



**Global Genomic  
Medicine Collaborative**

# **Establishing a Latin American Translational Genomics Institute**

**Spiros N. Agathos & Juergen Reichardt**

**Yachay Tech University, Urcuquí, Ecuador**



**ESCUELA DE  
CIENCIAS BIOLÓGICAS  
E INGENIERÍA**

**YACHAY  
TECH** 

**YACHAY**  
CIUDAD DEL CONOCIMIENTO

**Prof. Spiros N. Agathos, Ph.D.**

**Decano / Dean**

Escuela de Ciencias Biológicas e Ingeniería

**Yachay Tech University**

office: +593 2 3949100 | Ext. 2006/2613

[sagathos@yachaytech.edu.ec](mailto:sagathos@yachaytech.edu.ec)

Hacienda San José s/n y Proyecto Yachay

San Miguel de Urucuquí - Ecuador

[www.yachaytech.edu.ec](http://www.yachaytech.edu.ec)

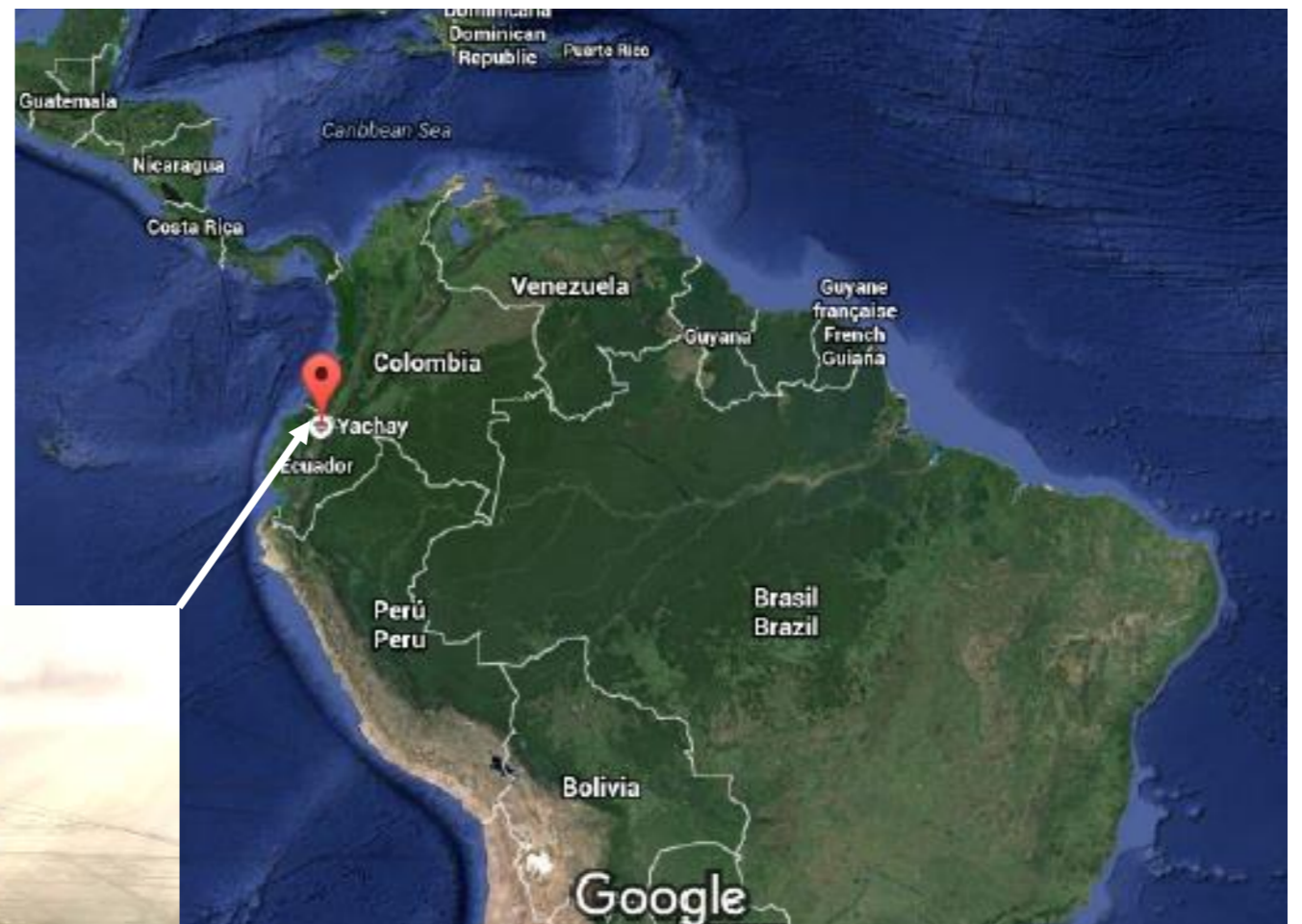
**YACHAY  
TECH**



UNIVERSIDAD  
DE INVESTIGACIÓN  
DE TECNOLOGÍA  
EXPERIMENTAL

# Yachay Tech, Ecuador (Yachay = Knowledge, Wisdom, in Quechua)

Designed to be the  
first research-  
intensive university  
in Ecuador



The City of Knowledge  
altitude 2225 m

# Yachay City of Knowledge

Home of Yachay Tech University – the first research university in Ecuador, Public Research Institutes, national and international firms for the production of high technology

City of Knowledge: a socially and environmentally responsible project to benefit the community, the country of Ecuador and the South America region

Direct and indirect employment in value-added sectors, access to high quality education, collaboration in cutting-edge projects

Yachay is central to the development strategy of higher education, science and technology in Ecuador and the region

Yachay will occupy an area > 4000 ha, the largest technology park in South America

### **Agricultural and biotechnological Sector**

The synergy between traditional agriculture and biotechnology in one place.

### **Knowledge Sector**

Is the main urban zone, where education, innovation and research start. It combines the university, research institutes, business engineering and industry.

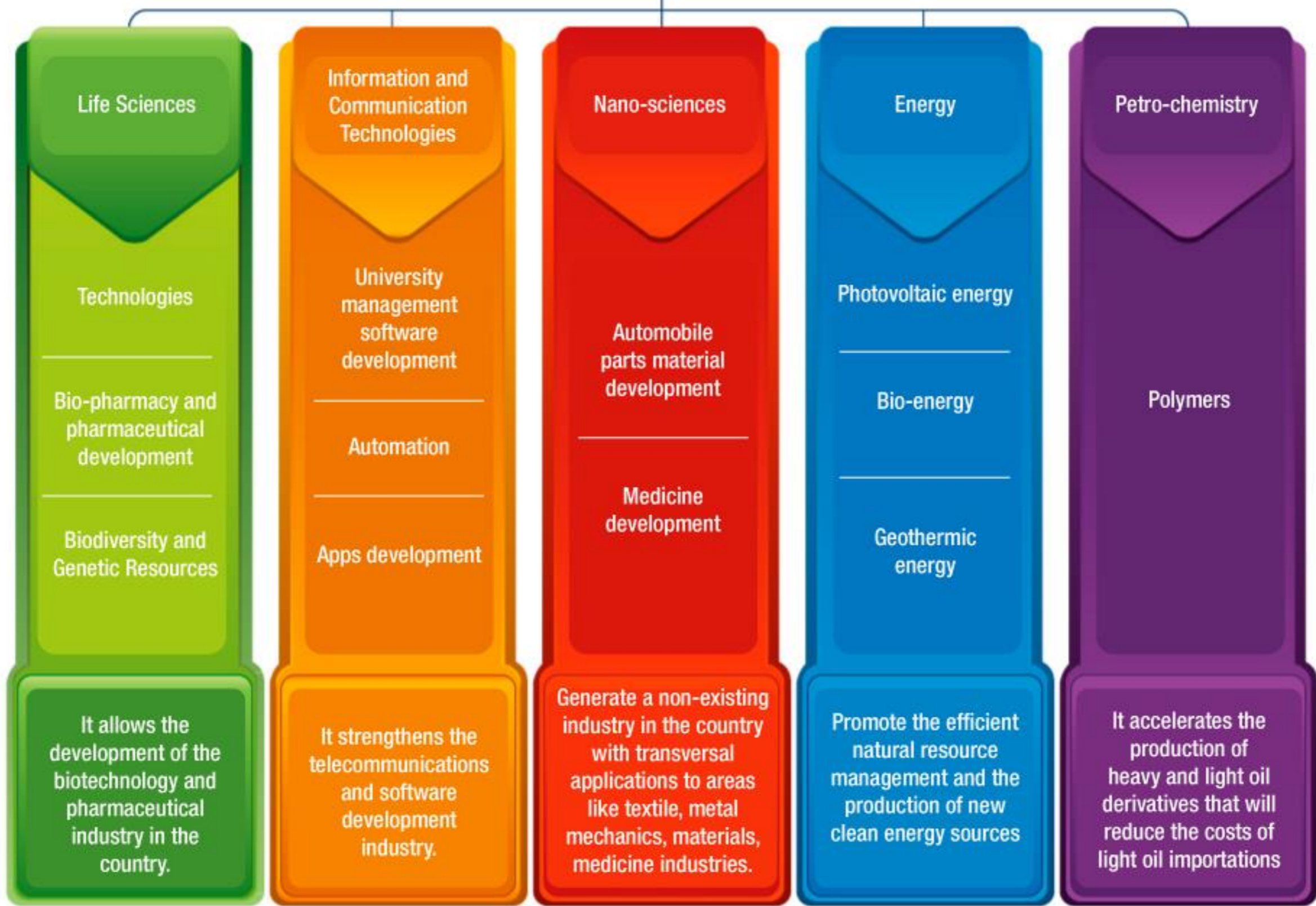
### **Industrial Technology Sector**

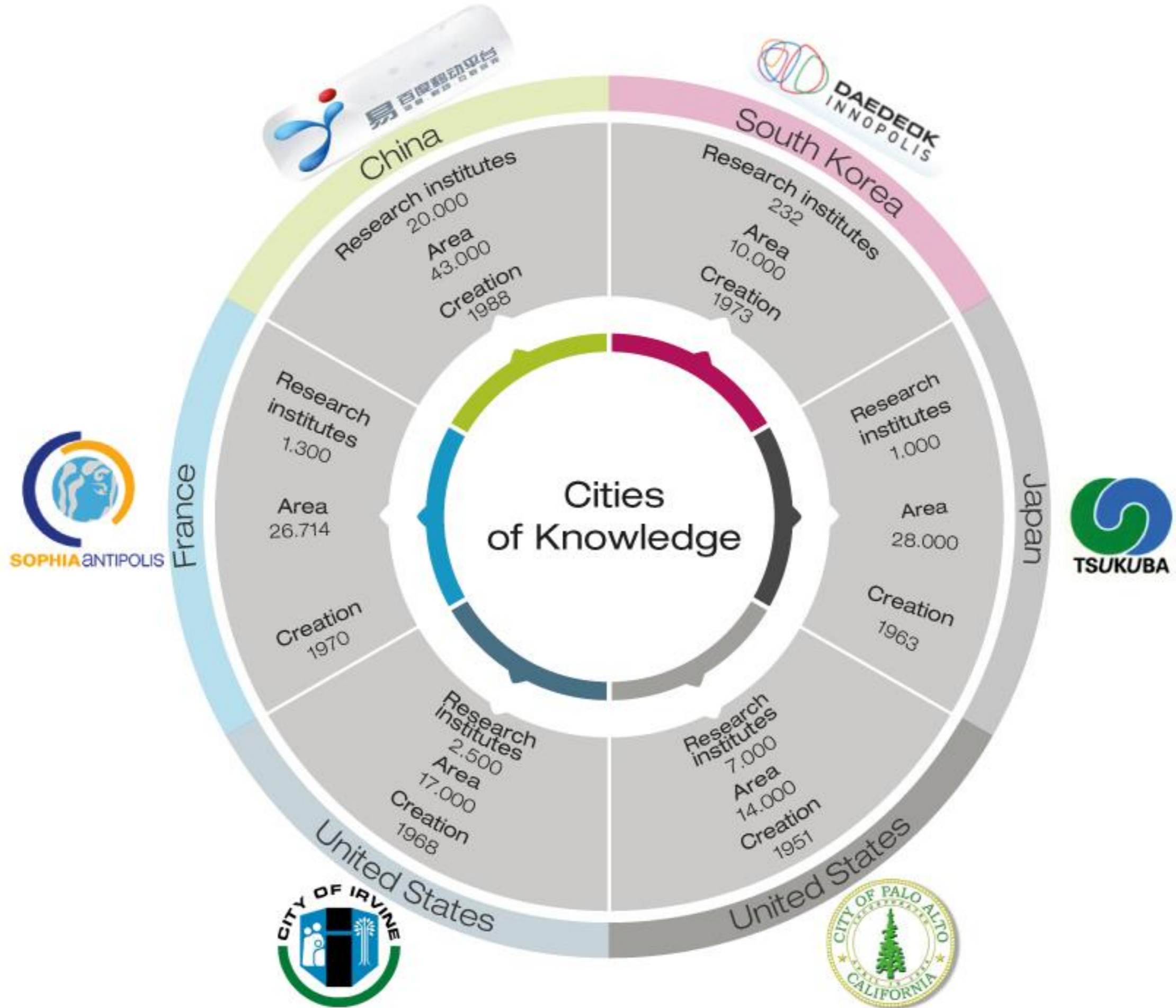
Industrial zone related to the production of innovation systems and new economy demands. This sector will be the place where knowledge produces. It will count with infrastructure for the industry that connects to the main highways and a complete logistics platform.

### **Entertainment Sector**

The entertainment sector will let entertainment activities develop across the city, for a sustainable living and completed with tourism spots inside the natural landscape.







Ubicación: Urcuquí, Provincia de Imbabura



# **Vision: An Ecuador-Based Latin American Translational Genomics Center**

After one-and-a-half decades of stability and growth, Ecuador is ready for establishing a Center aiming at the wider application of current advances in omics to health care, medical practice, diagnosis and disease prevention and to disseminate Precision Medicine in the wider region of South America.

The Center will carry out research and teaching in Genomics related to Systems Biology, Bioinformatics, Population Genetics, Pharmacogenomics and Translational Medicine.

Based at Yachay, it aspires to become a center of reference for Genomics in South America for analyzing genetic data on disease incidence and guiding research and public health policies. Further, it will be a key partner in research projects addressing the continent's biodiversity for novel biopharmaceuticals.

# Potential Partners for Yachay's Translational Genomics Center

Ministry of Public Health (MSP)

National Institute of Public Health Research (INSPI) – a pioneer in mapping disease incidence and health care outcomes

General Secretariat for Higher Education, Science, Technology and Innovation (SENESCYT)

Universidad Tecnológica Equinoccial (UTE) Genetics & Genomics Research Center (CIGG)

Yachay Supercomputing Facility for Data Storage and Analysis

Golden Helix Foundation for Know-how, Education & Training

# Potential Partners for a Latin American Precision Medicine Initiative ('LAPMI')

USA:

University of Georgia System (U. Georgia, Georgia Tech, Emory)

Arizona State University

George Mason University

ECUADOR

Pontificia Universidad Católica del Ecuador (PUCE)

Universidad de las Américas (UDLA)

COLOMBIA, BRAZIL, CHILE, ARGENTINA, PERU, MEXICO

# A Role in a Latin American Precision Medicine Initiative

The new Genomics Center will play a key role in a wider initiative to address endemic (e.g. infectious) diseases in Latin America: (key features: impoverished communities with significant infectious disease burden; mid-size and large cities with the infrastructure needed to facilitate scientific research).

Information gained could have profound impact on global health.

New knowledge will educate, train, and enable public health officials and scientists to better control infectious disease on both individual and epidemiological levels.

Precision Medicine to eradicate infectious diseases in Latin America by discovering correlations between specific diseases, metabolic pathways, genotypes, phenotypes (severity, progression, susceptibility to treatment), medical and nutritional histories, geography, and socio-economic conditions. This information will improve our ability to control outbreaks of vector-borne disease that emerge in new geographical locations through climate change.

# Latin America / Ecuador for Clinical Trials

Marked growth in clinical research, given Latin America's population diversity, the experience of its researchers, and its ability to conduct pharmaceutical clinical trials (CTs).

Region harmonized with stringent international regulations on clinical research, in compliance with Good Clinical Practice (GCP), and demonstrated the safety and effectiveness of different drug and vaccine products studied in Latin America.

Advantages attractive to pharmaceutical companies and other organizations: Population variability and size, research quality, low costs, easy access to patients, and interethnic representativeness within their diverse populations.

Clinical research makes it possible to attract foreign investment into the country, in addition to other economic and academic advantages, including the growth of the pharmaceutical industry.

## Ecuador for Clinical Trials

Ecuador 2000 – now: favorable transition period of economic stability, significant development, government-created conditions for academic interaction with the international scientific community by attracting talented foreign researchers to Ecuadorian universities and scientific institutes (e.g. *Prometeo* program, etc)

Ecuadorian government's active role in creating conditions for foreign investment in the country. State established legal provisions for the conduct of CTs to comply with GCP and achieve harmonization with the rest of the developed world regarding clinical research: driver for access to new technology, jobs and income.

Ecuador - a country with great biodiversity, opening a world of opportunities for sponsors of CTs. Intermixing process, gene pool interactions, (sub)populations with remarkable characteristics (disease susceptibility / immunity, environmental interactions, etc). Need for implementing Genomic Medicine to (sub)populations / individuals.

---

# Advances in Clinical Research in Ecuador

**Thelvia I. Ramos, MD, MSc<sup>1</sup>, Karina Alexandra Castro, MSc<sup>2</sup>,  
Luis Santiago Escalante, MD<sup>2</sup>, and Nelson Santiago Vispo, PhD<sup>3</sup>**

Therapeutic Innovation  
& Regulatory Science

1-7

© The Author(s) 2016

Reprints and permission:

[sagepub.com/journalsPermissions.nav](http://sagepub.com/journalsPermissions.nav)

DOI: 10.1177/2168479016680257

[journals.sagepub.com/home/tirs](http://journals.sagepub.com/home/tirs)

**Table 1.** Ethnic Variability Between Different Latin American Countries.

Country	Ethnicity, %					
	White	Mestizos	Mixed	Black	Amerindian	Other
Ecuador	6.1	71.9	7.4	7.2	7	0.4
Argentina	97		2.5			0.5
Brazil	47.7		43.1	7.6	0.5	1.1
Chile	52.7	44			2.5	0.8
Colombia	20	58	14	4	4	
Guatemala		60			40	
Mexico	9	60			30	1
Peru	15	37			45	3

Source: Salzano and Sans.<sup>6</sup>

**Table 2.** General Statistics of the Ecuadorian Population Covering Population Density and Health.

---

Total population (2015)	16,144,000
Life expectancy at birth M/F (years, 2015)	74/79
Probability of dying between 15 and 60 years of age, M/F (per 1000 inhabitants, 2013)	157/85
Total expenditure on health per capita (int, 2013)	789
Total expenditure on health as percentage of GDP (2013)	7.5%

---

Source: Global Health Observatory.

## Ecuador and Clinical Research Needs

Half of all deaths in Ecuador result from only 10 causes, 7 of which are chronic non-communicable diseases.

Cardiovascular and cerebrovascular diseases, diabetes mellitus, and hypertension have caused an increase in general mortality rates, possibly related to sedentary lifestyles and poor nutrition habits, without disregarding a hereditary component.

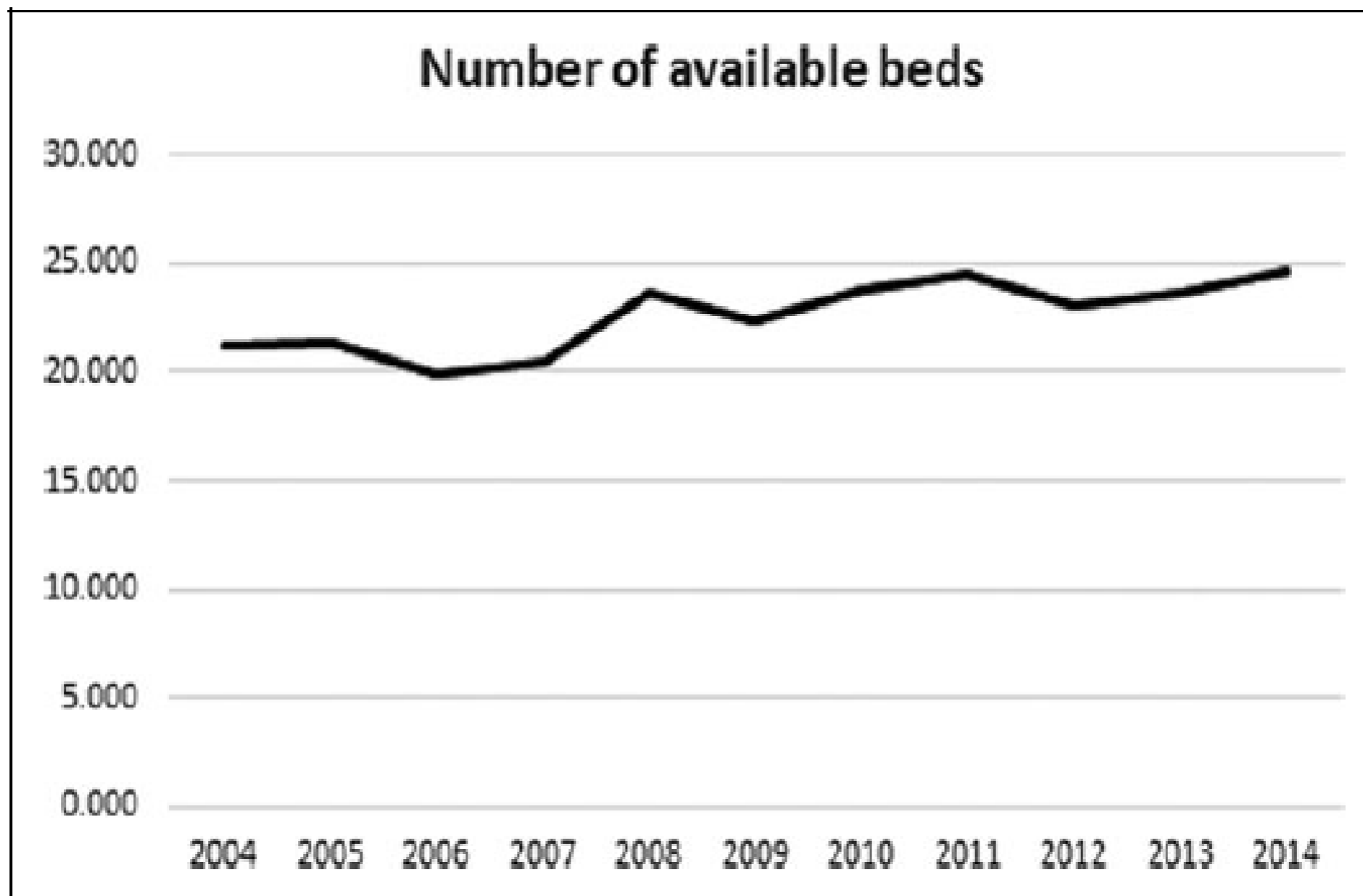
Arterial hypertension and diabetes mellitus = risk factors for cerebrovascular disease. Deaths resulting from these groups of chronic metabolic diseases are preventable, making Ecuador attractive for clinical research development conditions may be compared / contrasted from other nations, to evaluate the safety and effectiveness of different products targeting these diseases *in the genomic context of Ecuadorians* (Table 3).

**Table 3.** Cause-Specific Mortality in the Ecuadorian Population.<sup>a</sup>

Rank No.	Cause of Death	Number	%	Rate
1	Ischemic heart disease	4430	7.03	27.64
2	Diabetes mellitus	4401	6.99	27.46
3	Cerebrovascular disease	3777	6.00	23.57
4	Hypertensive diseases	3572	5.67	22.29
5	Influenza and pneumonia	3418	5.43	21.33
6	Land transport accidents	3059	4.86	19.09
7	Cirrhosis and other liver diseases	2038	3.24	12.72
8	Urinary tract diseases	1712	2.72	10.68
9	Chronic lower airway tract diseases	1656	2.63	10.33
10	Malignant neoplasm of the stomach	1585	2.52	9.89
11	Certain conditions originating in the perinatal period	1330	2.11	8.30
12	Heart failure, complications, and ill-defined diseases of the heart	1316	2.09	8.21
13	Events of undetermined intent	1311	2.08	8.18
14	Malignant neoplasm of lymphoid, hematopoietic, and related tissue, unspecified	1079	1.71	6.73
15	Assaults (homicides)	1045	1.66	6.52
16	Congenital malformations, deformations, and chromosomal abnormalities	850	1.35	5.30
17	Prostate cancer	833	1.32	5.20
18	Human immunodeficiency virus (HIV) disease	828	1.31	5.17
19	Intentionally self-inflicted injuries (suicide)	734	1.17	4.58
20	Malignant neoplasm of the uterus	720	1.14	4.49
21	Malignant neoplasm of the trachea, bronchus, and lung	717	1.14	4.47
22	Pulmonary edema and other respiratory diseases principally affecting the interstitium	708	1.12	4.42
23	Malignant neoplasm of the colon, sigmoid colon, rectum, and anus	678	1.08	4.23
24	Neoplasm (malignant, benign, in situ, or uncertain whether malignant or benign)	677	1.07	4.22
25	Malignant neoplasm of the liver and biliary tract	650	1.03	4.06
	Other causes	14,159	22.48	88.34
	Ill-defined causes	5698	9.05	35.55

Source: INEC, Estadísticas Vitales, defunciones 2014.

<sup>a</sup>Cause-specific mortality rates are expressed per 100,000 inhabitants, for purposes of international comparison.

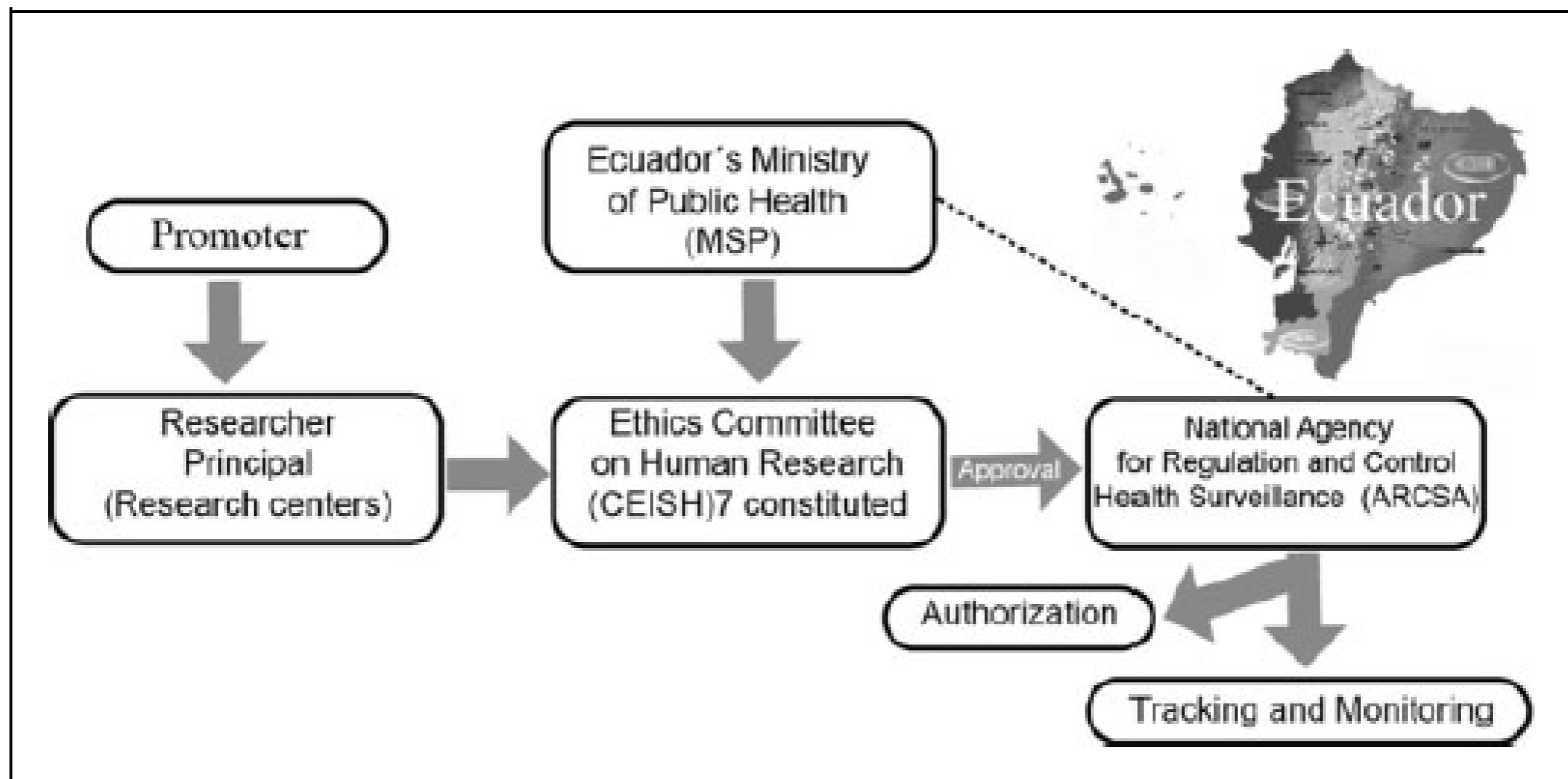


**Figure 1.** Number of available beds from 2004 to 2014 in Ecuador, according to Ministry of Public Health.

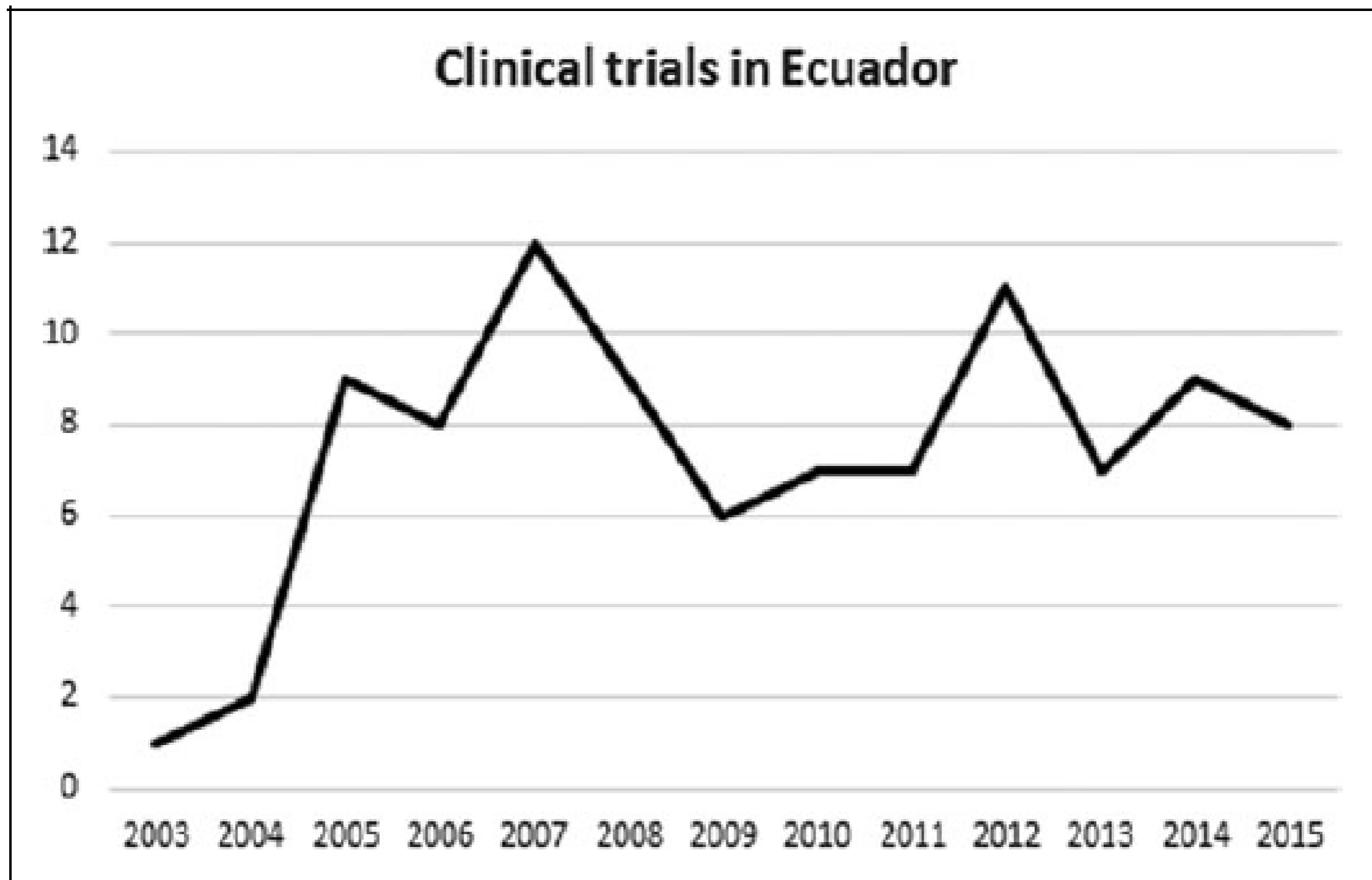
**Table 4.** Number of Hospitals by Type of Medical Specialty.

Health Facility by Type	n
Basic hospital	93
General hospital	76
Infectious diseases hospital	1
Obstetric-gynecological hospital	11
Pediatric hospital	4
Psychiatric hospital and alcoholism recovery center	4
Dermatological hospital (leprosarium)	1
Cancer hospital	8
Pulmonology hospital (sanatorium)	1
Geriatric hospital	1
Specialty hospital	9
General clinic (without specialties)	528
Obstetric-gynecological clinic	20
Pediatric clinic	1
Traumatology clinic	4
Psychiatric clinic	1
Other specialized clinics	6
Total	769

Source: Ecuador en cifras, Estadísticas Sociales, Camas y Egresos Hospitalarios.<sup>12</sup>



**Figure 2.** Diagram of institutions and organizations involved in conducting a clinical trial in Ecuador, according to Ministry of Public Health.



**Figure 3.** Ninety-eight CTs were conducted in Ecuador from 2003 to 2015, including phase III (60%) and phase IV (29.2%) CTs, according to [clinicaltrials.gov](http://clinicaltrials.gov).

# **Ecuador's Research Potential in the Health Sciences**

Ecuador increased the number of researchers linked to Public Scientific Research Institutes by almost 4-fold between 2007 and 2013

Ecuador increased the funding of health-related research projects by one order of magnitude: from 3,519,067.50 USD in 2007 to 32,341,544.97 USD in 2013.

## **Major Targets in the Era of Omics and Personalized Medicine**

Jump-start research and health care practice in a fast-changing landscape of Precision Medicine, given the lack of a strong R&D culture

Establish smart data connectivity for isolated and vulnerable (sub)populations

## Challenges = Opportunities

Close engagement by the Government (MSP, SENESCYT) for consistent funding and implementation of findings into health care practice both in the clinic and primary care / diagnosis / prevention

Public procurement dysfunctions (delays in instrument and reagent ordering and delivery) with fast-track measures

Balance generally dropping costs of NGS with stable and/or rising costs in data analysis

Creative ways of educating and training new generations of researchers and health care professionals (omics literacy, smart specializations)

National, regional and international collaborations and networking are key to a successful insertion of Precision Medicine in a society