Strengthening R&D capacity, financing and coordination among developing countries

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Outline of this presentation

- Developing countries, from the 1950s' → today
  - North / South dichotomy
  - "Three Human Development Clubs"
- We live in a networked world
  - Health innovation networks
  - Innovative Developing Countries (IDCs)
- Neglected diseases, epidemiological transition and the challenges ahead
  - The economic impact of new interventions
- Capacity building: Three examples
  - Internal capacity building on NTDs in Brazil
  - South-South cooperation
  - Global-South cooperation

Developing countries, from the 1950s' → today

The end of "North-South" dichotomy?

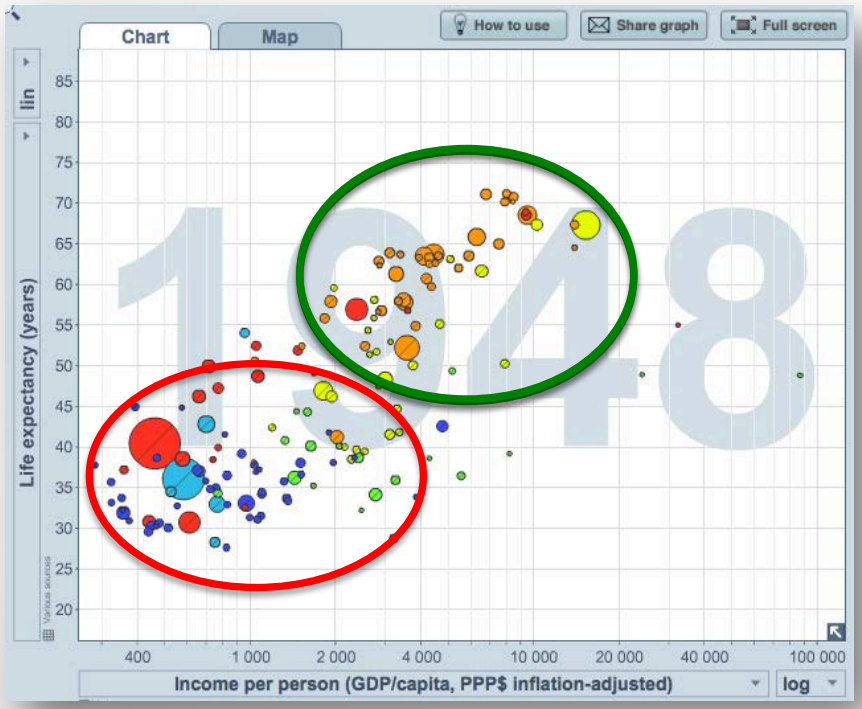
Three Human Development Clubs

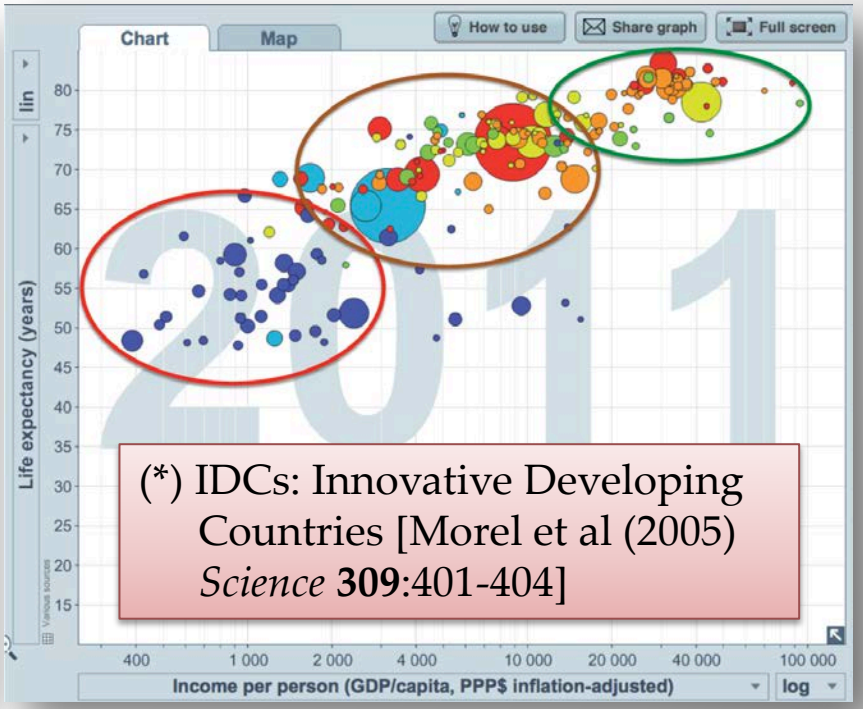
The world, 1948-2011: economy and health

1948: a bipolar world
North/South, rich/poor

Today: a multipolar world
North, South, BRICS, IDCs*

Life expectancy (years)





(*) IDCs: Innovative Developing Countries [Morel et al (2005) *Science* **309**:401-404]

Income per person, GDP/capita, PPP$ inflation-adjusted

OPEN ACCESS Freely available online

PLOS ONE

The Emergence of Three Human Development Clubs

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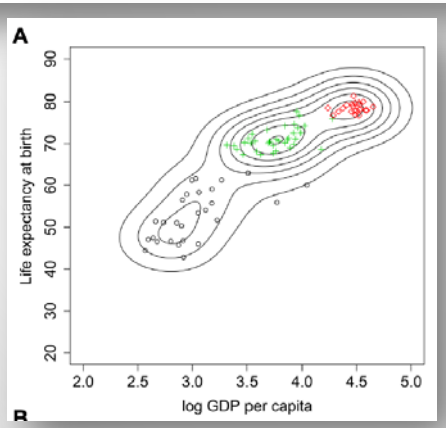
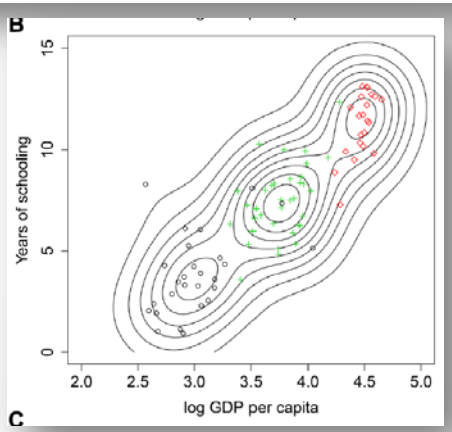
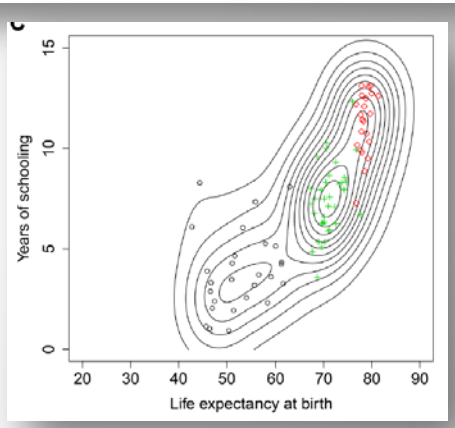
Abstract

We examine the joint distribution of levels of income per capita, life expectancy, and years of schooling across countries in 1960 and in 2000. In 1960 countries were clustered in two groups; a rich, highly educated, high longevity "developed" group and a poor less educated, high mortality, "underdeveloped" group. By 2000 however we see the emergence of three groups; one underdeveloped group remaining near 1960 levels, a developed group with higher levels of education, income, and health than in 1960, and an intermediate group lying between these two. This finding is consistent with both the ideas of a new "middle income trap" that countries face even if they escape the "low income trap", as well as the notion that countries which escaped the poverty trap form a temporary "transition regime" along their path to the "developed" group.

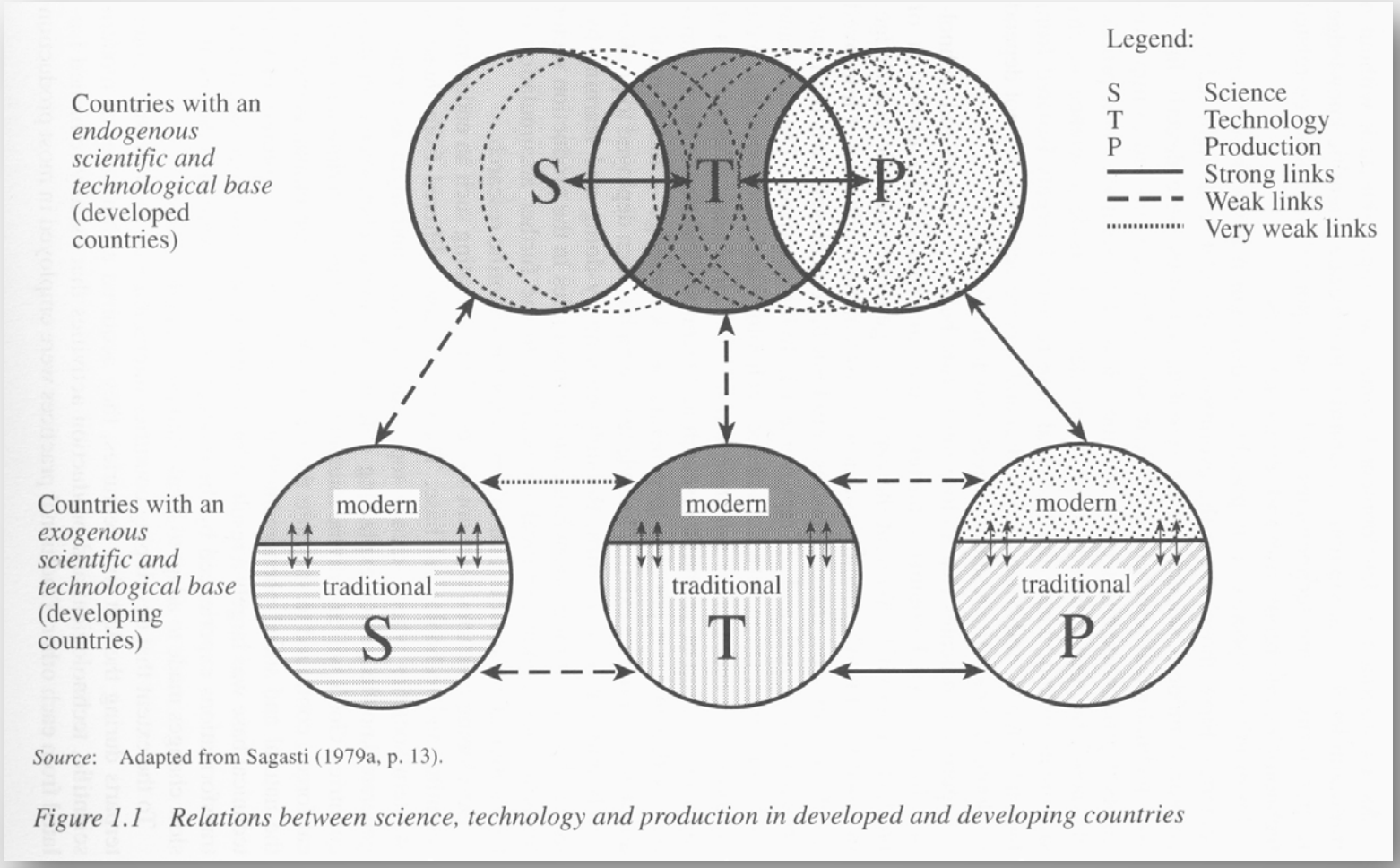
Citation: Vollmer S, Holzmann H, Ketterer F, Klasen S, Canning D (2013) The Emergence of Three Human Development Clubs. PLoS ONE 8(3): e57624. doi:10.1371/journal.pone.0057624







Science, technology and production in developed and developing countries

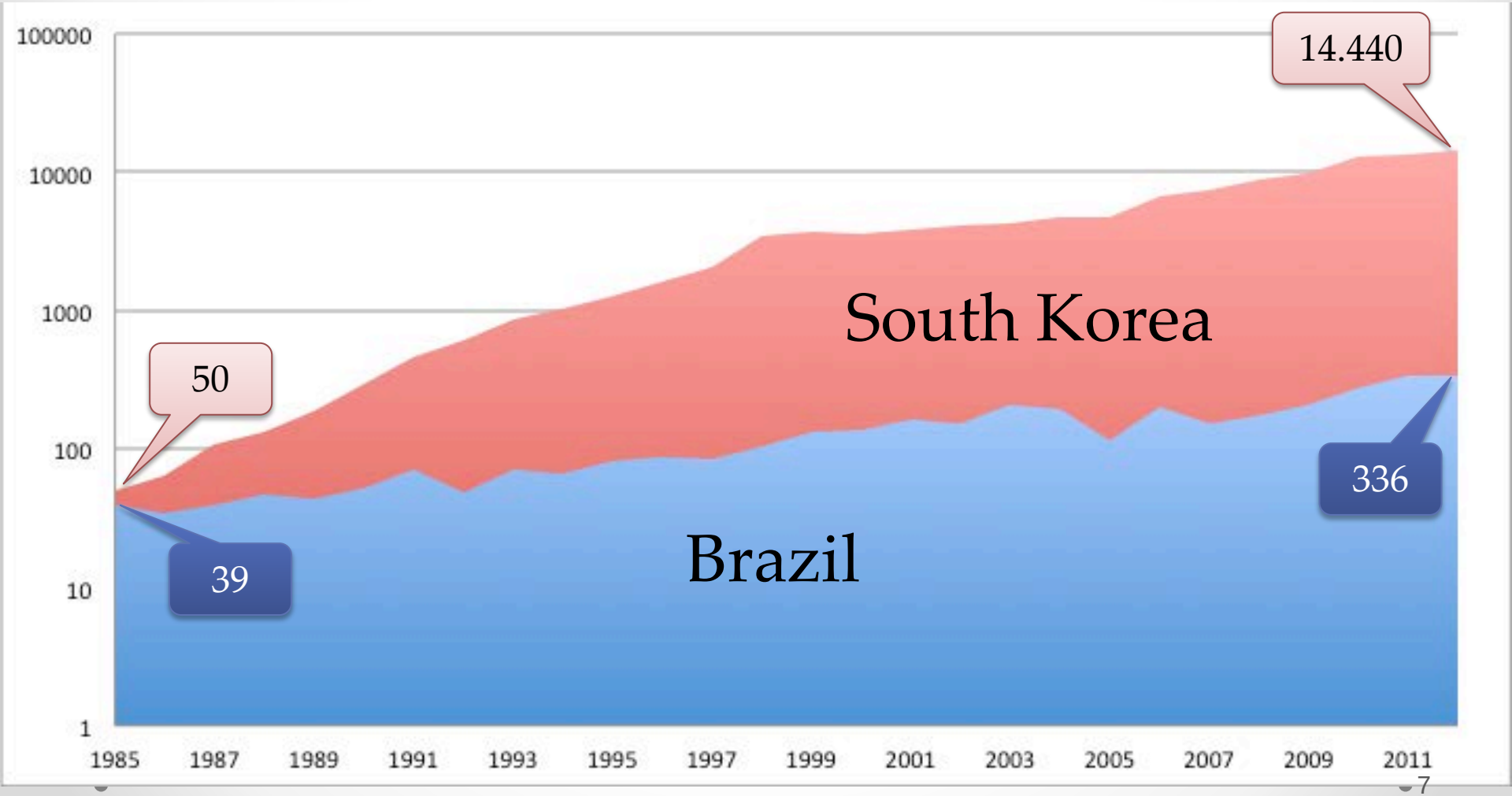


Source: Adapted from Sagasti (1979a, p. 13).

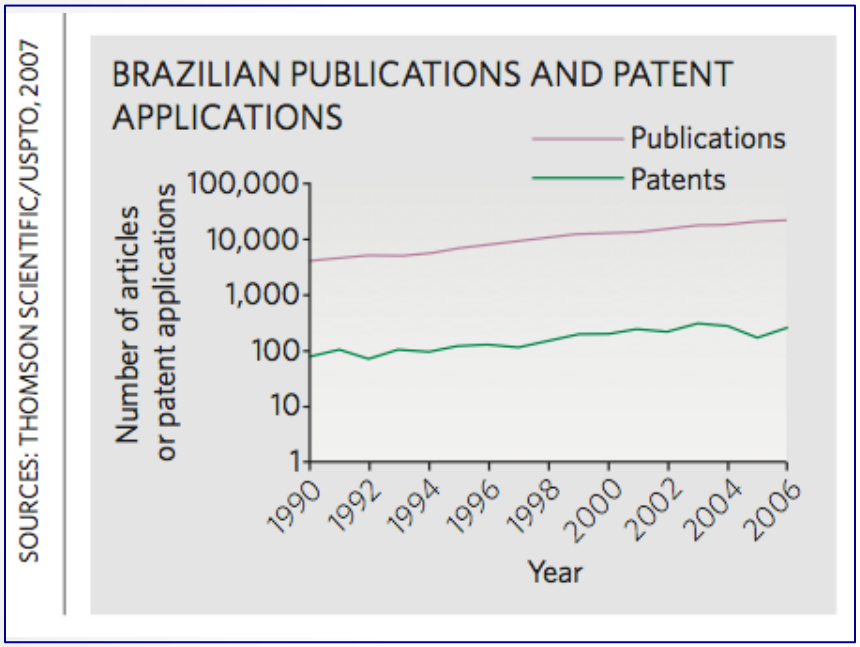
Figure 1.1 Relations between science, technology and production in developed and developing countries

Francisco Sagasti. *Knowledge and Innovation for Development: The Sisyphus Challenge of the 21st Century*. Edward Elgar Publishing, April 2004.

Patents/USPTO, 1985-2012 Brazil and South Korea

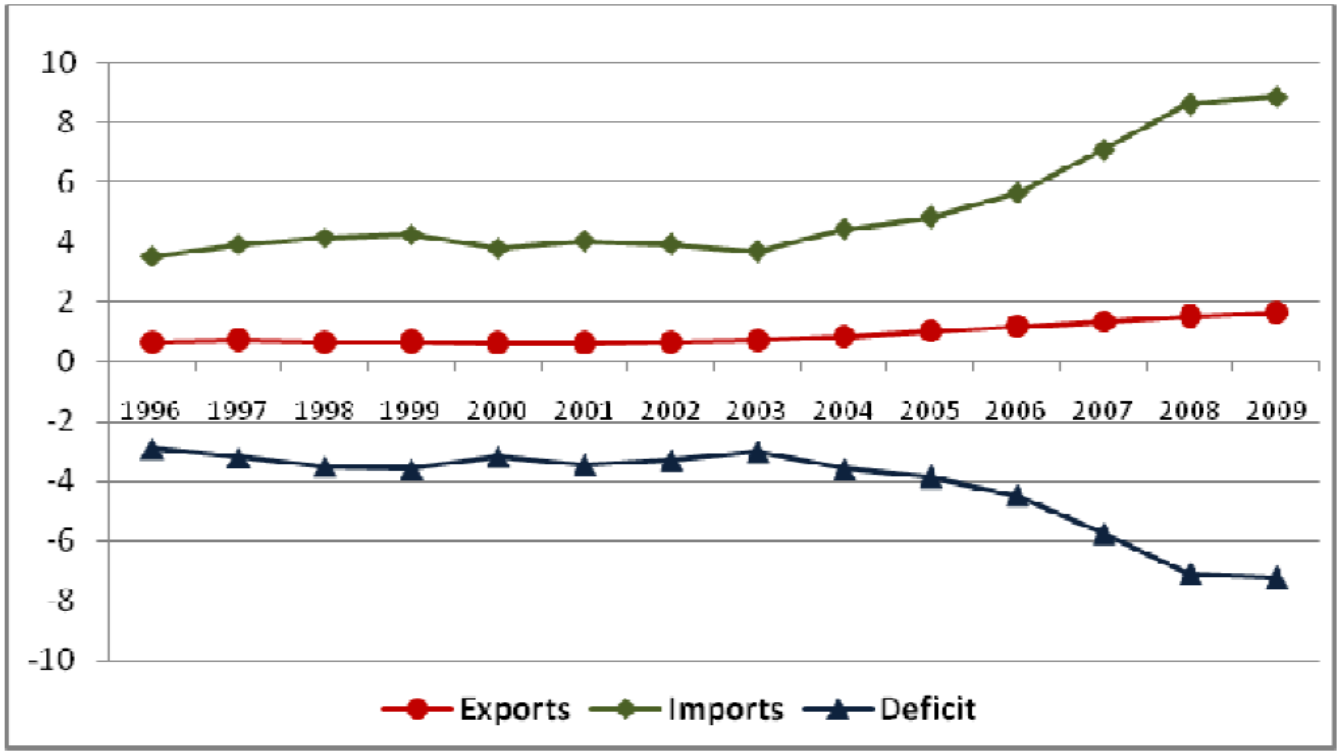


The Sisyphus Challenge in Brazil



Morel et al (2007) The road to recovery. *Nature* 449:180-182

Health Economic Industrial Complex



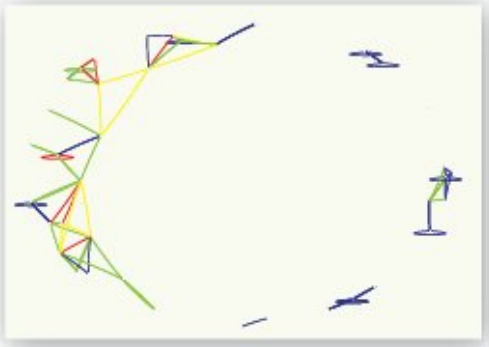
Source: GIS/ENSP–VPPIS/FIOCRUZ, from data of Rede Alice (SECEX/MDIC), 2010.
Note: values in US$ billion, updated by North-American CPI

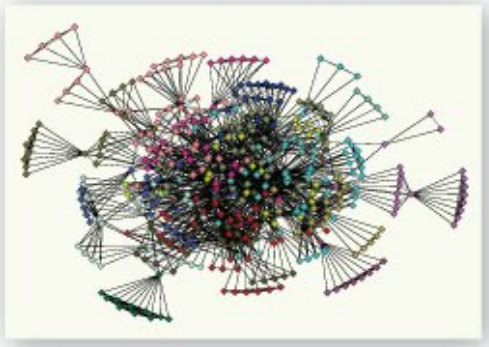
We live in a networked world

Health Innovation Networks

Innovative Developing Countries

Evolution of the scientific enterprise (Barabási A.L. (2005) *Science* 308:639-641)

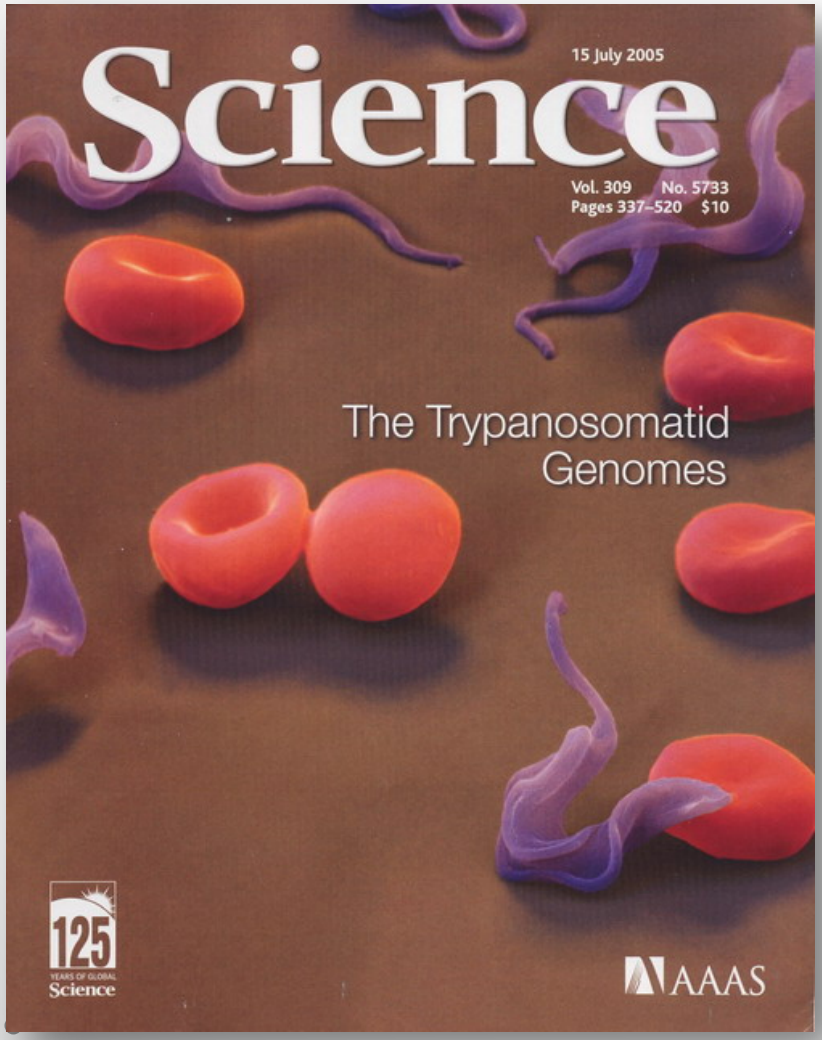




Evolution of the scientific enterprise. (**Left**) For centuries, creative individuals were embedded in an invisible college, that is, a community of scholars whose exchange of ideas represented the basis for scientific advances. Although intellectuals built on each other's work and communicated with each other, they published alone. Most great ideas were attributed to a few influential thinkers: Galileo, Newton, Darwin, and Einstein. Thus, the traditional scientific enterprise is best described by many isolated nodes (blue circles). (**Middle**) In the 20th century, science became an increasingly collaborative enterprise, resulting in such iconic pairs as the physicist Crick and the biologist Watson (left), who were responsible for unraveling DNA's structure. The joint publications documenting these collaborations shed light on the invisible college, replacing the hidden links with published coauthorships. (**Right**) Although it is unlikely that large collaborations—such as the D0 team in particle physics or the International Human Genome Sequencing Consortium pictured here—will come to dominate science, most fields need such collaborations. Indeed, the size of collaborative teams is increasing, turning the scientific enterprise into a densely interconnected network whose evolution is driven by simple universal laws.

Health Innovation Networks

(Morel et al (2005) *Science* 309:401-404)



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VIEWPOINT

SPECIAL SECTION

Health Innovation Networks to Help Developing Countries Address Neglected Diseases

Carlos M. Morel,[1*] Tara Acharya,[2] Denis Broun,[3] Ajit Dangi,[4] Christopher Elias,[5] N. K. Ganguly,[6] Charles A. Gardner,[7] R. K. Gupta,[8] Jane Haycock,[9] Anthony D. Heher,[10] Peter J. Hotez,[11] Hannah E. Kettler,[12] Gerald T. Keusch,[13] Anatole F. Krattiger,[14] Fernando T. Kreutz,[15] Sanjaya Lall,[16] Keun Lee,[17] Richard Mahoney,[14] Adolfo Martinez-Palomo,[18] R. A. Mashelkar,[19] Stephen A. Matlin,[20] Mandi Mzimba,[21] Joachim Oehler,[22] Robert G. Ridley,[23] Pramilla Senanayake,[24] Peter Singer,[25] Mikyung Yun[26]

Gross inequities in disease burden between developed and developing countries are now the subject of intense global attention. Public and private donors have marshaled resources and created organizational structures to accelerate the development of new health products and to procure and distribute drugs and vaccines for the poor. Despite these encouraging efforts directed primarily from and funded by industrialized countries, sufficiency and sustainability remain enormous challenges because of the sheer magnitude of the problem. Here we highlight a complementary and increasingly important means to improve health equity: the growing ability of some developing countries to undertake health innovation.

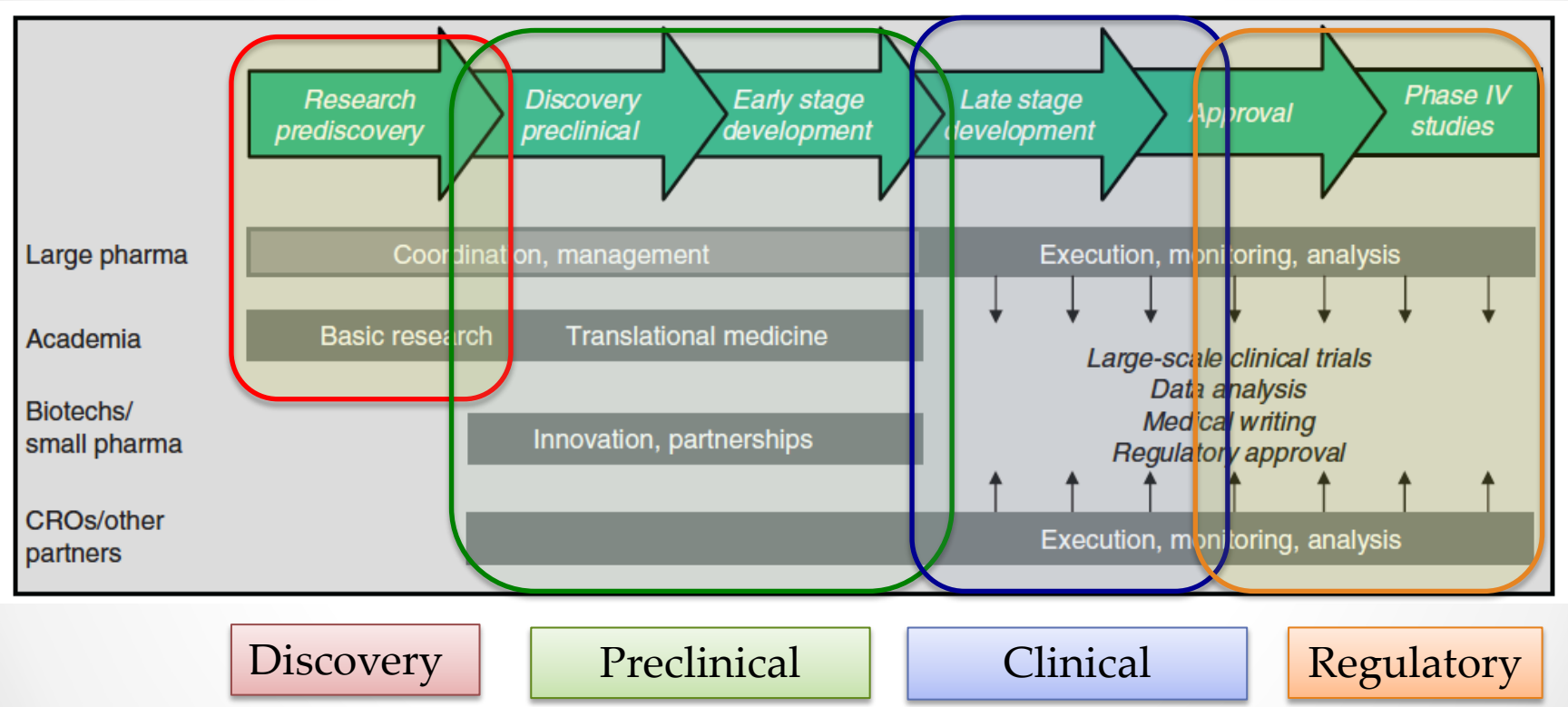
sources amounts to more than all that was spent in 2004 by the above-mentioned PDPs engaged in the development of drugs, vaccines, and diagnostics for diseases of the poor (*8*, *9*).

Patents and well-cited publications indicate the productivity of research investments, and in this light, IDCs have made major progress. The number of U.S. patents per capita is a common proxy used to measure the relative innovation

"All developing countries can undertake health innovation to varying degrees. Some developing countries, however, are more scientifically advanced than others and are starting to reap benefits from decades of investments in education, health research infrastructure, and manufacturing capacity. ***We refer to these as innovative developing countries (IDCs)****"*

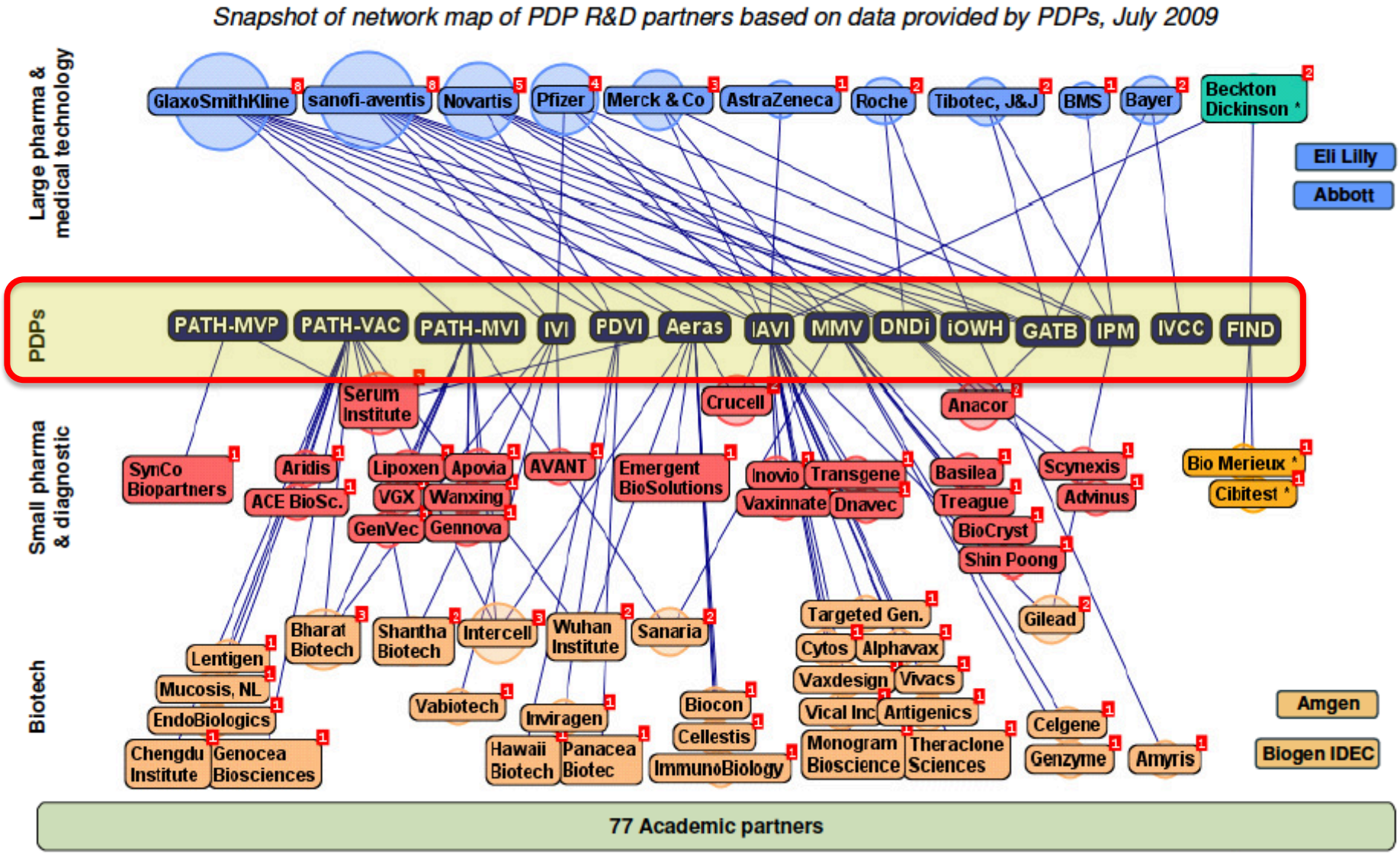
Morel et al (2005) *Science* 309:401-404, 2005

Network model of drug development (Kaitin, 2010)



Kaitin KI (2010) *Deconstructing the drug development process: The new face of innovation*. Clinical Pharmacology and Therapeutics **87**:356–361

PDPs are working with a constellation of biopharmaceutical and academic partners



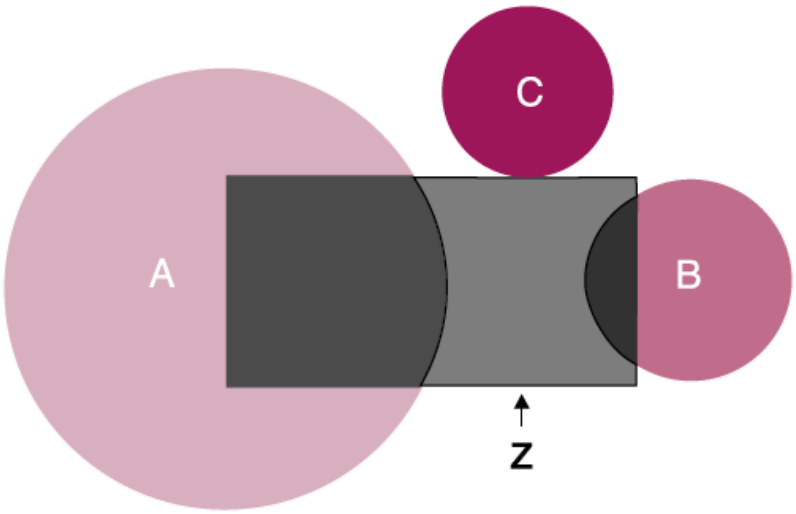
Note: Size of halo and number in red represent number of partner's connection to PDPs.
* Beckton Dinckinson is a medical device company, and Bio merieux and Cibitest are diagnostic companies.
Source: BCG analysis presented at PDP Forum, PDPs in 2009: State of the Art, July 2009

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/67678/lssns-pdps-estb-dev-new-hlth-tech-negl-diseases.pdf

Neglected diseases, epidemiological transition and challenges ahead

The economic impact of new interventions

2001: The *Fatal Imbalance* Report



The world pharmaceutical market

Figure 1B

What kinds of needs does the pharmaceutical market cover?

A represents Global Diseases,
such as cancer, cardiovascular diseases, mental illness and neurological disorders, which constitute the major focus of the R&D-based pharmaceutical industry. Although affecting developed and developing countries, most people in developing countries who have needs for drugs to treat these diseases cannot afford them, and are thus not covered by the pharmaceutical market.

B represents Neglected Diseases,
such as malaria and tuberculosis (TB), for which the R&D-based pharmaceutical industry has only marginal interest. Although also affecting people in wealthy countries, for example TB patients or people who get malaria while travelling, these illnesses primarily affect people in developing countries.

C represents the Most Neglected Diseases,
such as sleeping sickness, Chagas disease and leishmaniasis, which exclusively affect people in developing countries. Because most of these patients are too poor to pay for any kind of treatment, they represent virtually no market and for the most part fall outside the scope of the drug industry's R&D efforts, and thus outside the pharmaceutical market.

Z represents the part of the pharmaceutical market for products addressing conditions other than those which are purely medical (such as cellulite, baldness, wrinkles, dieting, stress and jet-lag), which nonetheless represent a highly profitable market segment in wealthy countries.

MSF Access to Essential Medicines Campaign (2001) **Fatal Imbalance: The Crisis in Research and Development for Drugs for Neglected Diseases**. *A report by the MSF Access to Essential Medicines Campaign and the Drugs for Neglected Diseases Working Group*. http://www.msf.org/source/access/2001/fatal/fatal.pdf

2012: The CEWG Report

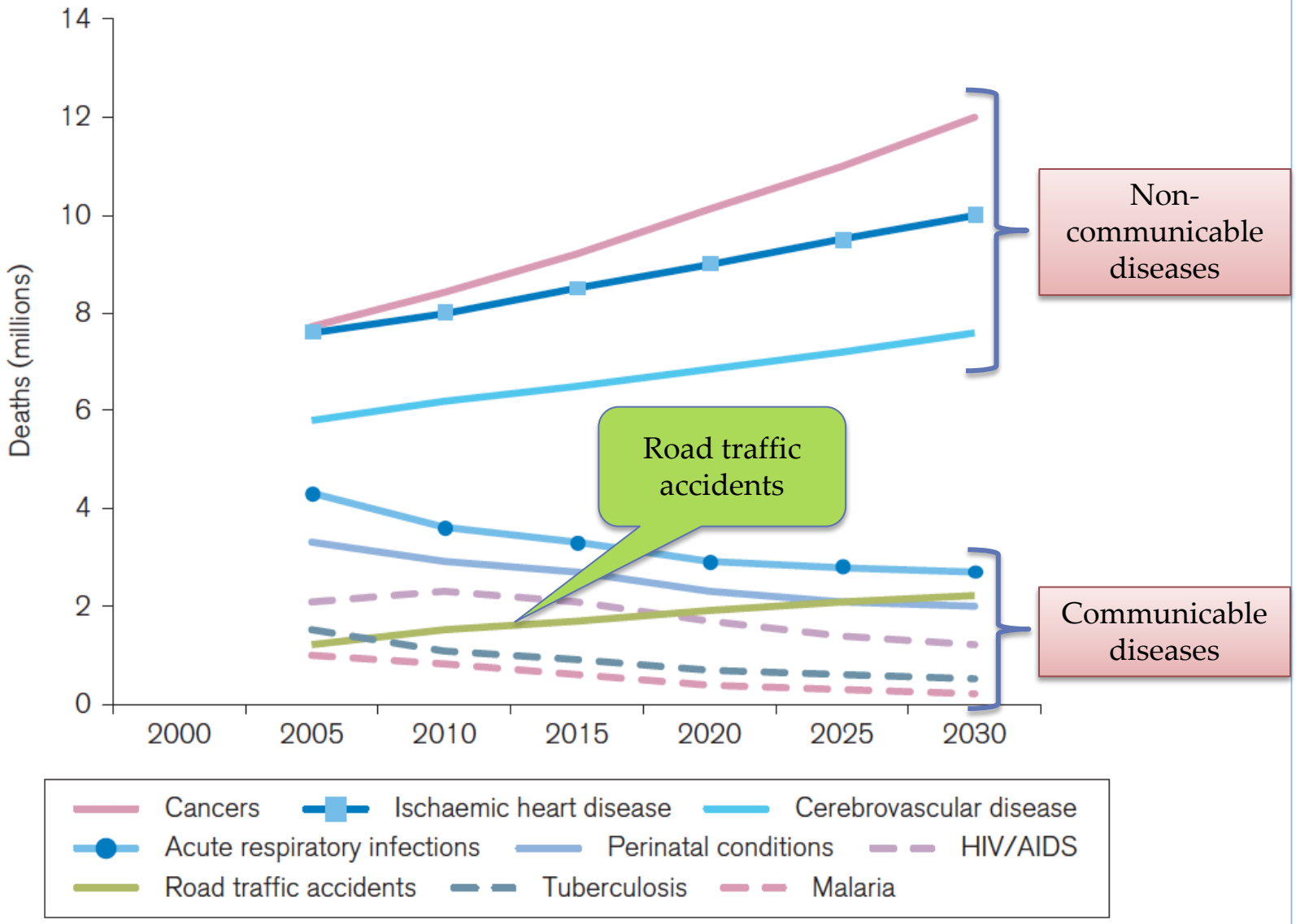
Global epidemiological transition, 2004→2030

Figure 1.1. **Projected changes in the ten leading causes of burden of diseases in 2004 and 2030**

2004 Disease or injury	As % of total DALYs	Rank	Rank	As % of total DALYs	2030 Disease or injury
Lower respiratory infections	6.2	1	1	6.2	Unipolar depressive disorders
Diarrhoeal diseases	4.8	2	2	5.5	Ischaemic heart disease
Unipolar depressive disorders	4.3	3	3	4.9	Road traffic accidents
Ischaemic heart disease	4.1	4	4	4.3	Cerebrovascular disease
HIV/AIDS	3.8	5	5	3.8	Chronic obstructive pulmonary disease
Cerebrovascular disease	3.1	6	6	3.2	Lower respiratory infections
Prematurity and low birth weight	2.9	7	7	2.9	Hearing loss, adult onset
Birth asphyxia and birth trauma	2.7	8	8	2.7	Refractive errors
Road traffic accidents	2.7	9	9	2.5	HIV/AIDS
Neonatal infections and other	2.7	10	10	2.3	Diabetes mellitus
Chronic obstructive pulmonary disease	2	13	11	1.9	Neonatal infections and other
Refractive errors	1.8	14	12	1.9	Prematurity and low birth weight
Hearing loss, adult onset	1.8	15	15	1.9	Birth asphyxia and birth trauma
Diabetes mellitus	1.3	19	18	1.6	Diarrhoeal diseases

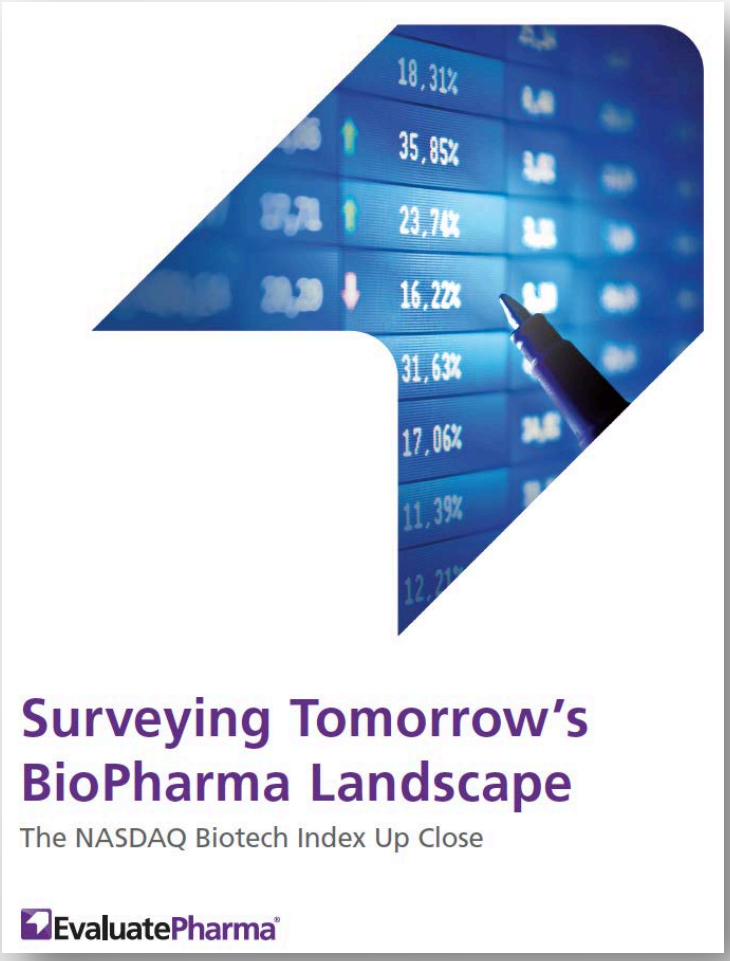
Source: WHO (2008).

Figure 1.2. **Projected global deaths for selected causes, 2004-2030**



Source: WHO (2008).

The BioPharma Landscape



NBI Company Listing

NASDAQ biotechnology holdings as of March 30, 2012[2]

Company Name	NASDAQ Ticker	Index Weight (%)	Market Cap ($M)	Company Name	NASDAQ Ticker	Index Weight (%)	Market Cap ($M)
Alexion Pharmaceuticals Inc.	ALXN	7.56%	$17,271	Optimer Pharmaceuticals Inc.	OPTR	0.27%	$650
Amgen Inc.	AMGN	7.14%	$53,180	Rigel Pharmaceuticals Inc.	RIGL	0.27%	$575
Regeneron Pharmaceuticals Inc.	REGN	6.61%	$10,703	Alnylam Pharmaceuticals Inc.	ALNY	0.25%	$574
Celgene Corp.	CELG	6.33%	$34,017	NPS Pharmaceuticals Inc.	NPSP	0.23%	$589
Gilead Sciences Inc.	GILD	5.35%	$37,039	Affymax Inc.	AFFY	0.23%	$420
Biogen Idec Inc.	BIIB	4.97%	$30,079	AVEO Pharmaceuticals Inc.	AVEO	0.22%	$541
Teva Pharmaceutical ADS	TEVA	4.55%	$42,463	Hi-Tech Pharmacal Co. Inc.	HITK	0.21%	$469
Perrigo Co.	PRGO	4.01%	$9,639	Sagent Pharmaceuticals Inc.	SGNT	0.21%	$499
Vertex Pharmaceuticals Inc.	VRTX	3.48%	$8,626	Sequenom Inc.	SQNM	0.20%	$466
Mylan Inc.	MYL	2.96%	$10,012	MannKind Corp.	MNKD	0.20%	$414
Illumina Inc.	ILMN	2.48%	$6,484	MAP Pharmaceuticals Inc.	MAPP	0.19%	$438
Shire PLC ADS	SHPGY	2.13%	$17,767	Avanir Pharmaceuticals Inc.	AVNR	0.19%	$454
BioMarin Pharmaceutical Inc.	BMRN	2.04%	$3,960	Enzon Pharmaceuticals Inc.	ENZN	0.19%	$330
Life Technologies Corp.	LIFE	1.60%	$8,703	Arena Pharmaceuticals Inc.	ARNA	0.19%	$555
Salix Pharmaceuticals Ltd.	SLXP	1.47%	$3,120	Santarus Inc.	SNTS	0.17%	$358
Onyx Pharmaceuticals Inc.	ONXX	1.42%	$2,414	Progenics Pharmaceuticals Inc.	PGNX	0.16%	$335
Cubist Pharmaceuticals Inc.	CBST	1.36%	$2,723	Curis Inc.	CRIS	0.16%	$374
United Therapeutics Corp.	UTHR	1.25%	$2,527	Ligand Pharmaceuticals Inc.	LGND	0.16%	$313
Incyte Corp.	INCY	1.24%	$2,458	AMAG Pharmaceuticals Inc.	AMAG	0.15%	$338
Medivation Inc.	MDVN	1.17%	$2,691	Ista Pharmaceuticals Inc.	ISTA	0.15%	$378
Questcor Pharmaceuticals Inc.	QCOR	1.14%	$2,393	SciClone Pharmaceuticals Inc.	SCLN	0.15%	$365
Warner Chilcott Plc	WCRX	1.11%	$4,191	Depomed Inc.	DEPO	0.13%	$348
Ariad Pharmaceuticals Inc.	ARIA	1.06%	$2,540	Cadence Pharmaceuticals Inc.	CADX	0.13%	$316
Endo Pharmaceuticals	ENDP	0.94%	$4,520	QLT Inc.	QLTI	0.13%	$343
Seattle Genetics Inc.	SGEN	0.94%	$2,371	Vical Inc.	VICL	0.13%	$292
Qiagen N.V.	QGEN	0.93%	$3,647	Immunomedics Inc.	IMMU	0.12%	$274
Alkermes PLC	ALKS	0.89%	$2,414	Geron Corp.	GERN	0.12%	$224
Viro Pharma Inc.	VPHM	0.88%	$2,127	Neurocrine Biosciences Inc.	NBIX	0.12%	$528
Gen-Probe Inc.	GPRO	0.88%	$3,004	Affymetrix Inc.	AFFX	0.12%	$301
Myriad Genetics Inc.	MYGN	0.80%	$1,994	Synta Pharmaceuticals Corp.	SNTA	0.12%	$248
Impax Laboratories Inc.	IPXL	0.78%	$1,642	Obagi Medical Products Inc.	OMPI	0.11%	$250
Theravance Inc.	THRX	0.76%	$1,686	ArQule Inc.	ARQL	0.11%	$377
VIVUS Inc.	VVUS	0.73%	$2,191	Sangamo BioSciences Inc.	SGMO	0.11%	$258
Amylin Pharmaceuticals Inc.	AMLN	0.73%	$4,014	GTx Inc.	GTXI	0.11%	$242
Techne Corp.	TECH	0.72%	$2,584	China Biologic Products Inc.	CBPO	0.10%	$238
Dendreon Corp.	DNDN	0.68%	$1,639	BioCryst Pharmaceuticals Inc.	BCRX	0.10%	$239
Halozyme Therapeutics Inc.	HALO	0.62%	$1,430	AVI BioPharma Inc.	AVII	0.09%	$209
InterMune Inc.	ITMN	0.60%	$958	Array BioPharma Inc.	ARRY	0.08%	$278
Grifols S.A. ADS	GRFS	0.55%	$1,750	SIGA Technologies Inc.	SIGA	0.08%	$174
Akorn Inc.	AKRX	0.52%	$1,112	Pacific Biosciences of California Inc.	PACB	0.08%	$187
Amarin Corp. PLC	AMRN	0.52%	$1,534	Targacept Inc.	TRGT	0.08%	$171
Nektar Therapeutics	NKTR	0.50%	$907	Osiris Therapeutics Inc.	OSIR	0.08%	$168
Acorda Therapeutics Inc.	ACOR	0.44%	$1,054	Astex Pharmaceuticals Inc.	ASTX	0.08%	$173
Exelixis Inc.	EXEL	0.44%	$769	Oncothyreon Inc.	ONTY	0.08%	$241
Luminex Corp.	LMNX	0.42%	$976	Dyax Corp.	DYAX	0.08%	$154
Idenix Pharmaceuticals Inc.	IDIX	0.42%	$1,053	Endocyte Inc.	ECYT	0.07%	$178
Genomic Health Inc.	GHDX	0.41%	$918	XenoPort Inc.	XNPT	0.07%	$160
Ironwood Pharmaceuticals Inc.	IRWD	0.41%	$903	Maxygen Inc.	MAXY	0.07%	$159
Isis Pharmaceuticals Inc.	ISIS	0.38%	$878	Novavax Inc.	NVAX	0.06%	$153
Lexicon Pharmaceuticals Inc.	LXRX	0.38%	$894	Savient Pharmaceuticals Inc.	SVNT	0.06%	$156
Auxilium Pharmaceuticals Inc.	AUXL	0.37%	$897	Vanda Pharmaceuticals Inc.	VNDA	0.06%	$135
Human Genome Sciences Inc.	HGSI	0.36%	$1,640	Cytori Therapeutics Inc.	CYTX	0.06%	$144
Momenta Pharmaceuticals Inc.	MNTA	0.36%	$786	Pain Therapeutics Inc.	PTIE	0.05%	$162
Immunogen Inc.	IMGN	0.34%	$1,104	Sinovac Biotech Ltd.	SVA	0.05%	$111
Ardea Biosciences Inc.	RDEA	0.34%	$799	BioSante Pharmaceuticals Inc.	BPAX	0.03%	$82
Medicines Co.	MDCO	0.34%	$1,091	Durect Corp.	DRRX	0.03%	$70
Spectrum Pharmaceuticals Inc.	SPPI	0.32%	$749	Columbia Laboratories Inc.	CBRX	0.03%	$62
Achillion Pharmaceuticals Inc.	ACHN	0.30%	$676	Cardiome Pharma Corp.	CRME	0.02%	$43
PDL BioPharma Inc.	PDLI	0.29%	$890				

2 As of May 21, 2012, the Nasdaq semi-annual rebalancing resulted in the addition of ten securities and the removal of five, for a net 122 companies. The ten added securities are: Cerus Corporation (CERS), Calldex Therapeutics, Inc. (CLDX), Amicus Therapeutics, Inc.(FOLD), Infinity Pharmaceuticals, Inc. (INFI), Jazz Pharmaceuticals plc (JAZZ), Omeros Corporation (OMER), Orexigen Therapeutics, Inc. (OREX), Pacira Pharmaceuticals, Inc. (PCRX), Raptor Pharmaceutical Corp. (RPTP) and Trius Therapeutics, Inc. (TSRX). The five removed are: BioSante Pharmaceuticals, Inc. (BPAX), China Biologic Products, Inc. (CBPO), Columbia Laboratories, Inc. (CBRX), Cardiome Pharma Corp (CRME) and DURECT Corporation (DRRX).
Source: NASDAQ

Small molecules→ →Biologics→$$$$$

Figure 3. Percentage of biologics vs. small molecules on the market and in the pipeline

Source: EvaluatePharma® (May 30, 2012)

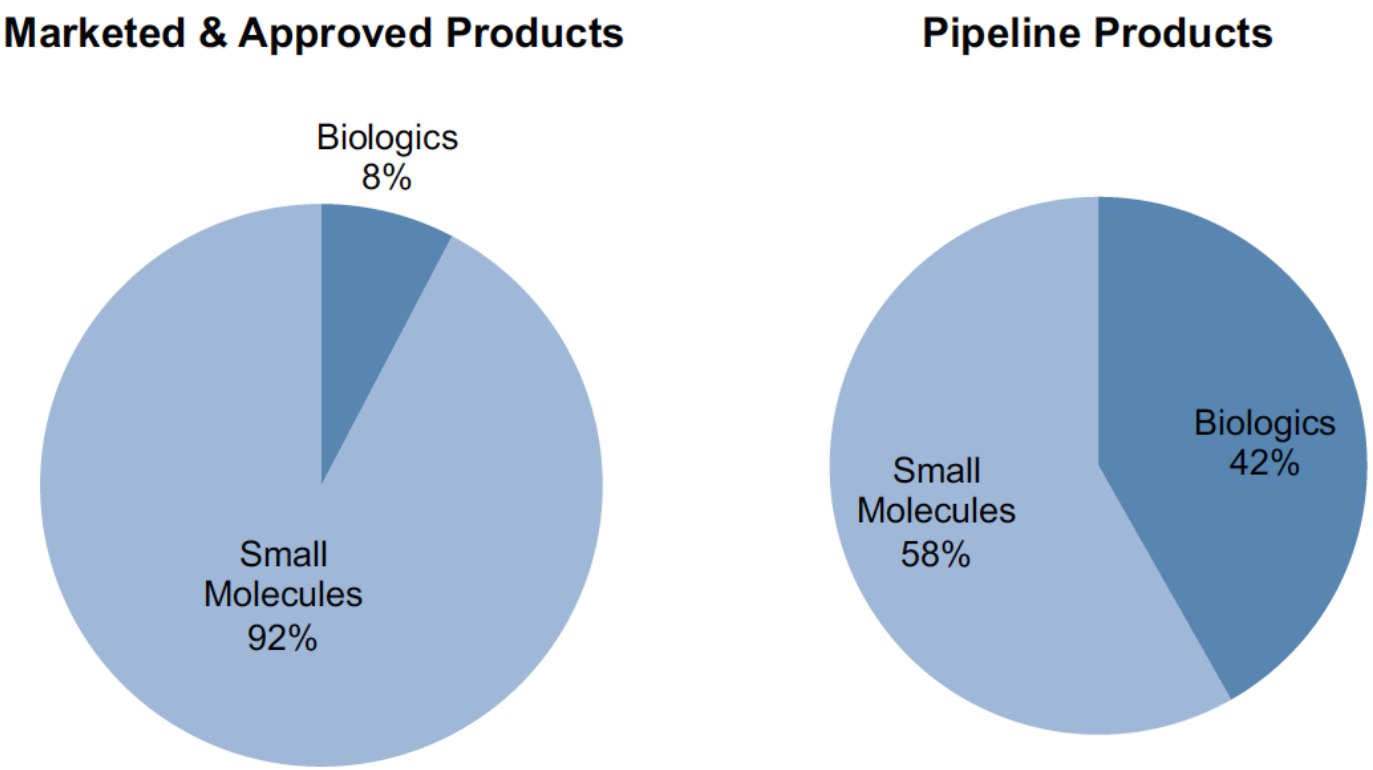
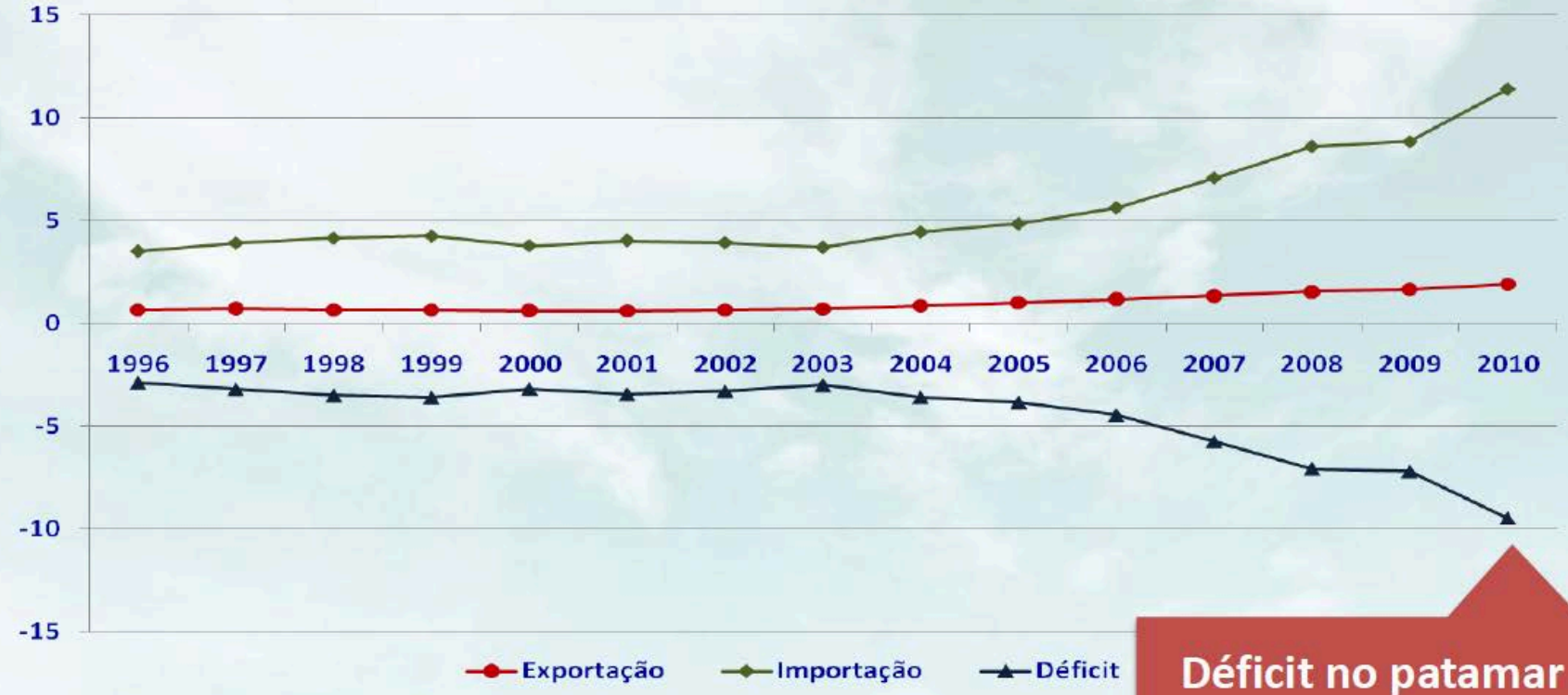


Table 2. Top 20 NBI pipeline products (Phase I,II,III, or Filed) ranked by estimated 2018 sales

Source: EvaluatePharma® (May 30, 2012)
Sales data are for sales made by the NBI company and do not include sales revenue of partners

Rank	Product	Company	Therapeutic Category	2018E ($M)	Phase (Current)
1	GS-7977	Gilead Sciences	Systemic Anti-infectives	$5,359	Phase III
2	BG-12	Biogen Idec	Central Nervous System	$3,400	Filed
3	Quad	Gilead Sciences	Systemic Anti-infectives	$2,793	Filed
4	Qnexa	VIVUS	Gastro-Intestinal	$983	Filed
5	Kyprolis	Onyx Pharmaceuticals	Oncology & Immunomodulators	$897	Filed
6	Ponatinib	ARIAD Pharmaceuticals	Oncology & Immunomodulators	$884	Phase II
7	AV-951	AVEO Oncology	Oncology & Immunomodulators	$515	Phase III
8	AMR101	Amarin	Cardiovascular	$510	Filed
9	VX-809	Vertex Pharmaceuticals	Respiratory	$490	Phase II
10	GRN163L	Geron	Oncology & Immunomodulators	$468	Phase II
11	Seasonal Flu VLP Vaccine	Novavax	Systemic Anti-infectives	$462	Phase II
12	Ganetespib	Synta Pharmaceuticals	Oncology & Immunomodulators	$449	Phase III
13	GALNS	BioMarin Pharmaceutical	Various	$429	Phase III
14	Allovectin-7	Vical	Oncology & Immunomodulators	$419	Phase III
15	ALN-TTR01	Alnylam Pharmaceuticals	Various	$385	Phase I
16	Elvitegravir	Gilead Sciences	Systemic Anti-infectives	$367	Phase III
17	Cabozantinib	Exelixis	Oncology & Immunomodulators	$327	Phase III
18	Gattex	NPS Pharmaceuticals	Gastro-Intestinal	$310	Filed
19	PEGylated-IFN β-1a	Biogen Idec	Central Nervous System	$308	Phase III
20	ENB-0040	Alexion Pharmaceuticals	Musculoskeletal	$302	Phase III

Déficit da Balança Comercial



Fonte: elaborado por GIS/ENSP /FIOCRUZ, 2011, a partir de dados da Rede Alice / MDIC.

Déficit no patamar de US$ 10 bilhões

SUS Ministério da Saúde

GOVERNO FEDERAL BRASIL PAÍS RICO É PAÍS SEM POBREZA

Capacity building: Three examples

Capacity building on NTDs in Brazil

South-South cooperation

Global-South cooperation

Capacity building: First example

Strengthening R&D on neglected diseases in Brazil

Collaboration academia – Ministry of Health on NTDs

Rev Saúde Pública 2010;44(1):200-2

Departamento de Ciência e Tecnologia, Secretaria de Ciência, Tecnologia e Insumos Estratégicos, Ministério da Saúde

Correspondência | Correspondence:
Decit – Departamento de Ciência e Tecnologia do Ministério da Saúde
Esplanada dos Ministérios
Bloco G sala 845
70058-900 Brasília, DF, Brasil

Texto de difusão técnico-científica do Ministério de Saúde.

Doenças negligenciadas: estratégias do Ministério da Saúde

Neglected diseases: the strategies of the Brazilian Ministry of Health

R&D Funding of NTDs by the MoH, Brazil, 2003-09

Year	Call for Applications	R$ (million)	US$ (million)	Exch. rate
2003	TB network	$1.90	$0.66	2.889
2004	Dengue	$0.95	$0.36	2.654
2005	Leprosy	$2.50	$1.07	2.337
2006	Neglected Diseases	$17.00	$7.97	2.1342
2007	Neglected Diseases	$22.00	$12.42	1.7713
2008	Malaria network	$15.40	$6.59	2.3362
2009	Dengue network	$22.70	$13.04	1.7404
		$82.45	**$42.11**	

Ministry of Health (2010) **Neglected diseases: the strategies of the Brazilian Ministry of Health**. *Revista de Saúde Pública* 44(1):200–2.

OPEN ACCESS Freely available online

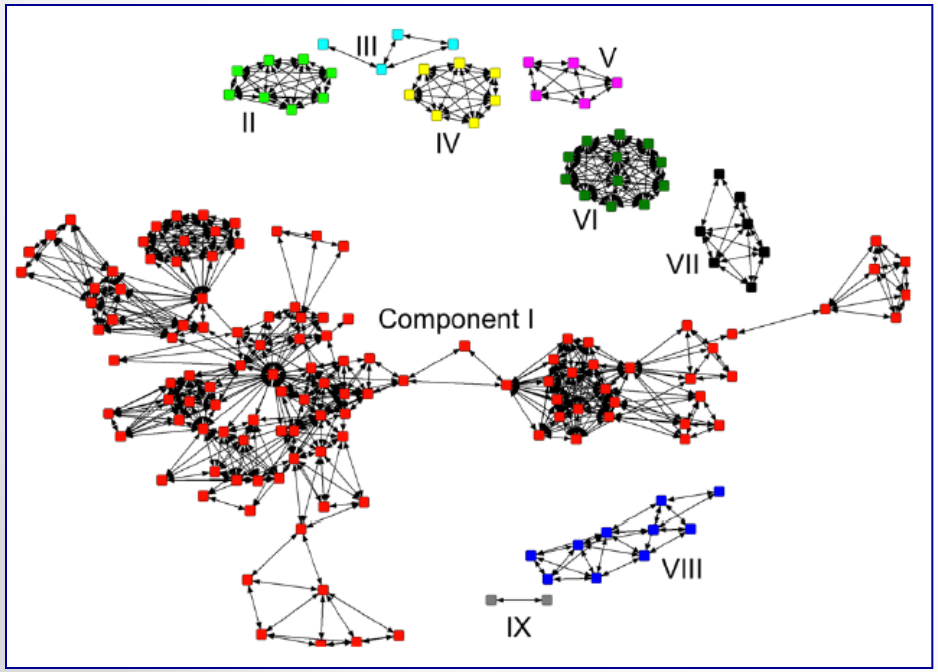
PLoS NEGLECTED TROPICAL DISEASES

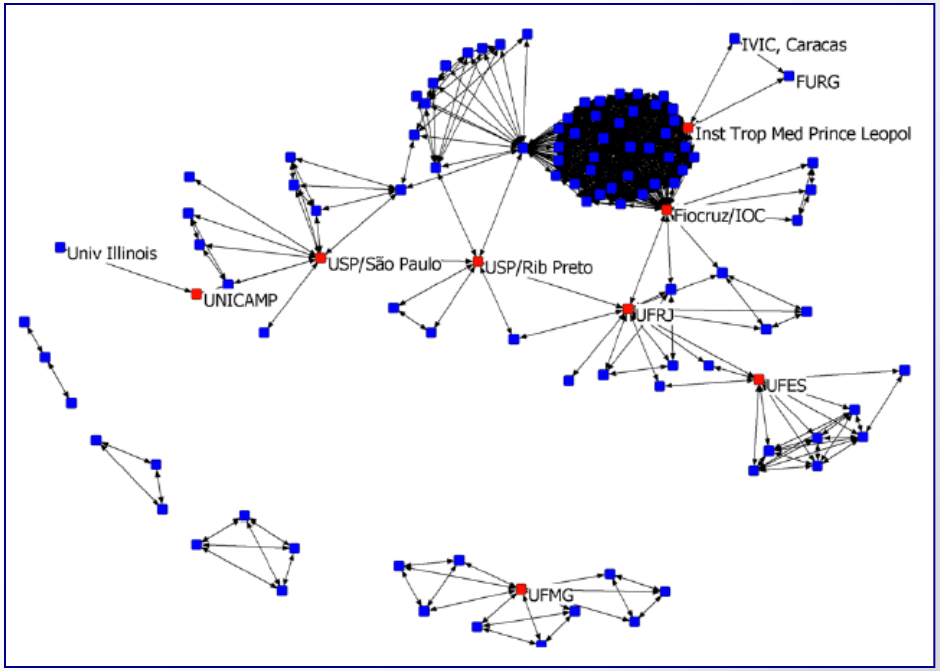
Co-authorship Network Analysis: A Powerful Tool for Strategic Planning of Research, Development and Capacity Building Programs on Neglected Diseases

Carlos Medicis Morel[1]*, Suzanne Jacob Serruya[2¤], Gerson Oliveira Penna[3], Reinaldo Guimarães[4]

1 National Institute for Science and Technology on Innovation on Neglected Diseases (INCT/IDN), Center for Technological Development in Health (CDTS), Oswaldo Cruz Foundation (Fiocruz), Rio de Janeiro, Brazil, **2** Department of Science and Technology (DECIT), Secretary of Science, Technology and Strategic Goods (SCTIE), Ministry of Health, Brasilia, Brazil, **3** Secretary of Health Surveillance (SVS), Ministry of Health, Brasilia, Brazil, **4** Secretary of Science, Technology and Strategic Goods (SCTIE), Ministry of Health, Brasilia, Brazil

PLoS Negl Trop Dis 3(8): e501. doi:10.1371/journal.pntd.0000501





Collaboration MoH-INPI
(National Institute Industrial Property)

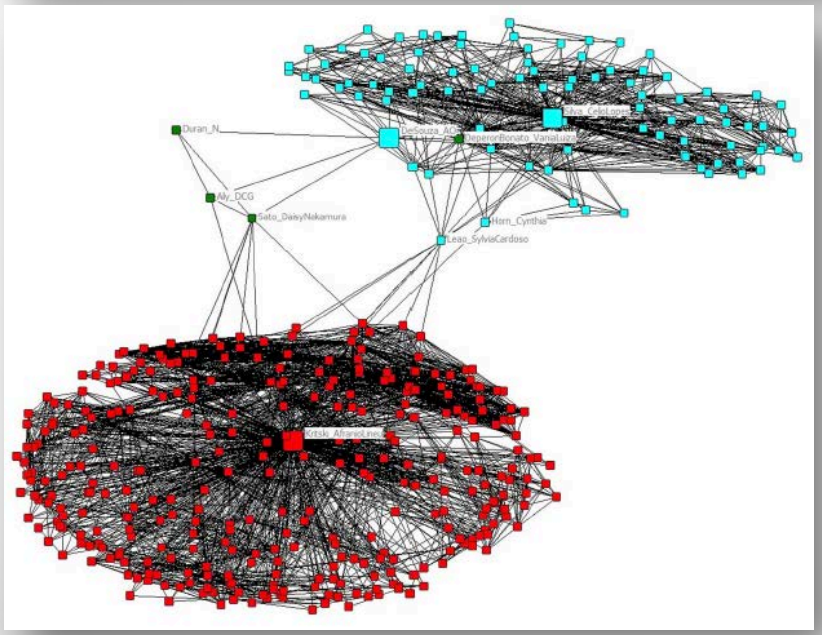
OPEN ACCESS Freely available online

PLOS | ONE

Enabling Policy Planning and Innovation Management through Patent Information and Co-Authorship Network Analyses: A Study of Tuberculosis in Brazil

Alexandre Guimarães Vasconcellos[1], **Carlos Medicis Morel**[2]*

1 National Institute of Industrial Property (INPI), Rio de Janeiro, RJ, Brazil, **2** National Institute for Science and Technology on Innovation on Neglected Diseases (INCT/IDN), Center for Technological Development in Health (CDTS), Oswaldo Cruz Foundation (Fiocruz), Rio de Janeiro, RJ, Brazil



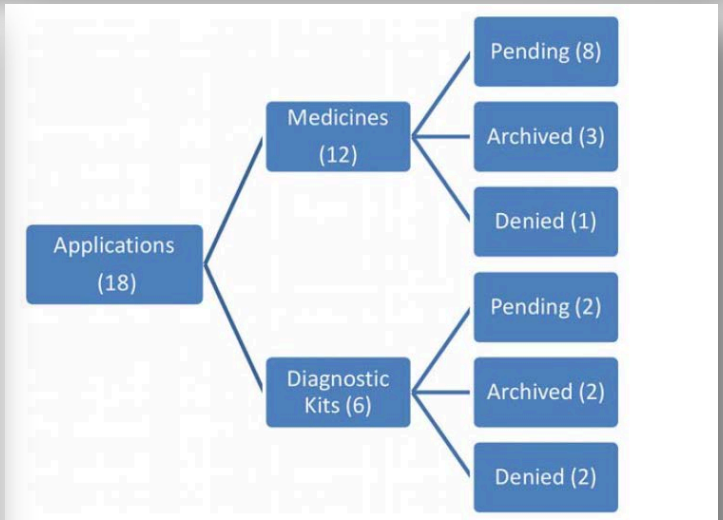


Figure 7. Status of patent applications related to TB medicines or diagnostics applied by Brazilian nationals, 1995–2008.
doi:10.1371/journal.pone.0045569.g007

Capacity building: Second example

South-South cooperation

Initiative for Antiretrovirals and Additional Drugs Factory Plant Installation in Mozambique

A Project of the International Technical Cooperation between Brazil and Mozambique in Health

licia@far.fiocruz.br

Brazilian References in International Cooperation

- Ministry of Agrarian Development
  - Family farming
- Ministry of Education
  - School feeding
- Ministry of Social Development
  - Conditional cash transfer programs
- Ministry of Health
  - HIV/AIDS treatment, human milk banks, policies for the public production of generic drugs

International priorities

- UNASUR - Union of South American Nations (www.unasursalud.org)
- ACTO - Amazon Cooperation Treaty Organization (www.otca.org.br)
- CPLP - Community of Portuguese Speaking Countries: Africa, Asia, Europe (www.cplp.org)

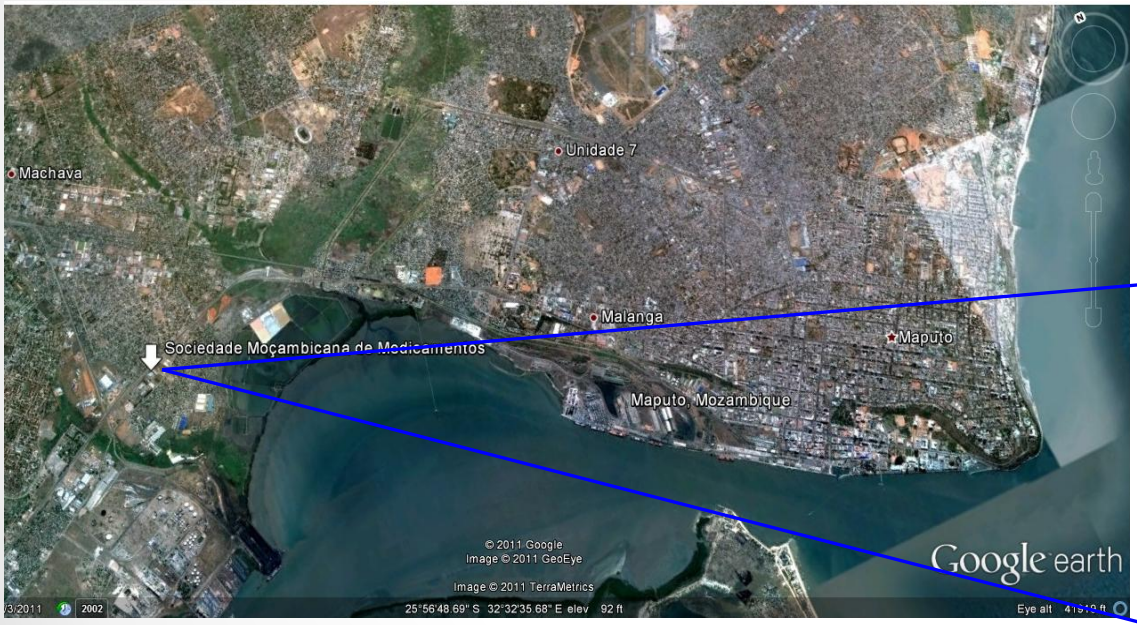
THE INITIATIVE

- **Objective**: To create a public enterprise in Mozambique aimed at sustainable production of antiretrovirals and additional drugs

"Sociedade Moçambicana de Medicamentos"
(SMM S.A.)

LOCALIZATION

- Aquisition of an area of 20,000 m², in Matola, Maputo´s Province, (3,000 m² for the new factory)



Activities of the initiative

- Training of human resources in Mozambique, both at the technical and managerial levels
- Technology transfer for industrial production and quality control of medicines by the SMM
- Assistance in the technical and administrative management of the pharmaceutical business
  - Goal: international certification for Good Manufacturing Practices (GMP)

Financing

- The Initiative is co-financed by the governments of Brazil and Mozambique over a 8-year period
  - Brazil invested about 21 million dollars
  - Mozambique about 15 million dollars
- Additional contribution of 4,4 million dollars donated by “Vale”, a private Brazilian company that operates in Mozambique

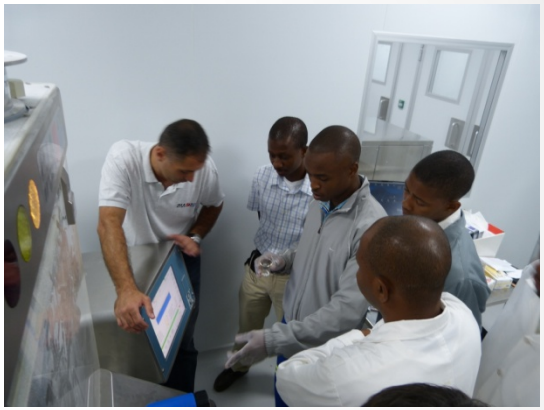
Expected outcomes

- Highly specialized local industry
- Economically sustainable public enterprise
- Strengthening the regulatory agency
- Demand to formulate pharmaceutical policies more articulated to other health policies
- Economic sustainability from year 7

2009 – 2011: Local capacity building and acquisition of equipment

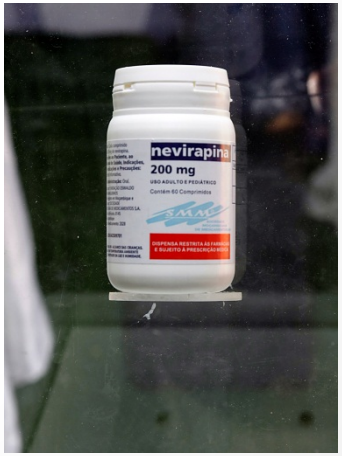
2011 – 2012: Delivery and installation of equipment

2012: Installation of equipment and local capacity building



2012: Capacity building at Farmanguinhos, Fiocruz, Rio de Janeiro

2012: Start up of the SMM operation



Visits of President Lula to SMM, 2008 and 2010

2012: Visit of the Vice-President of Brazil, Michel Temer

Challenges

- Composition of the public budget is 40% dependent of foreign donation
- Country is more than 80% dependent of medicines supplied by international donations.
- The country also faces an HIV/AIDS epidemic that affects about 18% of the population
- Treatment reaches less than 40% of adults and 25% of the infected children

MAIN AGENTS INVOLVED IN THE INITIATIVE

Ministério da Saúde

GOVERNO FEDERAL BRASIL PAÍS RICO É PAÍS SEM POBREZA

Ministério das Relações Exteriores

GOVERNO FEDERAL BRASIL PAÍS RICO É PAÍS SEM POBREZA

REPÚBLICA DE MOÇAMBIQUE

Agência Nacional de Vigilância Sanitária

BRASIL ABC Agência Brasileira de Cooperação

VALE

DEPARTAMENTO FARMACÊUTICO MINISTÉRIO DA SAÚDE -MISAU

MINISTÉRIO DAS FINANÇAS

MINISTÉRIO DOS NEGÓCIOS ESTRANGEIROS E COOPERAÇÃO

IGEPE - INSTITUTO DE GESTÃO DAS PARTICIPAÇÕES DO ESTADO

Additional information:
licia@far.fiocruz.br

Capacity building: Third example

Global-South cooperation:
Translation Science at Fiocruz

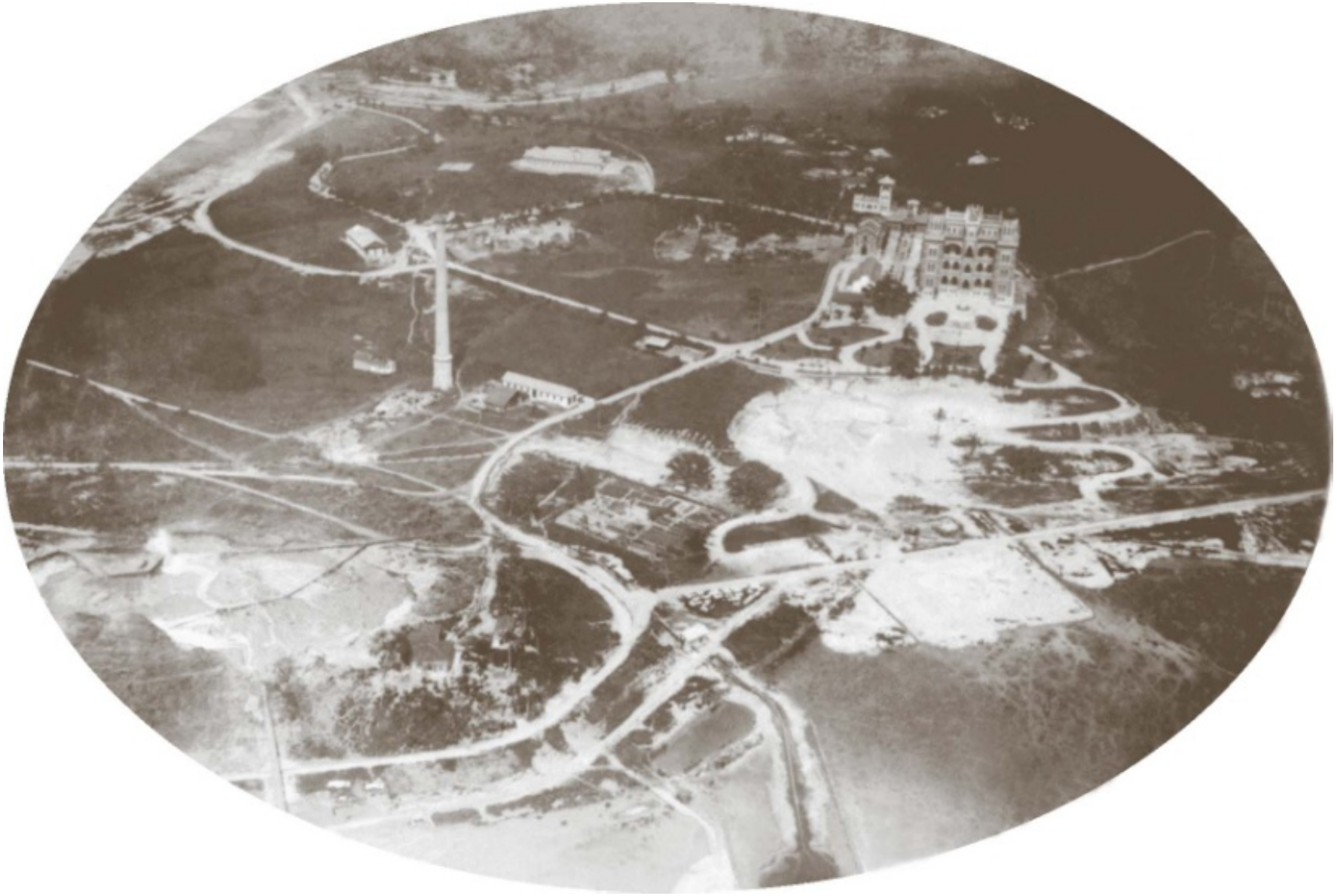
Fundação Oswaldo Cruz (Fiocruz)
Oswaldo Cruz Foundation
Ministry of Health of Brazil

1900 - 2014

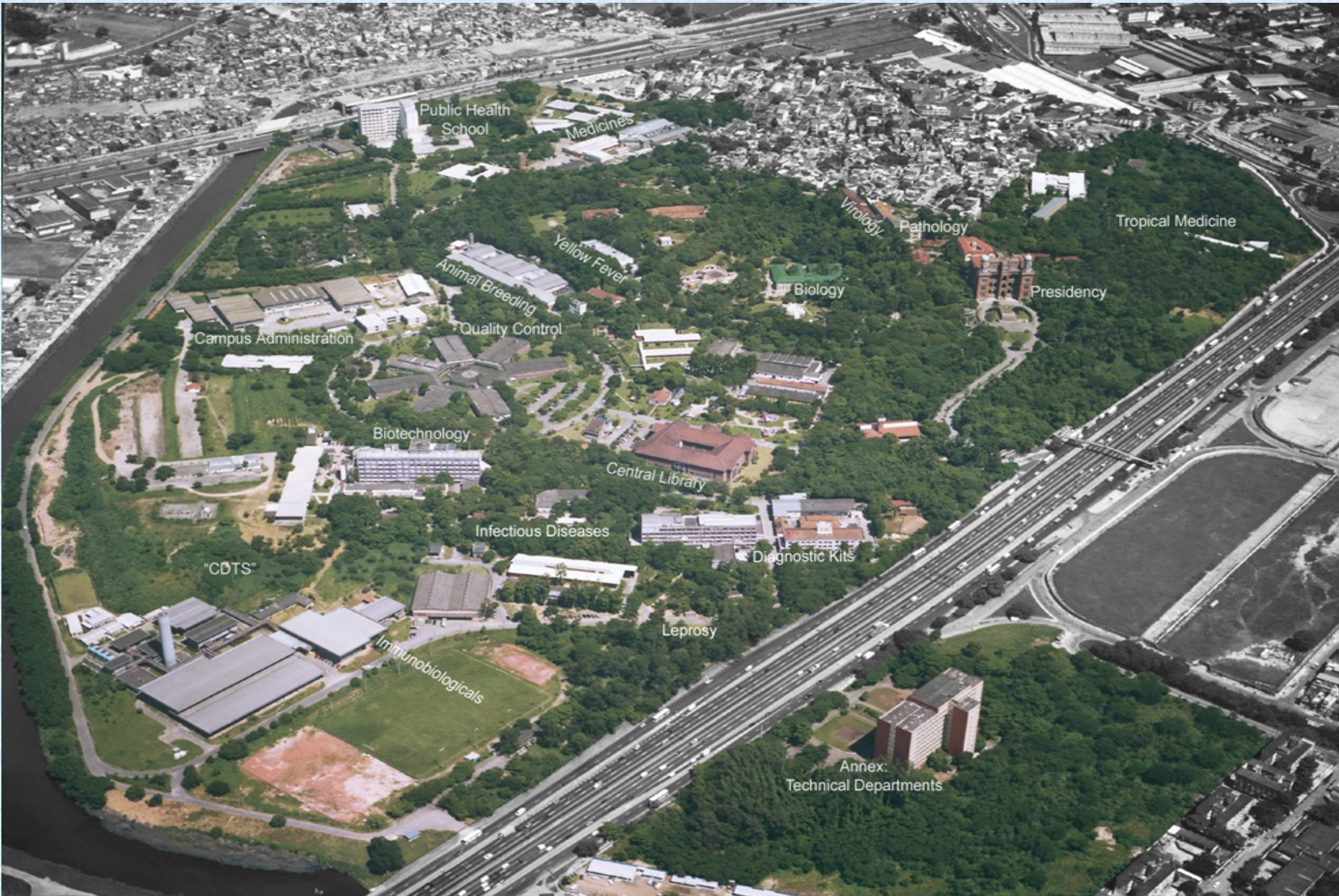
Ministério da Saúde

FIOCRUZ
Fundação Oswaldo Cruz

1900s’



Fiocruz: “Manguinhos” campus, Rio de Janeiro, RJ, Brazil



Fertile grounds

Can Brazil use its booming economy and abundant natural resources to become a life-sciences juggernaut? **Gene Russo** finds out.

DISTRIBUTION OF FIOCRUZ TECHNICAL UNITS in BRAZIL

IOC
ENSP
INCQS
IFF
COC
ICICT
IPEC
ESPJV
BIO
FAR
CECAL
CDTS

10 Research Institutes

3 Health Schools

2 Hospitals

2 Production Plants

1 Technological Center

1 Health History Center

1 Information Center

1 Quality Control Centerr

1 Public Health Center

Fiocruz: Some figures

- **Staff**: > 12 thousand, including 900 PhDs
- **Budget**: > US$ 1 billion
- **Research**: ~1,800 R&D ongoing projects and an average of 1,500 research papers per year
- **Teaching**: >10 thousand students
- **Annual industrial production**
  - ~110 million doses of vaccines
  - ~4 billion pharmaceutical units
  - ~3 million diagnostic tests

TECHNOLOGICAL PRODUCTS

PHARMACEUTICAL PRODUCTION

Malaria, leishmania, leprosy, TB, Chagas, hepatitis
Anti-retrovirals
Phytoterapeutic drugs; Bioinsecticides
Allergy, hypertension, diabetes

VACCINE PRODUCTION

- Actual prodution 150M/year:
  Yellow fever, measles, polio, meningitis A+C,
  DPT + Hib, triple viral
- New developments
  Double viral, tetra bacterial

Quick diagnostic test

HIV - Dengue
Leptospirosis - Leishmaniasis

Health & Medical Care Reference Centers

INFECTIOUS DISEASES

Leishmaniasis, mycoses, tuberculosis and other mycobacteria
Sexually transmitted diseases and HIV-AIDS
Dengue and other acute fevers
Focus on TB

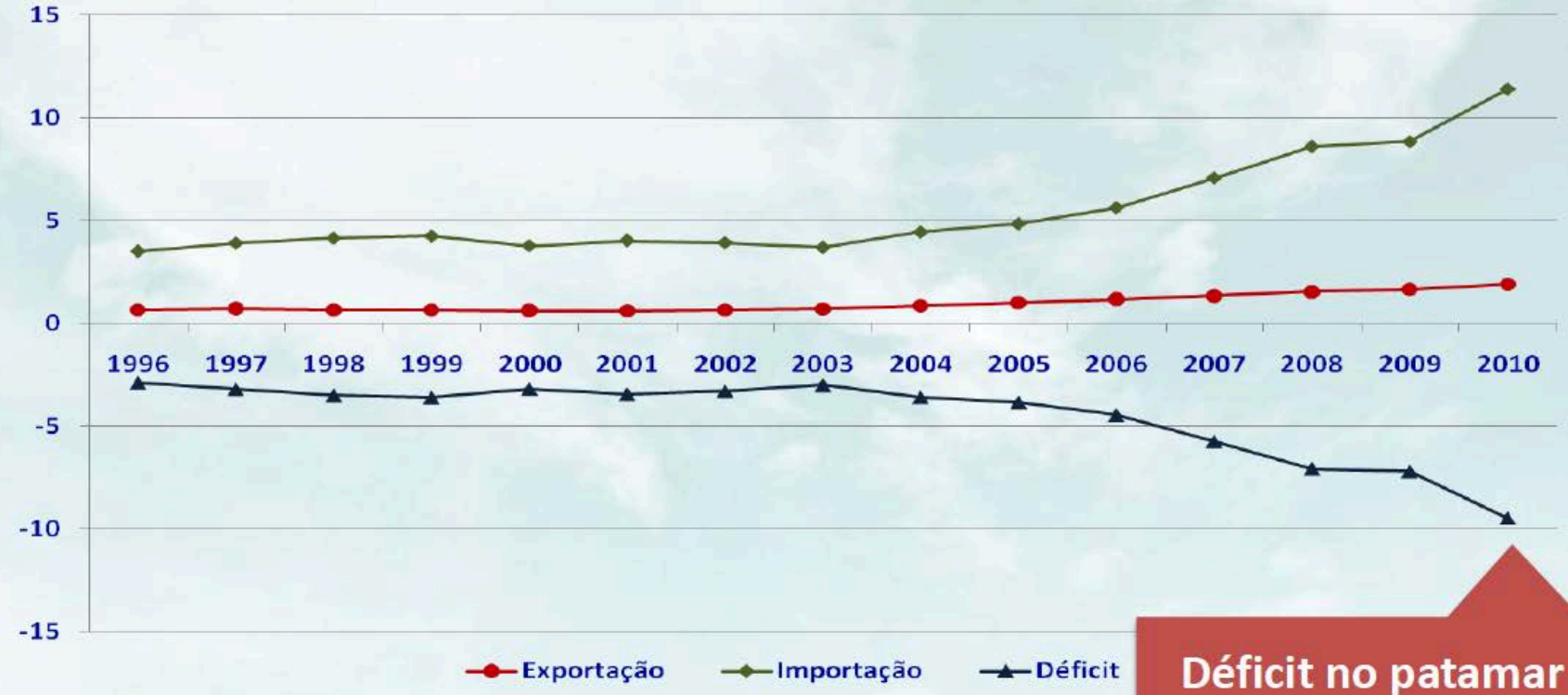
MATERNAL & INFANT CARE

High risk pregnancy, neonatology, genetic counseling, Pediatrics, lactation and human milk banks
Cervical and uterine cancers

HEALTH CENTER - PRIMARY CARE

Health promotion protocols (seniors , AIDS, drug addiction)
Prenatal care
Immunization programs
Clinical trials

Déficit da Balança Comercial



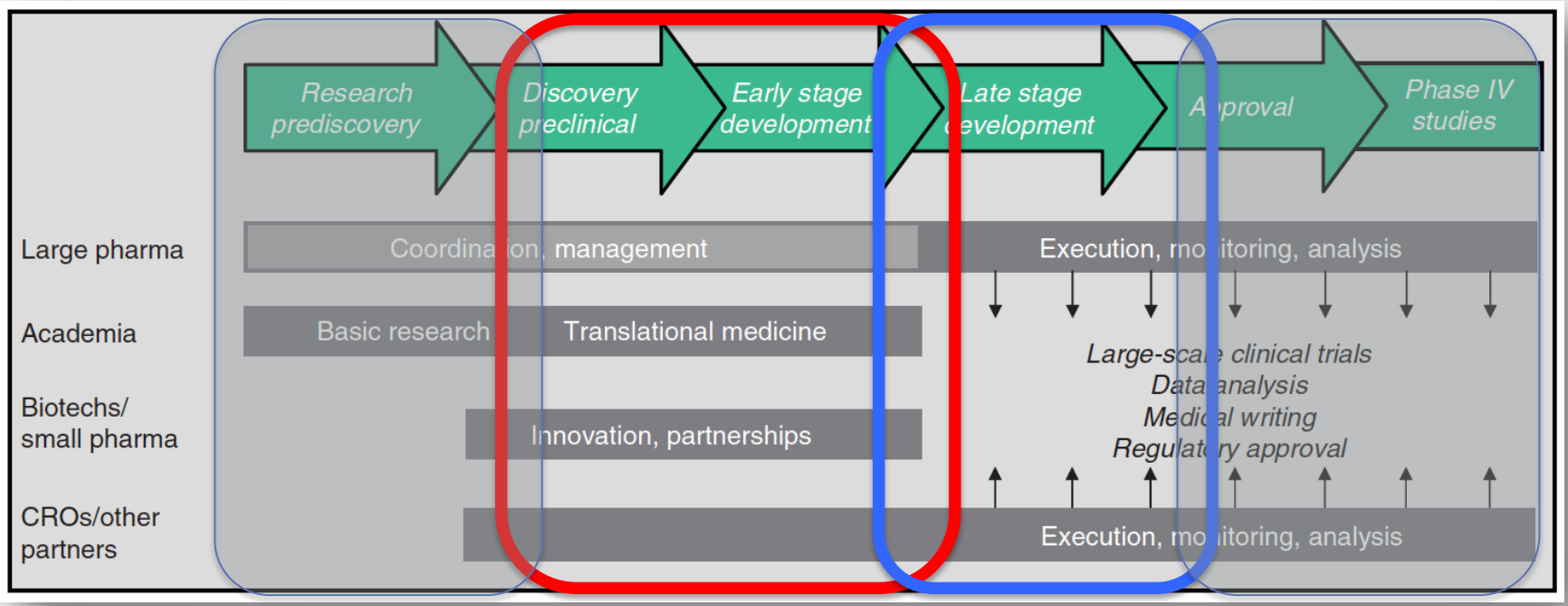
Fonte: elaborado por GIS/ENSP /FIOCRUZ, 2011, a partir de dados da Rede Alice / MDIC.

Déficit no patamar de US$ 10 bilhões

SUS Ministério da Saúde

GOVERNO FEDERAL BRASIL PAÍS RICO É PAÍS SEM POBREZA

How Fiocruz is shaping its innovation pipeline

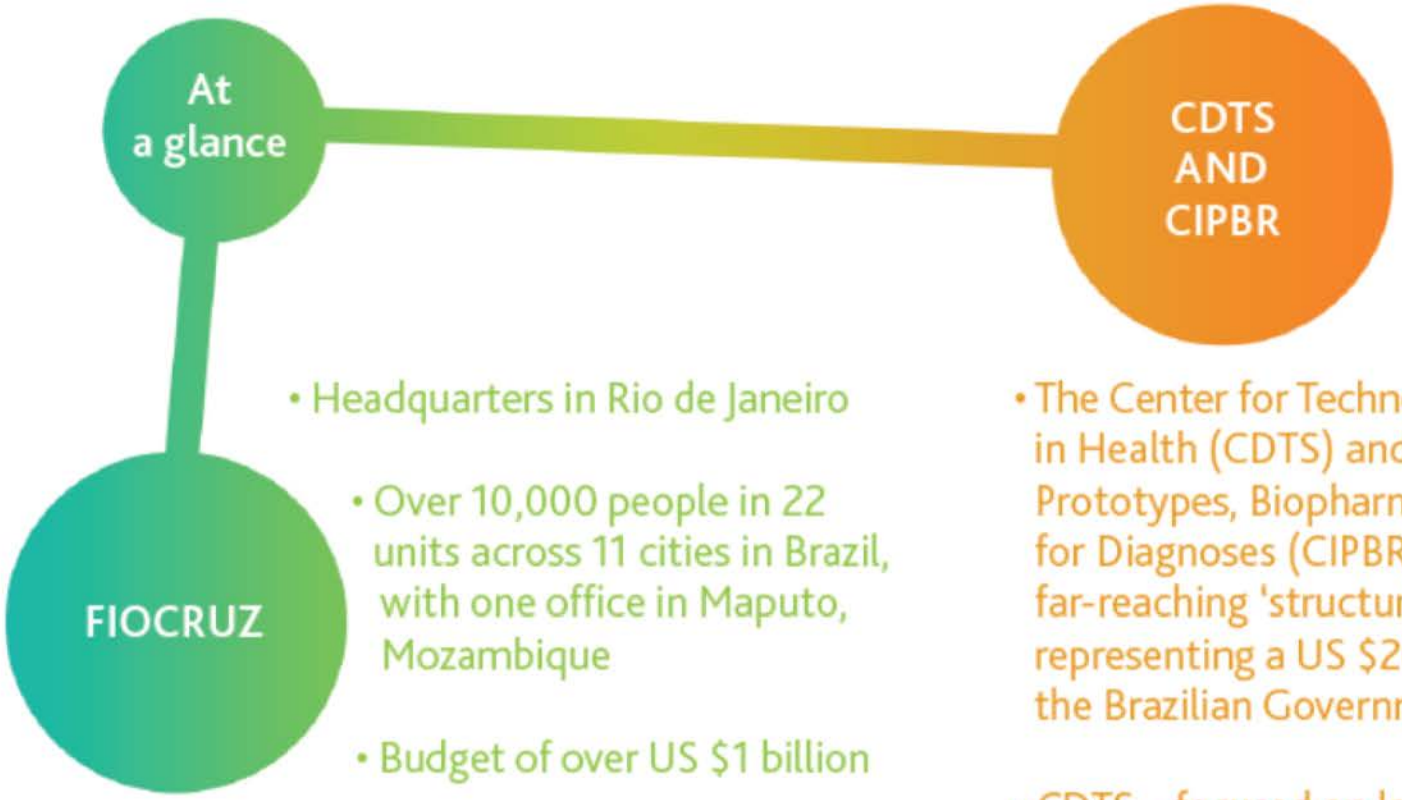


Research *push* → **CDTS** (GLP) **CIPBR** (GMP) → Market *pull*

Kaitin KI (2010) *Deconstructing the drug development process: The new face of innovation*. Clinical Pharmacology and Therapeutics **87**:356–361

CDTS & CIPBR at Fiocruz, Rio de Janeiro

CDTS + CIPBR: Strengthening Fiocruz technological innovation pipeline



- Headquarters in Rio de Janeiro
- Over 10,000 people in 22 units across 11 cities in Brazil, with one office in Maputo, Mozambique
- Budget of over US $1 billion
- Remit: research; education; technological production; reference services; information/ communication; planning and management

- The Center for Technological Development in Health (CDTS) and Integrated Center for Prototypes, Biopharmaceuticals and Reagents for Diagnoses (CIPBR) are two major, far-reaching 'structuring' Fiocruz projects, representing a US $200 million investment by the Brazilian Government
- CDTS – focused on late discovery and preclinical stages of development of health products under Good Laboratory Practices
- CIPBR – centred on late development, clinical stages and regulatory aspects of development and manufacture of health products under Good Manufacture Practices

Morel C (2014) **Bridging the gap**. *International Innovation*, Issue 131: Research Impacts (Research Media, UK, pp 17-19) ISSN 2054-6254

FIOCRUZ and CAPES agreed to sponsor a Fellowship Program to attract Visiting Scientists and Post-doctoral candidates for the Foundation's new Center for Technological Development in Health (CDTS)

An advertisement about the Program was published in the scientific journals *Science* and *Nature* on August 2006

Applications received were analyzed and prioritized by a scientific committee nominated by both institutions

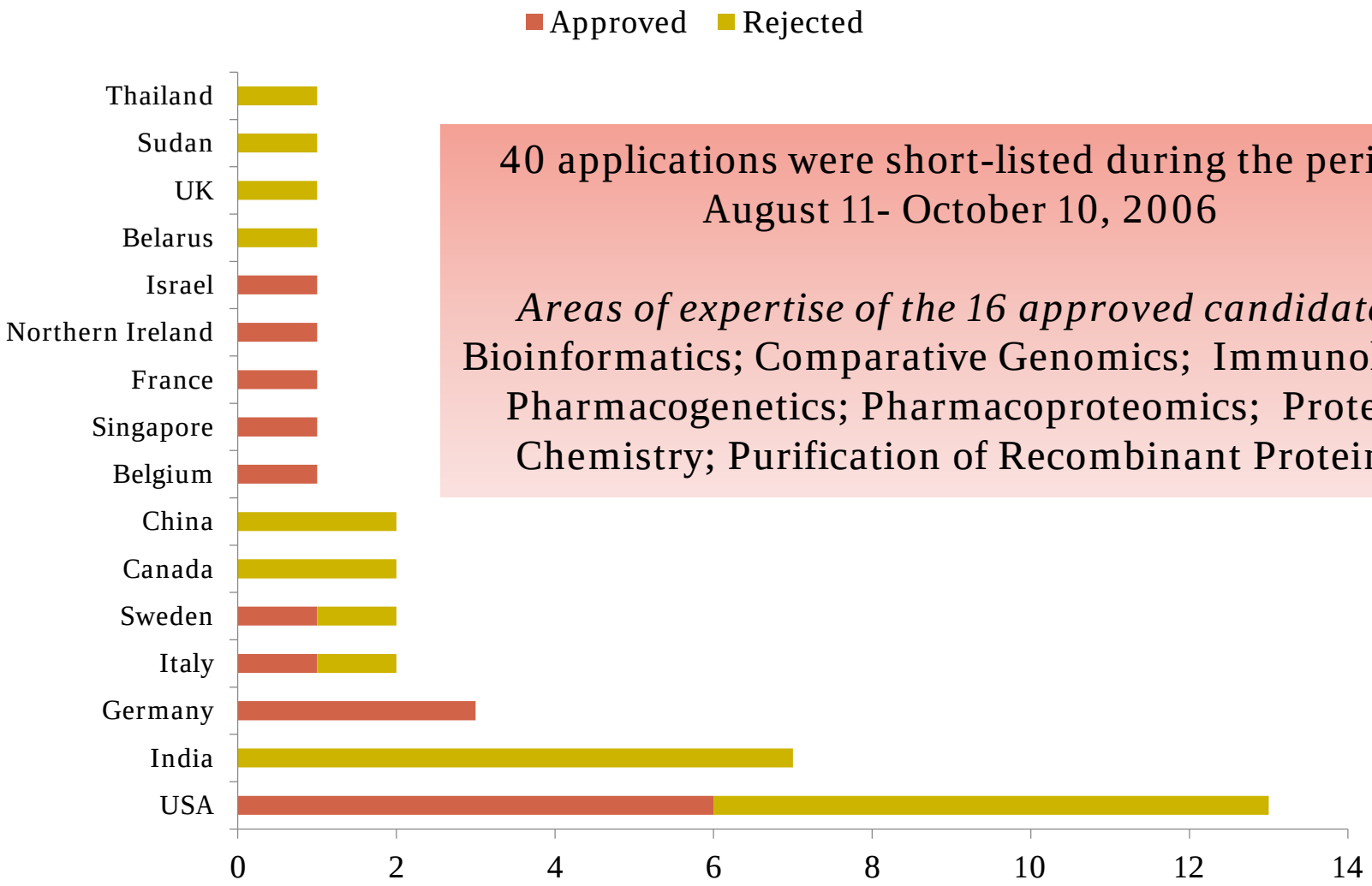
Nature

Thursday, August 10, 2006

Science

Friday, August 11, 2006

FIOCRUZ: Visiting Professor Fellowships



40 applications were short-listed during the period August 11- October 10, 2006

Areas of expertise of the 16 approved candidates
Bioinformatics; Comparative Genomics; Immunology; Pharmacogenetics; Pharmacoproteomics; Protein Chemistry; Purification of Recombinant Proteins

Scientists attracted by the Fellowship Program

Jochen Junker
Germany
NMR

Nicolas Carels
Belgium
Bioinformatics

William Provance
USA
Cell Biology

CENTER FOR TECHNOLOGICAL DEVELOPMENT IN HEALTH (CDTS)
OSWALDO CRUZ FOUNDATION (FIOCRUZ), RIO DE JANEIRO, BRAZIL

CAPES

VISITING-PROFESSOR, POST-DOCTORAL LONG-TERM COLLABORATION PROGRAM

The Oswaldo Cruz Foundation (Fiocruz; www.fiocruz.br), an institution affiliated to the Brazilian Ministry of Health, is building the Center for Technological Development in Health (CDTS for its acronym from Portuguese). Following its inauguration in 2014, the buildings of the CDTS will host technological platforms, animal experimentation and flexible laboratories in 20,000 m² of state of the art facilities. The CDTS will provide the necessary infrastructure to fully implement the spirit of the Brazilian 2004 Law on Innovation, which encourages partnerships between public and private sectors. Fiocruz has mandated the CDTS to establish and work in collaboration with other centers of scientific excellence for the joint development of health products against diseases that are of epidemiological or economic importance to Brazil, especially neglected tropical diseases.

To mobilize and strengthen the human resources needed, Fiocruz and CAPES (an agency of the Ministry of Education) have dedicated the following fellowships for PhD's to collaborate with the CDTS. In the long term the program aims to establish sustained partnerships between Fiocruz and other leading institutions, both public and private.

1. Post-doctoral Program

Open to Brazilian candidates who have completed their PhD/DSc work and are willing to perform post-doctoral training at public or private institutions in Brazil or abroad with a commitment to join a CDTS project upon the completion of the program.

- **RD-BR:** up to 20 (twenty) *Post-doctoral Fellowships* to train young Brazilian scientists in public or private R&D centers of excellence in Brazil (maximum 48 months);
- **PD:** up to 10 (ten) *Post-doctoral fellowships* to train young Brazilian scientists at institutions abroad (maximum 12 months).

2. Visiting Professor Program

pen to scientists and technology management professionals at PhD/DSc or equivalent level, from institutions of public or private sectors, with proven experience and outstanding achievement. Citizens from countries that maintain a diplomatic relationship with Brazil are eligible. The program is available for stays lasting from one week to one year and can be renewed. The work will be conducted at Fiocruz. Stipends will be determined based on experience.

- **PD-ES:** up to 10 (ten) *Visiting Professor Fellowships* to support senior Brazilian scientists to conduct research abroad (maximum 18 months);
- **PVE:** up to 10 (ten) *Visiting Professor Fellowships* to support foreign professionals for collaboration on projects within the CDTS and to participate in Fiocruz graduate programs (maximum 48 months);
- **PVNS:** up to 10 (ten) *Visiting Senior Professor Fellowships* to support senior Brazilian scientists to collaborate on projects within the CDTS and to participate in Fiocruz graduate programs (maximum 48 months).

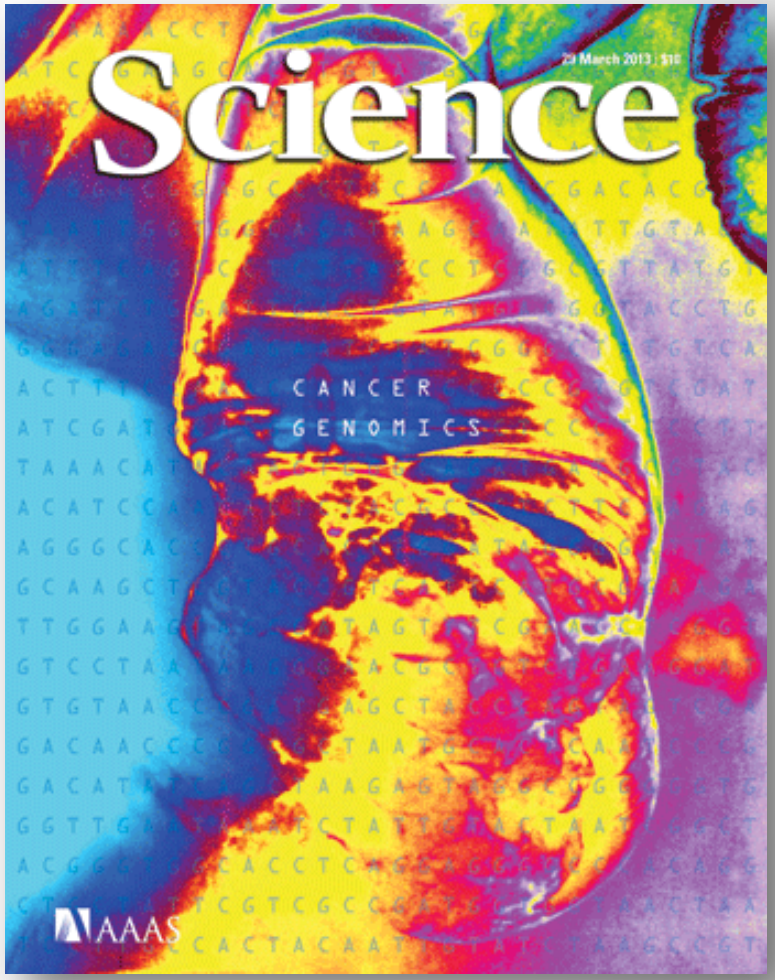
cruz objectives and goals;

3. Previous experience pertinent to the CDTS project and its long-term goals.

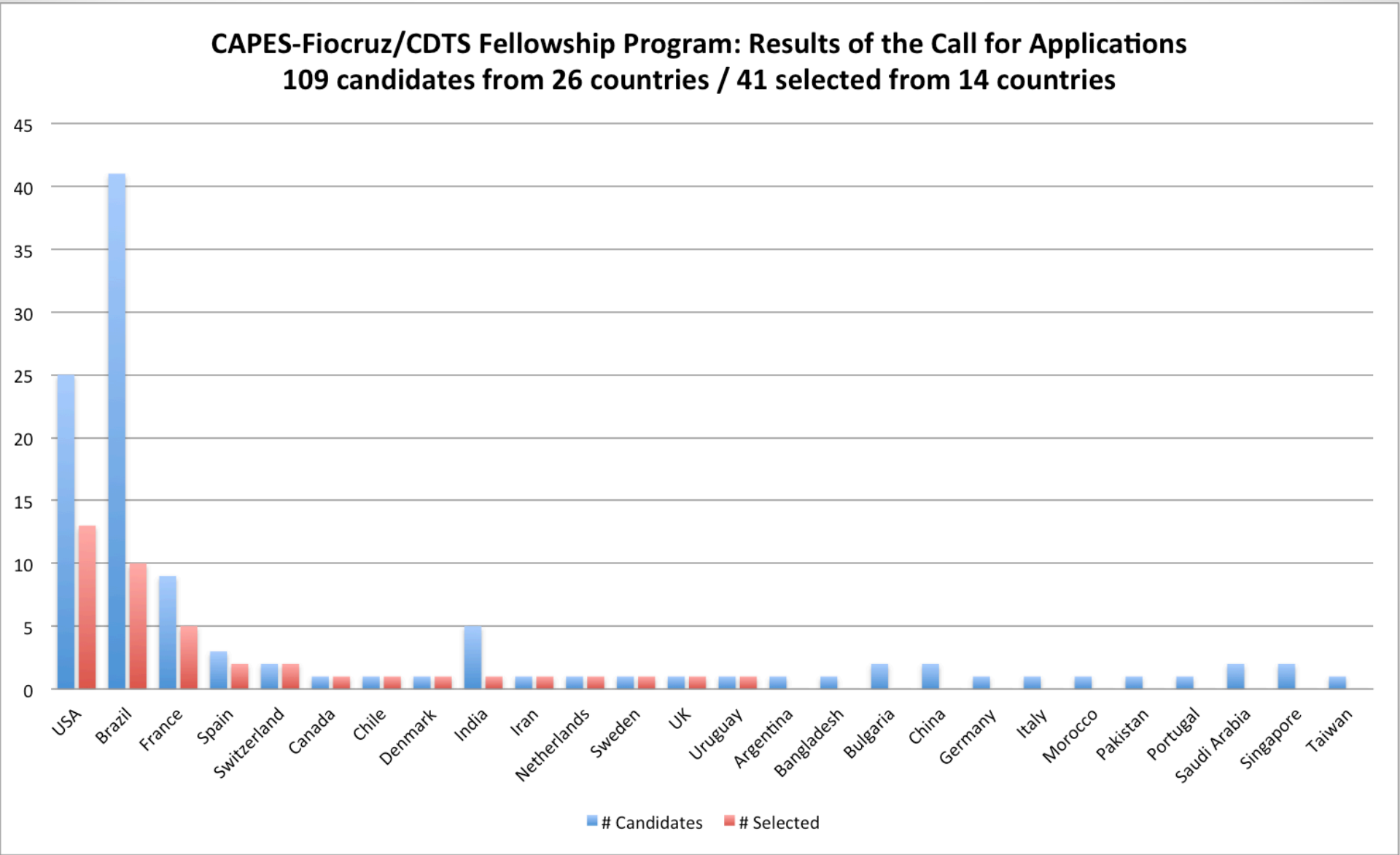
Candidates will be selected by a six-member expert panel nominated by Fiocruz and CAPES.
The program will run until 2016.

For further information or to express interest, contact: *Center for Technological Development in Health (CDTS)*

Science, 29/3/2013: Edital CAPES-Fiocruz/CDTS



2nd Phase of the Program



2-6 December 2013: Meeting in Rio de Janeiro, Brazil, with all 31 Visiting Professors

TRANSLATIONAL SCIENCE AT FIOCRUZ:
BUILDING INTERNATIONAL COLLABORATIONS

Thank you

Muito obrigado

morel@cdts.fiocruz.br

cmmorel@gmail.com

Ministério da Saúde

FIOCRUZ

Fundação Oswaldo Cruz

inct-idn

national institute of science and technology of innovation in neglected diseases