard for curricula. This project aims at integrating virtual libraries and facilitating more effective communication of researchers among themselves and with agencies.

This study used data from the Directory of Research Groups in Brazil. Developed since 1992, this aims at having the character of a census, with information on research groups working in the country. Participating in the Directory are universities, independent institutions of higher education, scientific research institutes, technological institutes, research and development laboratories of state companies, and some nongovernmental organizations involved in research. Beginning with the 2002 Census, the Directory succeeded in achieving significant coverage of research groups in operation. It is estimated that just over 80% of the active research groups in all knowledge areas are present in the database.

The groups are organized based on a leadership structure (sometimes two), with the institutional leaders of the participating research institutions (previously authorized by CNPq) taking responsibility for accreditation of group leaders and their certification. Information on the group, researchers, students, the technical support personnel, and lines of research are the responsibility of the group leaders. Personal data on researchers and students and data related to the scientific, technological, and artistic output are the responsibility of each researcher and student, who report them in their Lattes curricula with CNPq.

For this research, all research groups in the 2000 Research Directory that included human health as one of the sectors of application or activity linked to their research were selected, regardless of the principal area of knowledge for their activities. By area of knowledge, these groups were distributed as shown in Table 4:

Table 4: Research Groups with Research Having Application to Human Health

Knowledge Area Predominant in the Group Activities	Number	%
Agricultural Sciences	216	4.4
Biological Sciences	1,129	23.0
Health Sciences	2,507	51.0
Exact Sciences and Earth Sciences	319	6.5
Human Sciences	430	8.8
Applied Social Sciences	91	1.9
Engineering	199	4.0
Linguistics, Letters and Arts	23	0.5
Total	**4,914**	**100.0**

Source: CNPq, Directory of Research Groups (2002).

Information Collection on Resource Users in Institutions that are Sources of Health R&D Financing

For this, the study used, among others, reports of federal and state development agencies, information on the Web pages of research and academic institutions and related foundations, direct review of any financing received for health R&D by any source, and direct contact.

2.3. Research Strategies and Instruments

As already mentioned, the existing primary information on health R&D in our country is not only limited and incomplete, but also comes from multiple sources, although primarily from information produced by federal organs with national coverage.

To expand the coverage of information about health R&D activities, and improve its quality so that it can be used for formulation and evalua-

tion of policies for this area, it became necessary to undertake a twofold effort. On the one hand, the effort of collection, processing, systematization, and production of consolidated tables for information already available, frequently at a high level of aggregation and, on the other hand, efforts at production of primary data, to make it possible to fill in gaps of knowledge and/or to expand and validate already existing information.

These efforts led to contacts for acquisition of data with various institutions responsible for primary information already existing in the country, produced according to their own priorities, methodologies, and purposes. To complement this, methodological strategies were laid out for research to add new information and/or to better refine that already available.

This entire set of complementary methodological strategies had as its objective collecting the data needed for measuring the total flow of financial resources related to health R&D and for mapping the monetary flows among the various agents involved in the health research process. In addition, this made possible the construction of indicators, with a view to summarizing the information obtained and making relevant comparisons with macroeconomic aggregates and with information from other countries. Finally, this set of strategies also tried to contribute towards proposing general lines for a system of continuous and regular monitoring of financial flows in health R&D.

2.3.1. Research and Collection of Secondary Data

This strategy had two principal objectives:

1. reliminary mapping of:

    a. sources, intermediaries and users of health R&D resources in the country
    b. flows and amounts of the resources involved
    c. allocation of resources by the nature and field of activity of health research

2. construction of comparative measures for these amounts, according to total and public spending on health R&D, taking as a reference the budget of the Ministry of Health, the governmental budget and the Gross Domestic Product (GDP).

The research proceeded with the examination of data and information related to two sets of actors: (1) those that are sources of financial resources for health R&D activities and (2) those that are users of resources and implementers of research, in the public, private and international sectors.

For this, a broad and systematic review of existing secondary data was carried out to identify sources of information, types of data available and information gaps.

Much of the information directly available in many of the secondary data sources already listed did not refer to the full time period under investigation. Even when present, the available data were often found, also, at levels of aggregation that were not compatible with the detailed description required for adequate measurement of financial flows. Consequently, it was necessary to request additional information from the bodies and institutions that were sources of financing, based on the identification of the sectors and individuals responsible for the data and establishment of contacts through the Ministry of Health.

This process of requesting information was monitored, including the registry of requests and responses provided as well as the degree to which they were complete and whether there were new solicitations and clarifications, when necessary.

2.3.2. Notes Relating to the Source Financing Institutions

Ministry of Health

The principal source of financing for the Ministry of Health (MS) is the National Treasury, which

passes on financial resources principally from social security contributions[22]. A portion of these resources is managed by the National Health Fund (FNS) that releases the sums spent for the organs of the MS itself, and for other public and private institutions, through agreements and/or contracts. The Ministry of Health passes on, also through the FNS, resources for international organizations such as the Pan American Health Organization (PAHO) and the United Nations Educational, Scientific and Cultural Organization (UNESCO). These agencies, in partnership with national, public and private institutions, carry out projects of interest to the Ministry of Health in several areas, including research and development. Another portion of the resources of the National Treasury goes to Indirect Administration entities, such as the National Health Foundation (FUNASA), the Oswaldo Cruz Foundation (FIOCRUZ), and the two regulatory agencies, National Agency for Supplementary Health (ANS) and National Agency for Health Surveillance (ANVISA).

The Ministry of Health also manages external resources from loans from international organizations such as the World Bank and the Inter-American Development Bank, through contracts and/or international cooperation agreements. These resources are then directed to other public and private organizations and institutions, according to the interests of the Ministry. In this case, the Ministry of Health plays a double role, as an intermediary between the external financing and the end user of the resources / implementer of health R&D, when the origin of resources is external; and as the source of resources, when considering the matching component of this financing. There are also resources from private sources that finance research in Ministry of Health institutions, such as some carried out by the National Cancer Institute (INCa).

With a view to seeking better visualization of the origin and use of resources invested in health R&D in the Ministry of Health, the institutional organization of the collected information is shown below in Chart 6:

Chart 6: Information Collected, according to the Institutional Organization of the Ministry of Health, 2000 to 2002

MINISTRY OF HEALTH
DIRECT ADMINISTRATION
NATIONAL HEALTH FUND (FNS)
GESCON
PAHO
UNESCO
UNODC
NATIONAL CANCER INSTITUTE (INCA)
INDIRECT ADMINISTRATION
NATIONAL HEALTH FOUNDATION (FUNASA)
EVANDRO CHAGAS INSTITUTE
NATIONAL PRIMATE CENTER
PROFESSOR HÉLIO FRAGA REFERENCE CENTER
CENEPI
DENSP
OSWALDO CRUZ FOUNDATION
NATIONAL AGENCY FOR SUPPLEMENTARY HEALTH (ANS)
NATIONAL AGENCY FOR HEALTH SURVEILLANCE (ANVISA)

Source: Authors' research.

In the investigation of data for measurement of the Ministry of Health effort in health R&D presented in this text, only those actions related to activities of scientific or technological research *stricto sensu* were considered as health R&D, understood as any project referring to acquisition of knowledge or technologies applicable to the improvement of the health of individuals or groups and of health actions and services.

The search for information for each of the organs, sectors, and/or entities of direct or indirect administration followed, as a rule, two complementary alternatives: (1) collection and analy-

[22] For 2001, the levies from corporation profits, from financing of social security (CONFINS) and from financial transactions (CPMF) amounted to approximately 78% of the budget of the Ministry of Health. (Congresso Nacional, 2001)

sis of secondary data available in databases, reports, and other documents existing on the corresponding Web pages of the agencies; and (2) requesting specific information on health R&D from these institutions and/or sectors, through correspondence sent to the leadership and/or to other previously identified responsible parties, including forms with the following variables: name of the research project financed, contracted or implementing research institution, name of the coordinator, date of beginning and end of project, nature and field of activity of the research and value of the financing during the years covered by the study.

Values originating from direct administration, FNS, and indirect administration, ANVISA and FUNASA, were identified and removed from the computation of INCa expenditures. All other financial resources, when they could not be directly identified by the organ or entity in the MS that financed the research of this institute, were maintained in this stage of analysis.

There was significant difficulty in data collection for some of the organs in the indirect administration of the Ministry of Health. At times the values obtained were only for 2001, the middle year of the three-year period analyzed in the study. That occurred for the Prof. Hélio Fraga Reference Center, the National Primate Center, and the Evandro Chagas Institute, that at the time of study were organs linked to FUNASA.

Ministry of Science and Technology

The two principal organs linked to the MCT that are related to health R&D and that were addressed in this study are the National Council for Scientific and Technological Development (CNPq) and the Financing Agency for Studies and Projects (FINEP).

In CNPq the data include two major sets of investments in health R&D: (1) investments for development of research projects and research productivity fellowships[23]; and (2) grants aimed at human resources "in-service" education, including doctoral studies, postdoctoral studies, regional scientific development, and industrial technology development.

The results referring to development of research projects came from tabulations prepared by CNPq, especially to include activities that are classified in what that organization defines as Research and Development in Health (health R&D).

Research productivity fellowships, including those granted inside the country and abroad, are those for the broad areas of Health Sciences and Biological Sciences. It was decided to consider all fellowships related to the broad area of Biological Sciences as an equivalent to the part of biological sciences and other large areas that have health applications since; in the Directory of Research groups these proportions are similar. Finally, it should be pointed out that the great majority of the data came from direct surveys carried out by CNPq, complemented when necessary with information obtained from the Statistical Review of CNPq 1998-2003[24].

For FINEP, the investigation of projects of interest for estimates of resources dedicated to health R&D was carried out using two principal sources of information. The first one was by consulting the lists of *Approved Requests for Financing* for the years 2000 (with reported values) and 2001 (without reported values), which are found in the Activities Reports. The second, to fill in the gaps in data collection, was to rely on the technical staff who could help make lists of relevant projects for this work and on the persons in charge of the projects identified as health R&D.

---

[23] CNPq grants almost 8,000 research productivity fellowships to an elite of Brazilian researchers.
[24] Available at: ftp://ftp.cnpq.br/pub/doc/aei/resenha_1998_2003.pdf.

Ministry of Education - Federal Universities and Research Institutes

The value of health researchers' salaries paid by the Ministry of the Education (Federal Universities) was obtained based on a conservative estimate derived from the researchers' roster included in the Directory of Research Groups linked to lines associated with the Human Health activity sector. For those with doctoral degrees, the salary was estimated as equivalent to the basic salary of a level 4 full professor at the Federal University of Rio de Janeiro, equal to US$ 1,319.30[25], without the supplementary payment for participation in graduation classes. Other researchers were all considered as equivalent to level 4 assistant professors with master's degrees[26]. For these, the UFRJ salary was used as a basis, without the supplementary payment for participation in graduation classes, equal to US$ 902.18.

Ministry of Education - Coordinating Body for Upgrading of Higher Level Personnel (CAPES)

Its principal lines of investment are: (a) the Program for Social Demand, which has become the largest development program in CAPES; and (b) the *Program for Postgraduate Development (PROF). For the years 2001 and 2002, information was obtained from* the activity ***reports.*** For the year 2000, as well as for the investment by PROF, no data was available. The values for this year were estimated from the 2001 report. For the social demand program, the values for doctoral grants increased by 16% and for master's degree grants by 3%. The share of the broad area of Biological Sciences was 13% and that of Health Sciences was 15%, based on the average for 2001-2002.

For PROF, the values for 2000 were estimated from the 2001 report, using the following adjustments: an increase of 11% for doctoral grants and 9% for master's degree grants. The share for biology was 13% and that for health was 15%, based on the average for 2001-2002.

Finally, the values of the fellowships were classified in terms of the categories included in this study and refer to the broad areas of Health Sciences and Biological Sciences. It was decided to consider the total of fellowships related to the broad area of biological sciences as equivalent to the portion of the biological sciences and the other broad areas that apply to the health area, since these proportions are similar to those in the Directory of Research Groups.

State Research Foundations

For the State of São Paulo Research Foundation (FAPESP), the starting point was a list of all projects financed (totaling 12,459), with expenditures in the period 01/01/2000 to 31/12/2002 referring to the health area as provided by the Center for Data Processing (CPD) of FAPESP. The list was organized by year, for 2000, 2001, and 2002, including the title of the project, the beneficiary institution, and spending for the year. Thus, those pertaining to health R&D were identified by inspecting the list noting the repetition of some projects from year to year. Including the latter, a total of 1,707 projects were identified.

At the State of Rio de Janeiro Research Foundation (FAPERJ), the starting point for the study was a list of all projects financed (totaling 674) with expenditures in the period 01/01/2000 to 31/12/2002, referring to health sciences (164) and biological sciences (510), provided by the CPD of FAPERJ. The list included the title of the project, the beneficiary institution, and spending for 2000, 2001, and 2002. Those related to Health R&D were identified by inspection.

---

[25] Dollar conversion rate US$ 2.37, average value of the annual average for the three years studied (US$ 1.83 in 2000; US$ 2.35 in 2001 and US$ 2.92 in 2002).

[26] Approximately 95% of the researchers in the CNPq Directory of Research Groups database have doctoral or master's degrees.

For the State of Minas Gerais Research Foundation (FAPEMIG) an estimate was made in order to obtain a proxy for expenditures. Thus, FAPEMIG (2003) reports that assistance for research in 2003 was 50.7% of the total budget, of which 1.3% was applied to health and 18.2% to the area of biological sciences. In 2002, these percentages were 9.31% in health and 30.17% in biological sciences. As 78% of investment in research in the biological sciences sector would be related to the health sector, financing for health R&D for these two years on average would be 29.17% of total research spending. Applying this percentage to the total value allocated for research for the period 2000 and 2001, one can estimate which was the total effort for development made by FAPEMIG.

For the other State Research Foundations (FAPs), the estimate of investments was made based on information available, when this existed, from reports of activities, and from direct contacts with the institutions. Also added was data collected in DECIT on the resources passed on from the Ministry of Health to these institutions.

State Secretariats for Education and for Science and Technology – State Universities

As done for the federal universities, for the state universities the option taken was to make a conservative estimate based on the number of doctoral-level and other researchers represented in the research groups of these institutions at CNPq that reported human health as the application area. The estimated expenditure was taken as equivalent expenditure to the basic salary for a full professor of Rio de Janeiro State University, equal to US$ 1,659.50[27]. Other researchers were all considered as equivalent to assistant professors with master's degrees. For these, the equivalent was taken to be the salary at UERJ, equal to US$ 1,327.90.

2.3.3. Private Health Complex

Industrial Sector

The principal source of information available on the private industrial sector in the area of health is the Industrial Survey of Technological Innovation (PINTEC)[28]. This is carried out by the Brazilian Institute of Geography and Statistics (IBGE) with the support of FINEP, of the Ministry of Science and Technology. The objective of PINTEC was to construct national indicators of activities in technological innovation in Brazilian industrial companies, indicators that would be compatible with international recommendations in methodological and conceptual terms. For this, it used the methodological directives defined in the *1997 Oslo Manual* of the Organization for Economic Cooperation and Development (OECD).

In PINTEC-2000, a set of almost 72 thousand private industrial enterprises, located in the entire national territory, were included. The universe of data for selection of the sample was the Central Census of Companies (CEMPRE) of IBGE. Information requested referred to characteristics of the companies; to innovations implemented for products and processes; to innovative activities carried out; to spending and financing of these activities; to internal activities of R&D; and to the number, levels of qualification and time committed by people involved with this activity; to external procurement of R&D, to the impact of innovation; and to patents and other protection methods, among other topics. Quantitative information on expenses, personnel active on R&D, and spending on other innovative activities had the year 2000 as the period of reference.

---

[27] Dollar conversion rate US$ 2.37, average value of the annual average for the three years studied (US$ 1.83 in 2000; US$ 2.35 in 2001 and US$ 2.92 in 2002).

[28] Available at www.ibge.gov.br.

For purposes of this study, data from PINTEC-2000 were used referring to companies manufacturing pharmaceutical products and medical and hospital equipment. To obtain data for the years 2001 and 2002, estimates were used based on the spending profile. The categories considered as research and development activities were.

- **Internal R&D** – Creative work undertaken in a systematic way for development of new products and processes within the company

- **External R&D Procurement** – R&D carried out by another organization and acquired by the company

Higher Education Private Institutions

The number of doctoral-level and other researchers used for estimating the research effort in private institutions of higher education was obtained on the basis of the Directory of Research Groups of CNPq 2002 that reported research with application in the area of human health. As it was not possible to identify the existence of a standard salary for professionals of private higher education in the entire country, it was decided to use the salary base reported by the Union of Professors of Rio de Janeiro (SEPE - RJ) for full professors for the year 2001, at the level of US$ 10.29 hours of instruction[29]. The number of hours devoted to research was estimated at 6 hours a week for doctoral-level researchers as well as for other researchers, including the corresponding components of paid vacation and 13 monthly pay periods per year.

International Institutions

The World Bank (IBRD) and the Inter-American Development Bank (IDB), in the period covered by the study, financed the international cooperation project for Strengthening the Reorganization of the Unified Health System (REFORSUS) of the Ministry of Health. The data on the projects and agreements implemented were collected from spending data in tables on financial coordination. The base used was that of the subprojects developed under component II – actions, studies, and projects for improvement of management of the health system –that had expenditures for the period of analysis 2000-2002. Not considered were subprojects related to upgrading, training, and technical supervision activities.

Information on financing of health R&D obtained from other international institutions followed two complementary strategies. The first was to investigate the Web sites of institutions known for their involvement in financing health research such as the Ford Foundation and W. K. Kellogg Foundation, and to carry out searches using Google, Altavista, and Yahoo search engines. The other was to seek information directly from end users, such as was done for FIOCRUZ and the José Bonifácio Foundation of UFRJ.

[29] Dollar conversion rate US$ 1.83.

3. TOTAL EXPENDITURE AND FINANCIAL FLOWS OF HEALTH R&D IN BRAZIL – 2000-2002

3.1. Total Expenditure on Health R&D in Brazil– 2000-2002

The totals of resources applied to health R&D in Brazil are categorized in table 5 by type of the financing source. Total spending for the years 2000-2002 was US$ 1,719 billion, with an annual average of US$ 573 million. The public sector invested approximately US$ 1.2 billion, with an annual average of about US$ 417 million, corresponding to 72.8% of total spending. The federal government was responsible for 54.3% and the states for 45.6% of the total spending by the public sector.

Table 6 shows the distribution of resources received for health R&D by users in the study. Universities, research institutes, and related foundations, in the period 2000-2002, used US$ 1.2 billion, an annual average of US$ 401.7 million, corresponding to 70.1% of the overall total of expenditures. The private sector accounted for approximately 23.9% of the total, equivalent to

Table 5: Total Expenditure for Development of Health R&D in Brazil, by Type of Source– 2000-2002, in US dollars

SOURCES OF RESOURCES	2000	2001	2002	2000-2002	annual average
Federal Government	**262,604,143**	**227,788,605**	**190,056,764**	**680,449,513**	**226,816,504**
Ministry of Health	32,487,903	32,093,522	33,326,362	97,907,787	32,635,929
Ministry of Science and Technology	54,021,258	56,997,266	42,147,385	153,165,909	51,055,303
Ministry of Education	176,094,982	138,697,817	114,583,018	429,375,817	143,125,272
State Governments	**235,195,516**	**189,058,567**	**147,225,037**	**571,479,120**	**190,493,040**
State Education Secretariats	171,465,895	133,524,506	107,459,790	412,450,191	137,483,397
FAPs	63,729,621	55,534,061	39,765,247	159,028,929	53,009,643
Public sector	**497,799,659**	**416,847,172**	**337,281,802**	**1,251,928,633**	**417,309.544**
Private sector	**169,049,849**	**131,648,181**	**106,230,214**	**406,928,244**	**135,642,748**
International organizations	10,845,066	20,510,366	29,113,292	60,468,724	20,156,241
TOTAL	**677,694,574**	**569,005,719**	**472,625,308**	**1,719,325,601**	**573,108,534**

Source: Authors' calculations. Values in US dollars. Note: In the conversion of real to dollars the average rate for the year was used, according to the rates given by the Central Bank of Brazil. The conversion rates were: 2000 (1.83), 2001 (2.35) and 2002 (2.92).

Table 6: Total Expenditure on Health R&D in Brazil, by User Type, 2000-2002, in US dollars

USERS	2000	2001	2002	2000-2002	Annual average
Federal Government	**29,763,774**	**28,736,668**	**28,554,267**	**87,054,709**	**28,736,668**
Ministry of Health	29,057,975	27,639,645	27,383,344	84,080,964	28,026,988
INCa	1,219,713	2,619,216	1,511,786	5,350,715	1,783,572
FIOCRUZ	21,799,251	20,324,128	22,097,663	64,221,042	21,407,014
FUNASA	6,039,012	4,696,301	3,773,895	14,509,207	4,836,402
Other Ministries	705,799	1,097,023	1,170,923	2,973,744	991,248
State Governments	**3,399,737**	**3,188,825**	**3,008,789**	**9,597,351**	**3,199,117**
Universities, Research Institutes, and Related Foundations	483,198,412	401,619,371	320,446,112	1,205,263,895	401,754,632
Private Sector	**159,851,546**	**133,768,949**	**118,055,432**	**411,675,927**	**137,225,309**
Pharmaceutical Industry	110,581,002	86,108,173	69,295,998	265,985,173	88,661,724
Medical Equipment Industry	40,127,037	31,246,468	25,145,758	96,519,263	32,173,088
NGOs	959,681	1,513,768	2,095,615	4,569,064	1,523,021
Councils and Associations	663,345	1,003,395	1,429,355	3,096,095	1,032,032
Other Private Institutions	7,520,482	13,897,144	20,088,707	41,506,333	13,835,444
Not Identified	1,481,104	1,691,906	2,560,708	5,733,718	1,911,239
Grand Total	**677,694,574**	**569,005,719**	**472,625,308**	**1,719,325,601**	**573,108,534**

Source: Authors' calculations. Values in American dollars. Note: In the conversion of real to dollars the average rate for the year was used, according to the rates given by the Central Bank of Brazil. The conversion rates were: 2000 (1.83), 2001 (2.35) and 2002 (2.92).

US$ 411 million for the period 2000–2002, with an annual average of US$ 137 million.

3.2. Diagrams for Financial Flows of Health R&D

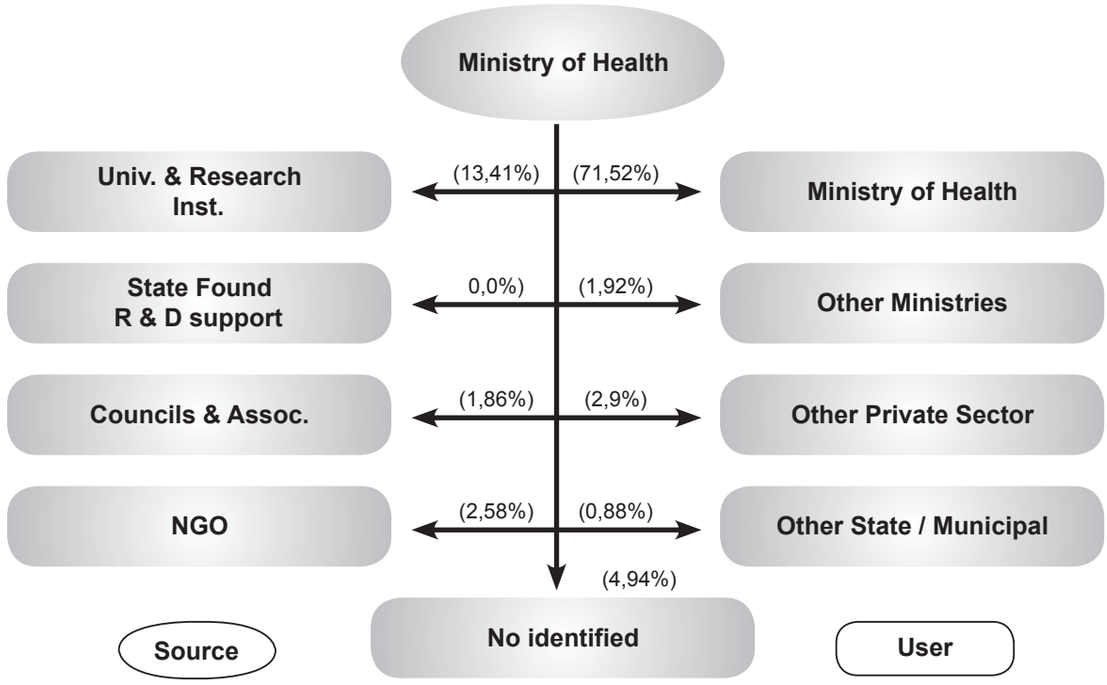
The tables shown above made possible setting up the following diagrams of financial flows between financing agents and users of health R&D resources in the country. The flows are presented at four levels of aggregation, by source, namely: (1) Ministry of Health source; (2) public sector source; (3) public sector and international organizations sources together; and (4) all sources. (Figures 2, 3, 4, and 5)

3.3. Source-User Matrix

A third way to see the flow of health R&D resources is by means of a source-user matrix. This relates the origin and the destination of the resources used. This allows for a quick visualization of how and with what weight each group of institution takes part in the health research effort.

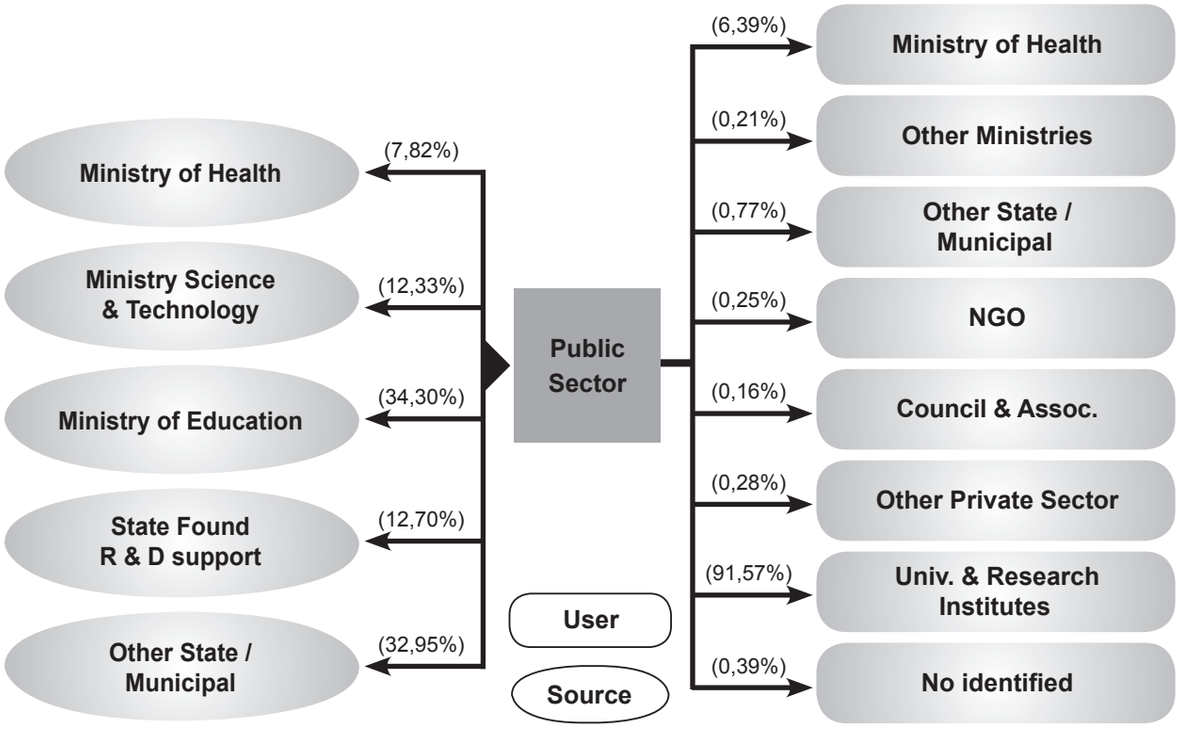
Table 7 below presents the profile of health research by type of institution, using the average spending on health R&D for the period 2000-2002. For the Ministry of Health, when, in some cases, it was not possible to identify average spending, it was decided to use the 2001 values,

Figure 2: Ministry of Health – Financial Flows in Health R&D by Type of Institution Using the Resources – Annual Average for the Period 2000-2002



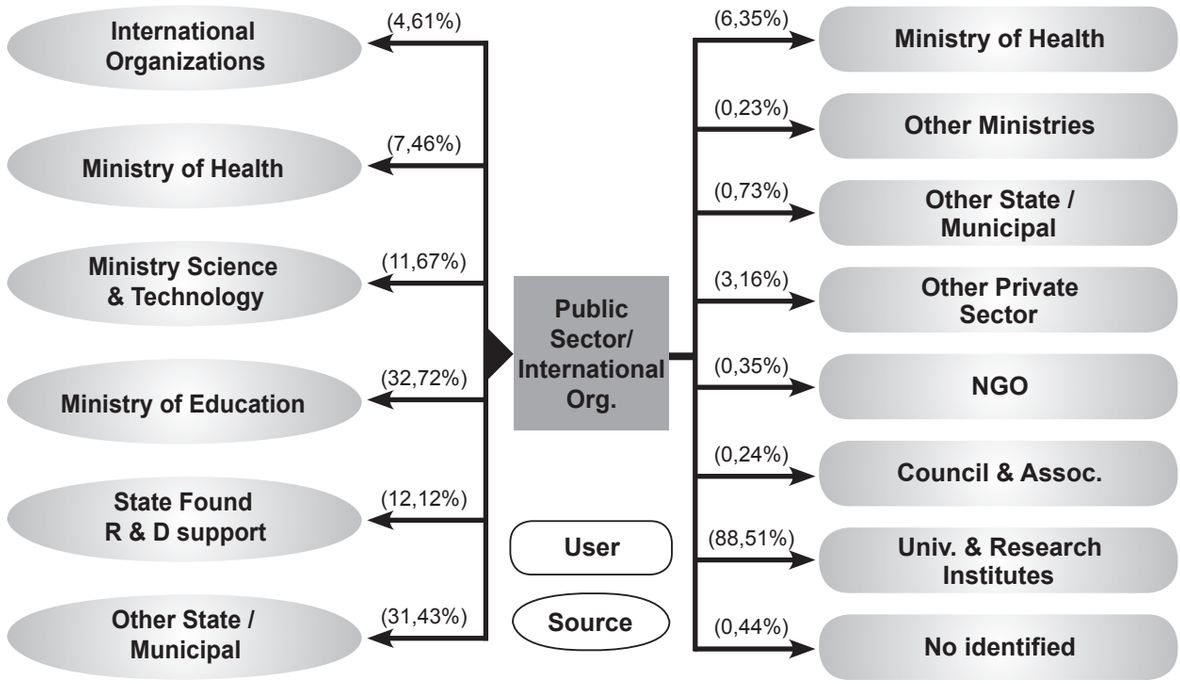
Source: Authors' calculations.

Figure 3: Public Sector – Financial Flows in Health R&D by Type of Institution Using the Resources – Annual Average for the Period 2000-2002



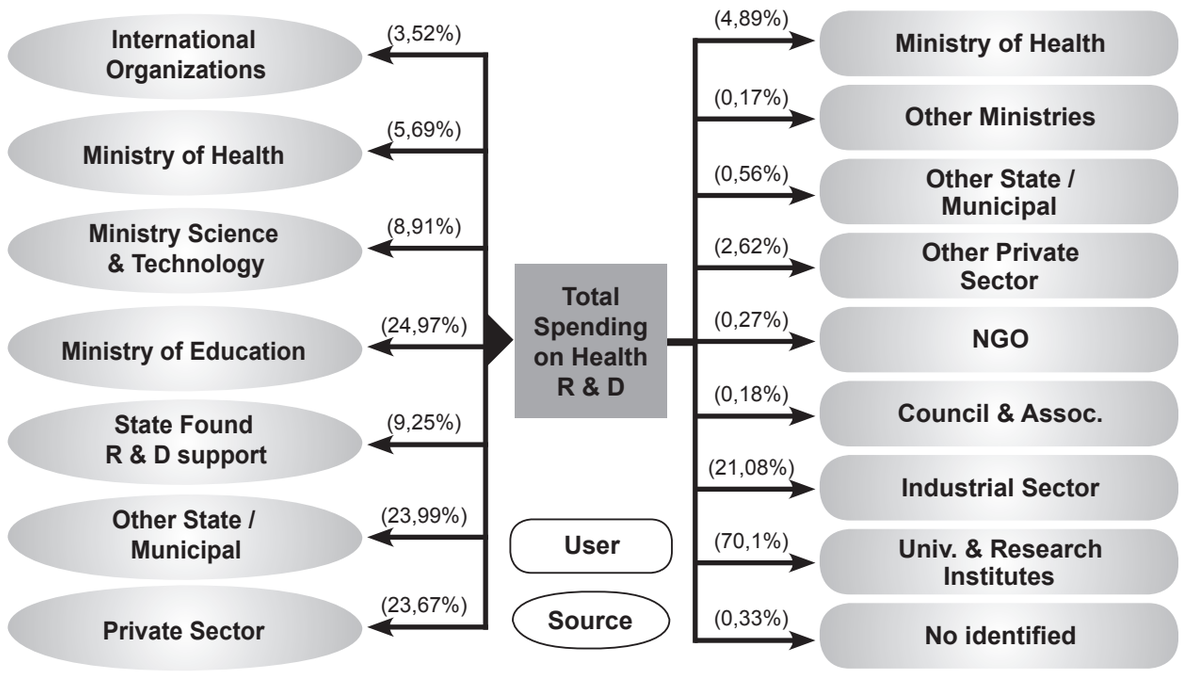
Source: Authors' calculations.

Figure 4: Public Sector and International Organizations – Financial Flows in Health R&D by Type of Institution Using the Resources – Annual Average for the Period 2000-2002



Source: Authors' calculations.

Figure 5: Total Expenditures on Health R&D – Financial Flows by Type of Institution Using the Resources – Annual Average for the Period 2000-2002



Source: Authors' calculations.

Table 7: Flow of Financial Resources by Type of Institution – Source-User Matrix – Annual Average for the Period 2000-2002

SOURCE / USER	Ministry of Health	Ministry of Science and Technology	Ministry of Education	FAPs	Other State Organs	Total Public Sector	International Organizations	Total Public Sector and International Organizations	Private Sector *	Total
Ministry of Health	23,341,513	2,299,897	0	1,004,697	0	26,646,107	1,138,633	27,784,739	242,249	28,026,988
Other Federal	625,227	122,114	0	109,582	0	856,923	134,325	991,248	0	991,248
Other State Organs	286,230	41,098	0	2,871,789	0	3,199,117	0	3,199,117	0	3,199,117
Subtotal Public Sector	**24,252,970**	**2,463,109**	**0**	**3,986,068**	**0**	**30,702,147**	**1,272,958**	**31,975,104**	**242,249**	**32,217,353**
Universities, Institutes, Foundations	4,376,789	48,429,836	143,125,272	48,717,890	137,483,397	382,133,185	5,055,760	387,188,945	14,565,687	401,754,632
Subtotal Public Sector and Universities	**28,629,759**	**50,892,945**	**143,125,272**	**52,703,958**	**137,483,397**	**412,835,332**	**6,328,718**	**419,164,049**	**14,807,936**	**433,971,985**
NGOs	840,382	74,092	0	139,789	0	1,054,263	468,758	1,523,021	0	1,523,021
Professional Councils	608,287	41,127	0	0	0	649,413	382,618	1,032,032	0	1,032,032
Industry	0	0	0	0	0	0	0	0	120,834,812	120,834,812
Other Private Sector Instit.	946,220	47,140	0	165,896	0	1,159,256	12,676,189	13,835,444	0	13,835,444
Subtotal Private Sector	**2,394,889**	**162,358**	**0**	**305,685**	**0**	**2,862,932**	**13,527,565**	**16,390,497**	**120,834,812**	**137,225,309**
Not Identified	1,611,281	0	0	0	0	1,611,281	299,959	**1,911,239**	0	**1,911,239**
Grand Total	**32,635,929**	**51,055,303**	**143,125,272**	**53,009,643**	**137,483,397**	**417,309,544**	**20,156,241**	**437,465,786**	**135,642,748**	**573,108,534**

Source: Authors' calculations. Note: values in American dollars. Data for the private industrial sector refer to the year 2000

as a proxy for average spending. For the private sector, due to lack of data, values used were for the year 2000, collected in PINTEC/IBGE (2002).

The tables that follow show the proportional distribution of resources, considering: (1) the public sector, (2) the public sector plus resources of external origin, and finally (3) a more complete matrix including the private sector.

In Table 8, considering only the public sector spending, the Ministry of Health is responsible for financing approximately 6.4% of the total resources for health R&D. It is interesting to observe, however, that of this percentage, 4.9% (corresponding to 76.6% of those of the Ministry) are related to organs of the Ministry itself, such as the FIOCRUZ Foundation (table 6). In other words, the effort of the MS to promote research is mainly directed to its own operations. It is basically intramural development.

One can also see that "other state organs" are the source for 32.9% of the resources from the public sector. These resources correspond to the salaries of researchers at the state universities and research institutes, particularly relevant in the state of São Paulo, but also present in the states of Rio de Janeiro, Paraná, and some others. Adding these resources to those coming from the Ministry of Education, also corresponding to salaries for the most part, one sees that 67.2% of the financial resources originating from the public sector for health R&D support went for payment of salaries of researchers at public institutions.

Finally, it is worth noting that in the period studied no financial flows from the public sector to the private industrial sector were detected.

The data in table 8 also show that financial resources from the Ministry of Science and Technology for health R&D (12.2%) are similar

Table 8: Source-User Matrix of Flows of Financial Resources – Distribution of Total Expenditure by the Public Sector by Type of Institution – Annual Average for the Period 2000-2002

SOURCE / USER	Ministry of Health	Ministry of Science and Technology	Ministry of Education	FAPs	Other State Organs	Total Public Sector
Ministry of Health	5.59%	0.55%	0.00%	0.24%	0.00%	6.39%
Other Federal	0.15%	0.03%	0.00%	0.03%	0.00%	0.21%
Other State Organs	0.07%	0.01%	0.00%	0.69%	0.00%	0.77%
Subtotal Public Sector	**5.81%**	**0.59%**	**0.00%**	**0.96%**	**0.00%**	**7.36%**
Universities, Institutes, Foundations	1.05%	11.61%	34.30%	11.67%	32.95%	91.57%
Subtotal Public Sector and Universities	**6.86%**	**12.20%**	**34.30%**	**12.63%**	**32.95%**	**98.93%**
NGOs	0.20%	0.02%	0.00%	0.03%	0.00%	0.25%
Professional Councils	0.15%	0.01%	0.00%	0.00%	0.00%	0.16%
Industry	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Other Private Sector Institutions	0.23%	0.01%	0.00%	0.04%	0.00%	0.28%
Subtotal Private Sector	**0.57%**	**0.04%**	**0.00%**	**0.07%**	**0.00%**	**0.69%**
Not Identified	0.39%	0.00%	0.00%	0.00%	0.00%	0.39%
Grand Total	**7.82%**	**12.23%**	**34.30%**	**12.70%**	**32.95%**	**100.00%**

Source: Authors' calculations.

Table 9: Source-User Matrix of Flows of Financial Resources – Distribution of Total Expenditures of the Public Sector and International Organizations by Type of Institution– Annual Average for the Period 2000-2002

SOURCE / USER	Ministry of Health	Ministry of Science and Technology	Ministry of Education	FAPs	Other State Organs	Total Public Sector	International Organizations	Total
Ministry of Health	5.34%	0.53%	0.00%	0.23%	0.00%	6.09%	0.26%	6.35%
Other Federal	0.14%	0.03%	0.00%	0.03%	0.00%	0.20%	0.03%	0.23%
Other State Organs	0.07%	0.01%	0.00%	0.66%	0.00%	0.73%	0.00%	0.73%
Subtotal Public Sector	**5.54%**	**0.56%**	**0.00%**	**0.91%**	**0.00%**	**7.02%**	**0.29%**	**7.31%**
Universities, Institutions, Foundations	1.00%	11.07%	32.72%	11.14%	31.43%	87.35%	1.16%	88.51%
Subtotal Public Sector and Universities	**6.54%**	**11.63%**	**32.72%**	**12.05%**	**31.43%**	**94.37%**	**1.45%**	**95.82%**
NGOs	0.19%	0.02%	0.00%	0.03%	0.00%	0.24%	0.11%	0.35%
Professional Councils	0.14%	0.01%	0.00%	0.00%	0.00%	0.15%	0.09%	0.24%
Industry	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Other Private Sector Institutions	0.22%	0.01%	0.00%	0.04%	0.00%	0.26%	2.90%	3.16%
Subtotal Private Sector	**0.55%**	**0.04%**	**0.00%**	**0.07%**	**0.00%**	**0.65%**	**3.09%**	**3.75%**
Not Identified	0.37%	0.00%	0.00%	0.00%	0.00%	0.37%	0.07%	0.44%
Grand Total	**7.46%**	**11.67%**	**32.72%**	**12.12%**	**31.43%**	**95.39%**	**4.61%**	**100.00%**

Source: Authors' calculations.

in amount to those coming from the state system of science and technology – State research foundations (12.7%). In the share of this system the role of FAPESP is notable.

In table 9, resources coming from international institutions channeled for financing health research were added to the total from the public sector. These corresponded to approximately 4.6% of the resources applied.

It should be pointed out that, unlike the public sector, most of this spending was directed to services delivery by the private sector, due mainly to the impact of loans from the Inter-American Development Bank (IDB). This observation should, however, be viewed with caution given that this financing is for specific projects and is not repeated annually.

Table 10 shows the share of institutions when the private sector is included. The value of the private sector spending may be underestimated, given that it was not possible to identify companies in all the sectors with a role in the health field, for example, the electronic and chemical industries. But one can see that the flow of resources coming from the private sector (23.6% of total financial flows) is nearly 1/3 of that from the public sector (72.8%). In addition, the flows of resources from the private sector are fully intrasectoral.

3.4. Nature and Field of Research Activity

Classification of resources invested in health R&D by nature and field of activity has a limitation that comes from the impossibility of ob-

Table 10: Source-User Matrix – Percentage Distribution of Total Flows of Financial Resources by Type of Institution – Annual Average for the Period 2000-2002

SOURCE / USER	Ministry of Health	Ministry of Science and Technology	Ministry of Education	FAPs	Other State Organs	Total Public Sector	Intern. Orgs.	Total Public Sector and International Orgs.	Private Sector*	Grand Total
Ministry of Health	4.07%	0.40%	0.00%	0.18%	0.00%	4.65%	0.20%	4.85%	0.04%	4.89%
Other Federal	0.11%	0.02%	0.00%	0.02%	0.00%	0.15%	0.02%	0.17%	0.00%	0.17%
Other State Organs	0.05%	0.01%	0.00%	0.50%	0.00%	0.56%	0.00%	0.56%	0.00%	0.56%
Public Sector	**4.23%**	**0.43%**	**0.00%**	**0.70%**	**0.00%**	**5.36%**	**0.22%**	**5.58%**	**0.04%**	**5.62%**
Universities, Institutes, Foundations	0.76%	8.45%	24.97%	8.50%	23.99%	66.68%	0.88%	67.56%	2.54%	70.10%
Public Sector and Universities	**5.00%**	**8.88%**	**24.97%**	**9.20%**	**23.99%**	**72.03%**	**1.10%**	**73.14%**	**2.58%**	**75.72%**
NGOs	0.15%	0.01%	0.00%	0.02%	0.00%	0.18%	0.08%	0.27%	0.00%	0.27%
Professional Councils	0.11%	0.01%	0.00%	0.00%	0.00%	0.11%	0.07%	0.18%	0.00%	0.18%
Industry	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	21.08%	21.08%
Other Private Sector Institutions	0.17%	0.01%	0.00%	0.03%	0.00%	0.20%	2.21%	2.41%	0.00%	2.41%
Private Sector	**0.42%**	**0.03%**	**0.00%**	**0.05%**	**0.00%**	**0.50%**	**2.36%**	**2.86%**	**21.08%**	**23.94%**
Not Identified	0.28%	0.00%	0.00%	0.00%	0.00%	0.28%	0.05%	0.33%	0.00%	0.33%
Grand Total	**5.69%**	**8.91%**	**24.97%**	**9.25%**	**23.99%**	**72.82%**	**3.52%**	**76.33%**	**23.67%**	**100.00%**

Source: Authors' calculations. Note: *Data for the private sector refer to the year 2000.

taining information for all types of expenditures. This lack of information is the result of having to include estimates for large aggregates, for example salaries of researchers at universities that cannot be attributed to specific projects and, therefore, could not be categorized by nature and field of activity.

In addition, spending related to the private industrial sector also lacks sufficiently detailed descriptions that would permit this categorization. Finally, there is a lack of data on projects financed by some institutions (for example, FUNASA), where information is not available for all kinds of research.

Therefore, the composition of the sample varies significantly by the source of financing. For example, only 60% of resources coming from the public sector had sufficient information to be analyzed by nature and field of activity of the research and, therefore, 40% of the resources from this source were not categorized by these categories. In contrast, almost 100% of the resources coming from international organizations were analyzed. Therefore, the observations below on variations in the data with respect to the nature and field of activity of research should be viewed very cautiously.

The tables below show the percentage of research projects that were identified, allowing classification by the nature and field of activity of research.

Table 11 shows the percentage of research projects that were identified, excluding salaries and training fellowships. Considering the public sector, for the period 2000-2002, nearly 91% of the projects could be classified by the nature and field of activity of health R&D. Including resources from international sources, this percentage stays around 92%. The large difference for the grand total (approximately 43%) is due, as noted in a previous paragraph, to the impossibility of categorizing the expenditures of the industrial sector.

Table 11: Percentage of Research Projects Classified by Nature and Field of Activity, Excluding Salaries and Training Fellowships

Category	2000	2001	2002	2000-2002
Nature of the Research				
PS/Total PS	88.94%	91.79%	91.69%	90.99%
PS/Total All Projects	30.38%	35.75%	34.46%	33.73%
(PS+IO)/Total (PS+IO)	89.32%	92.58%	93.82%	92.32%
(PS+IO)/Total All Projects	34.46%	44.46%	49.02%	43.27%
Field of Activity				
PS/Total PS	89.62%	92.15%	92.09%	91.45%
PS/Total All Projects	30.61%	35.89%	34.61%	33.90%
(PS+IO)/Total (PS+IO)	89.92%	92.13%	94.11%	92.43%
(PS+IO)/Total All Projects	34.69%	44.25%	49.17%	43.32%

Source: Authors' calculations. Note: PS–Public Sector; IO–International Organization.

Table 12: Percentage of Research Projects Identified by Nature and Field of Activity

Category	2000	2001	2002	2000-2002
Nature of Research				
PS/Total PS	14.99%	19.39%	20.29%	18.31%
PS/Total All Projects	11.01%	14.21%	14.48%	13.30%
(PS+IO)/Total (PS+IO)	16.64%	22.98%	26.57%	22.30%
(PS+IO)/Total All Projects	12.49%	17.67%	20.60%	17.07%
Field of Activity				
PS/Total PS	15.11%	19.47%	20.38%	18.40%
PS/Total All Projects	11.10%	14.26%	14.55%	13.37%
(PS+IO)/Total (PS+IO)	16.75%	22.87%	26.65%	22.33%
(PS+IO)/Total All Projects	12.57%	17.58%	20.66%	17.09%

Source: Authors' calculations. Note: PS–Public Sector; IO–International Organization.

Table 12 shows the share of research projects that could be identified when one includes salaries in universities and research institutes and training fellowships given by the development agencies, CNPq, CAPES and FAPs. For the period 2000-2002, approximately 18% of expenditures of the public sector were classified; and 13% considering the total expenditures on health R&D. Adding in projects financed by international organizations, 22% of the expenditures of the public sector and international organizations could be classified; and 17% of total spending on research.

Table 13 shows the total investment for the public sector categorized by the nature of research. The area of applied research received the greatest volume of resources with 63% of the total value. The area of basic research received 23% of the total value of resources. Graph 2 shows the evolution of total expenditure by the nature of research in percentages.

The same distribution as per categorization by nature of health R&D for the sum of public sector and international agencies investments is shown in Table 14. Although one can see the

Table 13: Total Public Sector Expenditure by the Nature of Health R&D, 2000-2002 (%)

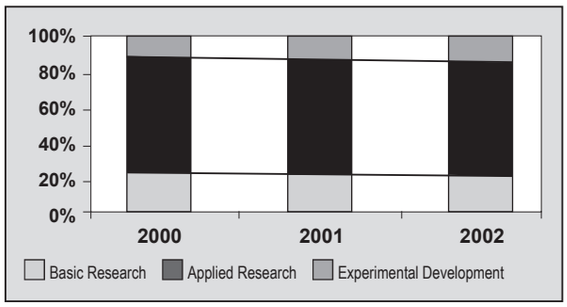
Nature	2000	2001	2002	2000-2002
Basic Research	24.41	23.06	22.39	23.16
Applied Research	64.21	63.41	62.96	63.44
Experimental Development	11.38	13.53	14.65	13.40
Total	**100.00**	**100.00**	**100.00**	**100.00**

Source: Authors' calculations. Values are included only for projects with sufficient information to categorize spending by the nature of research.

predominance of spending for applied research, there is also a significant expansion of expenditures for experimental development, which increased from 13.4% of the total (in Table 13) to 25.4% (Graph 3)

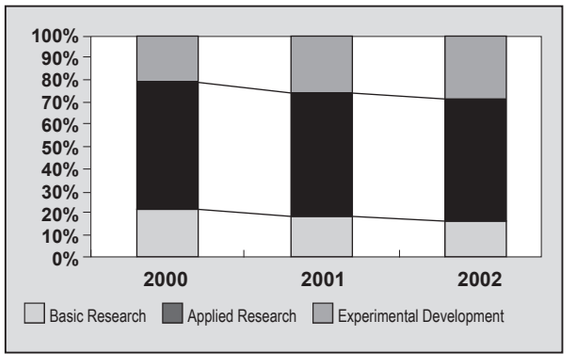
Table 15 shows public sector spending by the **field of activity of health R&D**, making it possible to see that spending on research in the area of medical sciences makes up about 62% of the total. One can also see that, over the period, spending on health research in the social and economic sciences was the field of activity that grew most rapidly, as also shown in Graph 4.

Graph 2: Total Public Sector Expenditure by the Nature of Health R&D, 2000-2002



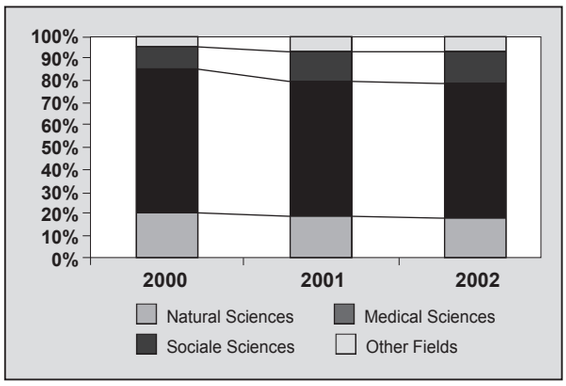
Source: Authors' calculations. Note: Values are included only for projects with sufficient information to categorize spending by the nature of the research.

Graph 3: Total Expenditure by the Public Sector and International Organizations, by the Nature of Health R&D, 2000-2002



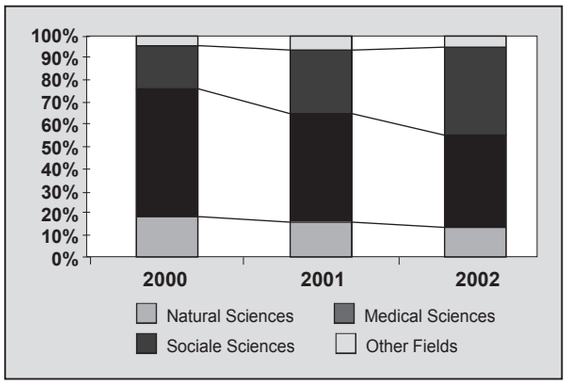
Source: Authors' calculations. Note: Values are only included for projects with sufficient information to categorize spending by the nature of research.

Graph 4: Total Public Sector Expenditure, by Field of Activity of Health R&D, 2000-2002



Source: Authors' calculations. Note: Values are included only for projects with sufficient information to categorize spending by the field of activity of health R&D.

Graph 5: Total Expenditure by the Public Sector and International Organizations, by Field of Activity of Health R&D, 2000-2002



Source: Authors' calculations. Note: Values are included only for projects with sufficient information to categorize spending field of activity.

When one looks at aggregate spending by the public sector and international organizations (Table 16), the trend mentioned earlier is accentuated, that is, spending on research in the area of medical sciences makes up only 49% of total expenditures, while expenditures involved with health research in the area of social and economic sciences reaches close to 1/3 of the total. Over the period from 2000 to 2002, expenditures in this activity field more than triple, as can be seen in Graph 5.

3.5. Indicators of Health R&D Expenditures

The percentage share of health R&D spending, in comparison with principal aggregate economic indicators, can be seen in Table 17. Total spending on health R&D only represented 0.1085% of GDP and 5.7% of actual spending in the budget of the Ministry of Health.

Compared to total public sector spending, investments in health R&D were equivalent to nearly 0.61% of expenses for social security and 4.15% of the expenses of the Ministry of Health.

Table 14: Total Expenditure by the Public Sector and International Organizations, by the Nature of Reseach, 2000-2002 (%)

Nature	2000	2001	2002	2000-2002
Basic Research	21.61	18.74	15.99	18.24
Applied Research	58.03	56.10	55.73	56.39
Experimental Development	20.36	25.16	28.28	25.37
Total	**100.00**	**100.00**	**100.00**	**100.00**

Source: Authors' calculations. Note: Values are included only for projects with sufficient information to categorize spending by the nature of research.

Table 15: Total Public Sector Expenditure by Field of Activity of Health R&D, 2000– 2002 (%)

Field of Activity	2000	2001	2002	2000-2002
Natural Sciences	20.24	18.69	17.50	18.64
Medical Sciences	65.06	60.02	61.41	62.18
Social Sciences	9.69	13.18	13.94	12.56
Other Fields	5.01	7.21	7.15	6.62
Total	**100.00**	**100.00**	**100.00**	**100.00**

Source: Authors' calculations. Note: Values are only included for projects with sufficient information to categorize spending by the field of activity.

Table 16: Total Expenditure by the Public Sector and International Organizations, by Field of Activity of Health R&D, 2000-2002(%)

Field of Activity	2000	2001	2002	2000-2002
Natural Sciences	17.87	15.30	12.70	14.80
Medical Sciences	57.86	49.96	43.91	49.23
Social Sciences	19.76	28.89	37.95	30.60
Other Fields	4.51	5.85	5.4	5.37
Total	**100.00**	**100.00**	**100.00**	**100.00**

Source: Authors' calculations. Note: Values are included only for projects with sufficient information to categorize spending by field of activity.

Finally, it is worth emphasizing that the Ministry of Health, as a rule, only dedicated 0.33% of its budget to research in health.

With respect to national health expenditures, estimated at 7.5% of GDP for 2002, the proportion of total spending on health R&D was 1.48%.

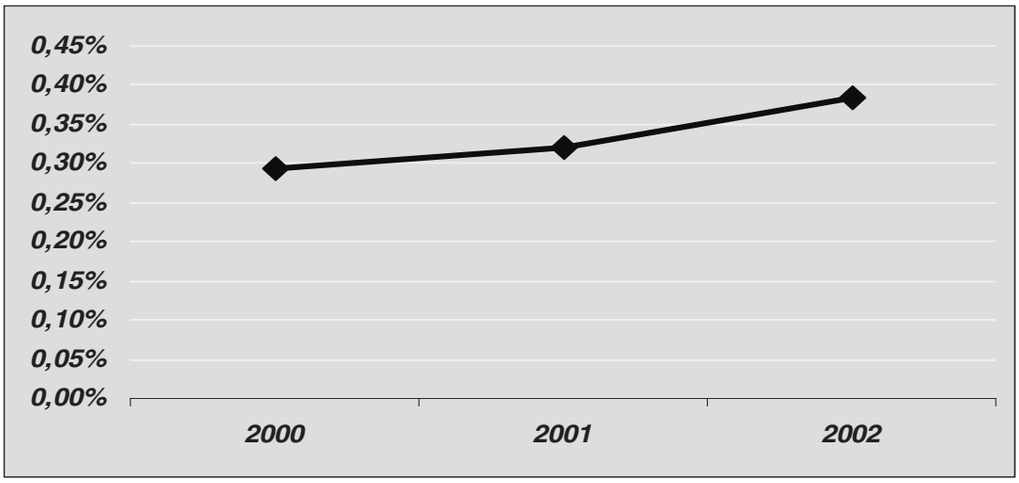
Although the value of investment by the Ministry of Health represents a very small part of the budget of this ministry, these proportions showed a rising trend over the period studied, as shown in Graph 6 below.

Table 17: Percentage of Expenditure for Health R&D, Compared to the Principal National Aggregates – Annual Average for the Period 2000-2002

National Aggregates[1]	Total MS Health R&D (%)	Total Public Sector Health R&D (%)	Total Health R&D (%)
GDP *	0.0064%	0.0789%	**0.1085%**
General Expenses of the Union **	0.0123%	0.1521%	0.2093%
Budget for Social Security **	0.0498%	**0.6171%**	0.8493%
Total Expenses on Health***	0.0843%	1.0789%	1.4815%
Public Expenses on Health	0.1875%	2.3968%	3.2923%
Ministry of Health **	**0.3355%**	**4.1549%**	**5.7183%**

Sources: * IBGE: http:/www.ibge.gov.br/home/estatistica/economia/contasnacionais/2002/tab05.pdf;
** General Budget of the Union– http:/www.cgu.gov.br/;
Note: 1–Data on national aggregates refers to the annual average for the period 2000-2002.
*** Estimated at 7.5% of GDP

Graph 6: Relationship between Health Ministry Expenditure on Health R&D and the Health Budget, 2000-2002



Source: Authors' calculations.

4. FINAL CONSIDERATIONS

The general objective of this work was to map and measure the flows of financial resources for health R&D in Brazil for the years 2000 to 2002. The study also had the complementary objective of developing a system for applying the methodology for these processes proposed by the Global Forum for Health Research, to allow international comparisons and the development of elements for setting up a system to monitor these flows through the country.
The total annual average of resources invested in health R&D was on the order of US$ 573 million. The public sector as a whole invested US$ 417 million (72.8%) and the Ministry of Health, US$ 32 million (5.6%).

In percentage terms, the public sector invested approximately 4.15% of the health budget in health R&D. However, the Ministry of Health put only 0.33% of its budget into investment in health research in the country. It should also be noted that the resources of the Ministry of Health were allocated almost entirely to its own institutions.

Universities and research institutes received 92.5% of public resources for health R&D in Brazil, amounting to approximately US$ 382 million per year. Of these, the largest part was used for payment of salaries for professors and researchers. It is worth noting that the private sector receives a small fraction of the public resources, about 0.69% of the total expenditures. It should also be mentioned that this small proportion of public resources for support for R&D in the private sector, was all allocated to NGOs and professional associations in the health field. During this period, there were no public financial resources identified as allocated to companies producing inputs for health.

Besides the more exact mapping of the amounts of resources and the flows between finance sources and users of health R&D financial resources, another objective of this study was a more precise delimitation of the type of research financed by its nature and field of activity. Despite every effort made, the data related to these dimensions are in general precarious, both because of unavailability of the information in the different institutions as well as the fact that the research was concentrated in a time period relatively distant from the moment it was carried out.

With respect to classification of spending by the nature and field of activity of research, although it has been possible to do an initial analysis of these categorizations for the public sector and international organizations, the results are still quite imprecise. That is because information on the topics, objectives, and expected outcomes of research financed was only available for about 40% of the resources in these sectors.

The development process of this work made it possible to establish some bases for designing a monitoring system for information related to health R&D financing. In the proposal, key institutions, which are important because they finance health R&D, organize and make available information on research projects, and have a coordinating role in research development, are identified. Also, the categories used in the Center for Economic Policy Research methodology are considered practical once adapted to the institutional panorama of the Brazilian system of science, technology and innovation.

It is recommended that the monitoring system should be coordinated by the government in order to be able to establish partnerships with key institutions and thus establishing a participatory process. The monitoring system would be the tool necessary for evaluation of the potentialities of the scientific and technological base in the country, for identification of the

most promising activities and projects for the future, and for strategic decisions by managers of scientific and technological policy for health. It should lead to obtaining more cost-effective results from the resources used. In this regard, this monitoring system can help strengthen partnerships with the research community in the country.

The expectation of this study is that carrying out these activities may lead to overcome the existing information gaps, making it possible for the Ministry of Health to have a more reliable picture of the financial amounts and the flows of resources among the various agents concerned with health R&D in Brazil.

With respect to the use of the methodology of the Center for Economic Policy Research and the Council on Health Research for Development for measuring financial flows in health R&D, it should be stressed that this work and its results are the concrete application of the methodology to a local situation, in this case Brazil. The necessary adaptations included the identification and selection of source institutions, intermediaries, and users of financial resources in health R&D; the sources of information present and identified in each of these institutions; the methods used for data collection; the content available for classification by the nature and field of activity of the research; and the proposal for implementation of a monitoring system.

5. REFERENCES

ALANO JR., B. P.; ALMARIO, E. S. *Tracking Country Resource Flows for Health Research and Development (R&D)*. Manila: Center for Economic Policy Research, 2000.

ASSOCIAÇÃO BRASILEIRA DE PÓS-GRADUAÇÃO EM SAÚDE COLETIVA (ABRASCO). Manifesto enviado ao Plenário da Conferência Nacional da Ciência, Tecnologia e Inovação. Brasília, set. 2001.

BARRETO, L. M. A pesquisa em Saúde Coletiva no Brasil. *Cadernos de Saúde Pública*, Rio de Janeiro, v. 19, n. 2, p. 354-355, mar-abr. 2003.

BRASIL. CONGRESSO NACIONAL. *Orçamento 2001*. Área Temática VII Saúde. Available at: <http://www2.senado.gov.br/orcamento/doc/orc2001/loa/relsetapres/rel_apres_07.pdf>. Accessed on 5 maio 2004.

BRASIL. INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA. PIB Brasil. Available at em <http://www.ibge.gov.br/home/estatistica/economia/contasnacionais/2002/tab05.pdf>. Accessed on 23 mar. 2004.

BRASIL. MINISTÉRIO DA CI NCIA E TECNOLOGIA. *Brasil:* recursos humanos em atividades de C&T (RHCT): fontes de informação; metodologia e resultados para o caso brasileiro. Brasília: Ministério da Ciência e Tecnologia, 1995.

BRASIL. MINISTÉRIO DA CI NCIA E TECNOLOGIA. *Ciência e tecnologia no Governo Federal*. Brasília: Ministério da Ciência e Tecnologia, 1998.

BRASIL. MINISTÉRIO DA CI NCIA E TECNOLOGIA. *Indicadores de P&D e C&T.* Brasília: Ministério da Ciência e Tecnologia, dez. 2002.

BRASIL. MINISTÉRIO DA CI NCIA E TECNOLOGIA. *Indicadores nacionais de ciência e tecnologia 1990-96*. Brasília: Ministério da Ciência e Tecnologia, 1997.

BRASIL. MINISTÉRIO DA CI NCIA E TECNOLOGIA. *Livro branco*: ciência, tecnologia e inovação. Brasília: Ministério da Ciência e Tecnologia, 2002.

BRASIL. MINISTÉRIO DA SAÚDE. *Ciência e tecnologia em saúde*. Subsídios do Ministério da Saúde às discussões da Conferência Nacional de Ciência, Tecnologia e Inovação. Brasília: Ministério da Saúde, 2001. Mimeo.

BRASIL. MINISTÉRIO DA SAÚDE. Dados e pesquisa em DST/AIDS, pesquisa em DST e AIDS. In: Ministério da Saúde. *Resumo das Pesquisas do Programa Nacional de AIDS*. Brasília: MS, 2004. Available at: <www.aids.gov.br>. Accessed on 10 fev. 2004.

BRASIL. MINISTÉRIO DA SAÚDE. Diretoria de Normas e Habilitação de Produtos (DIPRO/ANS). *Produção de conhecimento*. Rio de Janeiro: ANS, 2004. CD-rom.

BRASIL. MINISTÉRIO DA SAÚDE. Edital de chamada pública 030/2003 para contratação de instituição executora da pesquisa "Fluxos financeiros de pesquisa e desenvolvimento em saúde no Brasil". Brasília: MS/Unesco, 2003.

BRASIL. MINISTÉRIO DA SAÚDE. *Relatório Geral*. Investimentos em Ações de CTS, Brasília: MS, 2003. Mimeo.

BRASIL. MINISTÉRIO DA SAÚDE. Secretaria de Ciência, Tecnologia e Insumos Estratégicos. Departamento de Ciência e Tecnologia. *Investimentos em ações de ciência e tecnologia no Ministério da Saúde – 2001*. Brasília: Ministério da Saúde. Available at: <www.saude.gov.br>. Accessed on 10 fev. 2004.

BRASIL. MINISTÉRIO DA SAÚDE. Secretaria de Políticas de Saúde. Departamento de Ciência e Tecnologia em Saúde. *Diretrizes para Planejamento de Ações de Ciência e Tecnologia em Saúde*. Brasília: Ministério da Saúde, dez. 2002.

BRASIL. MINISTÉRIO DA SAÚDE. UNIDADE CENTRAL DE PROJETOS. Programa da AIDS. *Acompanhamento de projetos apoiados pela CN-DST/AIDS*. Available at: <www.aids.gov.br>. Accessed on 10 fev. 2004.

BRASIL. Presidência da República. *Balanço Geral da União - 2000*. Available at: <http://www.cgu.gov.br/bgu/>. Accessed on 29 set. 2003.

BRASIL. PRESIDÊNCIA DA REPÚBLICA. *Balanço Geral da União 2001*. Available at: <http://www.cgu.gov.br/bgu2001/>. Accessed on 29 set. 2003.

BRASIL. PRESIDÊNCIA DA REPÚBLICA. *Balanço Geral da União 2002*. Available at: <http://www.cgu.gov.br/bgu2002/>. Accessed on 29 set. 2003.

CONSELHO NACIONAL DE DESENVOLVIMENTO CIENTÍFICO E TECNOLÓGICO. *Diretório dos Grupos de Pesquisa* – 5.0. 2001. Available at: <http://www.cnpq.br). Accessed on 2 out. 2003.

CONSELHO NACIONAL DE DESENVOLVIMENTO CIENTÍFICO E TECNOLÓGICO. *Séries Históricas do Fomento do CNPq - 1995/98*. Available at: <http://www.cnpq.br/sup/fomento/tabela9.html). Accessed on 2 out. 2003.

DAVEY, Sheila (Ed.). *The 10/90 Report on Health Research 2001-2002*. Genebra: Global Forum for Health Research, 2002. Available at: <www.globalforumhealth.org>. Accessed on 2 fev. 2004.

ESCOLA NACIONAL DE SAÚDE PÚBLICA DA FIOCRUZ. *Linhas de pesquisa e pesquisas*. Rio de Janeiro: FIOCRUZ. Available at: <http://ensp.fiocruz.br/pesquisa/pesquisa.html>. Accessed on 22 jan. 2004.

FUNDAÇÃO ARY FRAUZINO. *Relatório de Atividades 2000*. Rio de Janeiro: FAF. Available at: <http://www.faf.org.br/rel_00/index.html>. Accessed on 22 jan. 2004.

FUNDAÇÃO ARY FRAUZINO. *Relatório de Atividades 2001* Rio de Janeiro: FAF. Available at: <http://www.faf.org.br/rel_01/index.html>. Accessed on 22 jan. 2004.

FUNDAÇÃO ARY FRAUZINO. *Relatório de Atividades 2002*. Rio de Janeiro: FAF. Available at: <http://www.faf.org.br/rel_02/2002.pdfl>. Accessed on 22 jan. 2004.

FUNDAÇÃO NACIONAL DE SAÚDE. *Convênios celebrados e liberados no exercício de 1999 a 2003*. Brasília: FUNASA. Available at: <http://www.funasa.gov.br/sitefunasa/conv/pdfs/convenios_celebrados.zip>. Accessed on 2 mar. 2004.

FUNDAÇÃO NACIONAL DE SAÚDE. *Estudos e pesquisas*. Brasília: FUNASA. Available at: http://www.funasa.gov.br/sitefunasa/estud_pesq/estud_pesq00.htm>. Accessed on 2 mar. 2004.

FUNDAÇÃO NACIONAL DE SAÚDE. *Relatório das Principais Atividades e Resultados - 1999 a 2002*. Brasília: FUNASA. Available at: <http://www.funasa.gov.br/sitefunasa/fns/PDF/relatorio_1999_2002.pdf>. Accessed on 4 mar. 2004.

FUNDAÇÃO NACIONAL DE SAÚDE. *Relatório de Gestão de 2000*. Brasília: FUNASA. Available at: <http://www.funasa.gov.br/sitefunasa/fns/PDF/relatorio_gestao_2000.pdf>. Accessed on 3 mar. 2004.

FUNDAÇÃO NACIONAL DE SAÚDE. *Relatório de Gestão de 2001*. Brasília: FUNASA. Available at: <http://www.funasa.gov.br/sitefunasa/fns/PDF/relatorio_gestao_2001.pdf>. Accessed on 3 mar. 2004.

FUNDAÇÃO NACIONAL DE SAÚDE. *Relatório de Gestão de 2002*. Brasília: FUNASA. Available at: <http://www.funasa.gov.br/sitefunasa/fns/PDF/relatorio_gestao_2002.pdf>. Accessed on 3 mar. 2004.

FUNDAÇÃO NACIONAL DE SAÚDE. *Sistema de Informações de Aplicação de Recursos*. Available at: <https://sis.funasa.gov.br/siar/>. Accessed on 4 mar. 2004.

FUNDAÇÃO OSWALDO CRUZ. *Linhas de pesquisa*. Rio de Janeiro: FIOCRUZ. Available at: <http://www.fiocruz.br/linhas/linhas.htm>. Accessed on 22 jan. 2004.

FUNDAÇÃO OSWALDO CRUZ. *Programa de Pesquisa e Desenvolvimento Tecnológico*. Rio de Janeiro: FIOCRUZ. Available at: <http://www.fiocruz.br/programas/programas.html>. Accessed on 22 jan. 2004.

FUNDAÇÃO OSWALDO CRUZ. *Projeto Inovação em Saúde*. Rio de Janeiro: FIOCRUZ. Available at: <http://www.fiocruz.br/projetos/inovacaoemsaude/projeto.pdf>. Accessed on 22 jan. 2004.

FUNDAÇÃO OSWALDO CRUZ. *Projetos de pesquisa*. Rio de Janeiro: FIOCRUZ. Available at: <http://www.fiocruz.br/projetos/projetos.html>. Accessed on 22 jan. 2004.

FUNDAÇÃO OSWALDO CRUZ. *Relatório de Atividades 2000*. Rio de Janeiro: FIOCRUZ. Available at: <http://www.fiocruz.br/planejamento/rela2000.pdf>. Accessed on 22 jan. 2004.

FUNDAÇÃO OSWALDO CRUZ. *Relatório de Atividades 2001*. Rio de Janeiro: FIOCRUZ. Available at: <http://www.fiocruz.br/planejamento/rela2001.pdf>. Accessed on 22 jan. 2004.

FUNDAÇÃO OSWALDO CRUZ. *Relatório de Atividades 2002*. Rio de Janeiro: FIOCRUZ. Available at: <http://www.fiocruz.br/planejamento/rela2002.pdf>. Accessed on 22 jan. 2004.

FUNDAÇÃO OSWALDO CRUZ. *Relatório de Gestão 2001*. Rio de Janeiro: FIOCRUZ. Available at: <http://www.fiocruz.br/planejamento/relatoriogestao/index.html>. Accessed on 22 jan. 2004.

FUNDAÇÃO OSWALDO CRUZ. *Relatório de Gestão 2002*. Rio de Janeiro: FIOCRUZ. Available at: <http://www.fiocruz.br/planejamento/rela/relagestao2002.pdf>. Accessed on 22 jan. 2004.

GLOBAL FORUM FOR HEALTH RESEARCH (Org.). *Monitoring financial flows for health research*. Genebra: GFHR, 2001.

GLOBAL FORUM FOR HEALTH RESEARCH (Org.). *The 10/90 Report on Health Research 2000*. Genebra: GFHR, 2001. Available at <www.globalforumhealth.org>. Accessed on 2 out. 2003.

GLOBAL FORUM FOR HEALTH RESEARCH (Org.). *The 10/90 Report on Health Research 1999*. Genebra: Global Forum for Health Research, 1999 Available at: <www.globalforumhealth.org>. Accessed on 2 out. 2003.

GLOBAL FORUM FOR HEALTH RESEARCH. *Monitoring financial flows for health research*. Genebra: GFHR, 2004.

GUIMARÃES R. Bases para uma política nacional de ciência, tecnologia e inovação em saúde. *Ciência & Saúde Coletiva*. Rio de Janeiro, v. 9, n. 2, p. 375-387, 2004

GUIMARÃES, R. Pesquisa no Brasil: a reforma tardia. *São Paulo em Perspectiva*. São Paulo, v. 16, n. 4, p. 41-47, 2002.

GUIMARÃES, R. Por uma política de ciência, tecnologia e inovação em saúde. *Cadernos de Saúde Pública*. Rio de Janeiro, v. 18, n. 6, p. 496-497, 2002

GUIMARÃES, R.; LOURENÇO, R.; COSAC, S. A pesquisa epidemiológica no Brasil. *Revista de Saúde Pública*, São Paulo, v. 35, n. 4, p. 321-340, 2001.

INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA. *Pesquisa industrial*. inovação tecnológica 2000. Rio de Janeiro: IBGE, 2002.

ORGANIZATION FOR ECONOMIC COOPERATION AND DEVELOPMENT. *Main definitions and conventions for the measurement of research and experimental development*. A Summary of the *Frascati Manual*. Paris: OECD, 1994.

PELLEGRINI FILHO, A. *Ciencia en pro de la salud.* Notas sobre la organización de la actividad científica para el desarrollo de la salud en América Latina y el Caribe. Washington, D.C.: OPS, 2000 (*Publicación Científica y Técnica*; 578).

PELLEGRINI FILHO, A. Science for health: notes on the organization of scientific activity for the development of health in Latin America and the Caribbean. *Pan Am J Public Health,* v. 7, n. 5, p. 345-349, 2000.

RED IBEROAMERICANA DE CIENCIA Y TECNOLOGIA. *El estado de la ciencia: principales indicadores de ciencia y tecnología Iberoamericanos/Interamericanos*. Quilmes:RICYT, 2000.

SILVA, C. G.; MELO, L. C. P. (Orgs.). *Ciência, tecnologia e inovação*: desafio para a sociedade brasileira - Livro Verde. Brasília: Ministério da Ciência e Tecnologia, 2001.

STOKES, D. E. *Pasteur's quadrant, basic science and technological innovation*. Washington: Brookings Institution Press, 1997.