



INSTITUTO DE CIENCIAS MÉDICAS

RESEARCH AGENDA

2023-2030

“From the heart of Panama, doing science with a conscience”



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BACKGROUND

Instituto de Ciencias Médicas (ICM) is a private non-profit organization whose mission is to contribute to the prevention and treatment of diseases through research, education and public health actions. Since its founding in 2012, the ICM has focused on the development of research whose products can contribute to the development and management of public policies with an impact on health.

At Instituto de Ciencias Médicas we have three research units:

- A. Genetics and Public Health.
- B. Microbiology and Public Health.
- C. Social Sciences and Health Policies.

Each of the units works in the development of scientific research for which its members have the academic profile and experience to execute them. In this sense, after a consensual work of analysis and discussion, four lines of research developed by the research units of the ICM have been defined.

This document presents the research agenda of Instituto de Ciencias Médicas for the period 2023-2030, which includes four lines of research:

1. Generation of Scientific Evidence for the Formulation of Public Policy.
2. Genetics and Public Health.
3. Microbiology and Public Health.
4. Public, Environmental, Global and Planetary Health.

1. LINES OF RESEARCH

1.1. Generation of Scientific Evidence for the Formulation of Public Policies.

Epidemiology is a scientific discipline that investigates and describes the dynamics of health in populations, combining principles of social and biological sciences. As a first line of research, we will conduct epidemiological studies on topics of great importance in public health, so that our research will have an impact on public policies in the country. This line of research is aimed at epidemiological studies on the characteristics of suicide and the epidemiology of road traffic injuries in Panama.

In Panama, the number of trauma-related deaths is a prevalent public health problem, being after the first year of life the second cause of death in children up to 14 years of age. Instituto de Ciencias Médicas has developed studies framed in road safety and public policy advocacy such as Virginia Nuñez Samudio, Javier Jaramillo-Morales & Ivan Landires (2016) Prevalence and characteristics of child victims in motor vehicle collisions in Panama, *Traffic Injury Prevention*, 17:4, 391-393, doi: <https://doi.org/10.1080/15389588.2015.1092524>

Our results showed that during the years 2005-2012, 10,603 traffic accident victims aged 0-14 years were registered in Panama, resulting in 213 deaths. With our study we were able to demonstrate that the infant mortality rate in Panama due to traffic accidents is 3 to 4 times higher than in Spain. In addition, another study has been conducted comparing mortality and lethality due to traffic accidents in minors in different Central American countries, finding that they are higher in Panama and Guatemala than in Costa Rica: Nuñez-Samudio, V.; Mayorga-Marín, F.; López Castillo, H.; Landires, I. Epidemiological characteristics of traffic accident injuries involving children in three Central American countries, 2012-2015. *Int. J. Environ. Res. Public Health* 2021, 18, 37. <https://doi.org/10.3390/ijerph18010037>.

Our study showed that, in Panama, children under 5 years of age have a higher risk of death, probably due to the lack of specific legislation on the use of child restraint systems, since it is documented that their correct installation and use in the vehicle reduces mortality in children under 1 year of age by approximately 71%, and between 54 to 80% in children between 1-4 years of age. For this reason, we have recommended an urgent public policy in this regard to promote better road safety and adequate legislation that will lead to a reduction in child casualties in traffic

accidents. We have succeeded in making our study a fundamental part of the explanatory memorandum of a bill recently submitted to the National Assembly on the regulation in Panama of the Child Restraint System in automobiles. See Links:

- http://www.asamblea.gob.pa/proyley/2017_P_510.pdf
- <http://www.asamblea.gob.pa/a-tercer-debate-proyecto-de-ley-que-regula-el-uso-de-sillas-de-retencion-infantil/>
- https://impresaprensa.com/panorama/Ninos-vulnerables-accidentes-vehiculares_0_4446305328.html
- http://www.telemetro.com/nacionales/entrevistas/Explican-importancia-sillas-retencion-infantil_3_1055924417.html

This line of research includes studies on suicide, which is a public health problem of great relevance that affects a significant number of Panamanians, currently representing a rate of 3.1% per 100 thousand inhabitants in the country and threatens to become a pandemic due to its rapid expansion, representing in our country the third cause of death in young people between 15 and 19 years of age. Our research group conducted a retrospective descriptive epidemiological study of suicide-related mortality (Panama, 2007-2016). Where data were obtained from 1475 suicide deaths, 86% were male and 47% were between 20 and 39 years old. The mean mortality rate was estimated at 3.91 per 100 000 population with a mean rate of years of potential life lost of 3.79 per 1000 population. Exploratory analyses showed no significant correlation between the multidimensional poverty index and suicide rates. Our study showed a male to female suicide ratio of 6: 1, mainly affecting the age groups 20 to 29 years and over 80 years. (Núñez-Samudio, et al.. Epidemiologic Characteristics of Suicide in Panama, 2007–2016. *Medicina* 2020, 56, 442. <https://doi.org/10.3390/medicina56090442>)

General objectives:

- a. To determine the prevalence and characteristics of victims in the general population in motor vehicle accidents in Panama.
- b. To identify the prevalence of disabled persons secondary to injuries caused by traffic accidents in Panama.
- c. Determine the prevalence and characteristics of suicides in the general population.
- d. Determine the epidemiological prevalence of different diseases in Panama.

Line of Action: The following are contemplated:

- 1) Design of new methodology for the development of the research.
- 2) Design of new instruments for data collection.
- 3) Establishment of new collaborations with related entities.
- 4) Promotion and dissemination of results for consideration in the creation of public policies.

Responsible for the activity:

Dr. Virginia Núñez-Samudio head of the Microbiology and Public Health Unit.

Dr. Iván Landires, head of the Genetics and Public Health Unit.

1.1. Genetic and Public Health.

Cytogenetic studies: Figures from the Comptroller General's Office revealed that the crisis of the La Villa river due to contamination with atrazine, which in September 2014 forced authorities to restrict water supply to 14 townships in the Azuero region, affected approximately 83 thousand people (La Prensa, 20 Sep 2014). Justification: The contamination of water and environmental resources, as well as the increase in the incidence of pathologies related to exposure to environmental pollutants such as agrochemicals is a growing Public Health problem in our country. Cytogenetic techniques in peripheral blood lymphocytes and other human tissues such as the study of chromosomal aberrations, micronuclei and other cytogenetic techniques allow identifying changes in the normal structure or in the number of chromosomes, which makes them very useful for monitoring exposed populations, since they allow identifying chemical substances with mutagenic genetic properties that induce congenital and carcinogenic malformations through the evaluation of the entire cellular genome. Through the ITE15-026 project financed by Senacyt, a Genetic Toxicology laboratory has been established at Instituto de Ciencias Médicas, to our knowledge, the first and only one in Panama to carry out studies on how diverse environmental contaminations could induce genetic damage in living beings, including the human species. The cytogenetic techniques of micronucleus, DNA polymorphisms and telomere length standardized at Instituto de Ciencias Médicas with this project are unprecedented in Panama.

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Genetics of Cancer: In Panama, as in many countries of the world, breast cancer is the most frequent type of cancer in women. Its cause is multifactorial and there are several determinants described that influence the development of breast cancer, among which we can mention the lifestyle of people and genetics or hereditary predisposition to breast cancer, that is to say, that they are carriers of a genetic alteration that favors the development of the disease. The main genes known for hereditary predisposition to breast cancer are called BRCA1 and BRCA2; women carrying the genetic alteration have a much higher risk of developing breast cancer. Within our genetics line, a study is being carried out to determine the genes related to the development and genetic predisposition to breast cancer in patients with breast cancer in Panama. Through the IOMS18-016 project financed by Senacyt, at Instituto de Ciencias Médicas of Las Tablas we have been able to install and put into operation for the first time in the interior of Panama, the first MiniSeq platform of Massive DNA Sequencing of New Generation type to perform analysis of mutations of susceptibility to Breast Cancer in Panamanian women. This equipment is available for scientific collaborations in diverse topics with national and international researchers.

Genetics of non-traditional chronic kidney disease: within this line of research, whose principal investigator is Dr. Karen Courville, a researcher at Instituto de Ciencias Médicas, studies are being conducted on non-traditional chronic kidney disease (NT-CKD), which refers to a kidney condition identified in Central America, present in areas dedicated to agriculture, that mainly affects young male workers. It occurs in patients who do not suffer from diabetes, arterial hypertension or have birth problems in the urinary tract. This type of disease affects the kidneys and if it is not identified and managed in time, it can evolve into end-stage chronic kidney disease. Therefore, within our line of research in genetics, we will investigate the genes or genetic variants related to the development of NT-CKD, through exome sequencing and genetic panel. On the other hand, it is worth mentioning that NT-CKD continues to affect all countries in the Central American region, with higher mortality in young patients, and the cause or triggering factors have not been identified. Due to the type of patient in which it presents, young men and with activities related to agriculture, within our genetic line we intend to investigate occupational and environmental risk factors by means of mutagenesis techniques, such as micronuclei and chromosomal alterations, if there is correlation between the measurement of pesticide residues and heavy metals with such damage at chromosomal level and with characteristic patterns of global epigenetics that could be related to the environmental exposures studied. A study carried out in our laboratory has analyzed

variants in genes of genetic predisposition to Non-Traditional Chronic Kidney Disease. Through the IOMS19-013 project we have been able to install and set up the QuantStudio3 quantitative PCR equipment for the analysis of gene expression in patients with CKD. This equipment is available for scientific collaborations in various topics with national and international researchers.

General objectives:

- a. To study by means of cytogenetic techniques the people exposed to agrochemicals in Azuero and their impact on human health.
- b. To identify determinants for the development of breast cancer related to lifestyle and genetics of women residing in the Azuero region.
- c. Determine the genetic characteristics of non-traditional CKD in Azuero.
- d. To study probable exposure risk factors (exposome) and their effect at the chromosomal and epigenetic level in patients with NT-CKD.

Line of action: the following is contemplated:

1. Epidemiological study of pesticides and congenital malformations in Azuero.
2. To study the genomic effects of pesticides by means of cytogenetic techniques.
3. Measure metabolites of pesticides in urine and blood.
4. To measure heavy metals in urine and blood.
5. Statistical association analysis.
6. Exome sequencing in patients with non-traditional CKD.
7. Panel sequencing.
8. Promotion and dissemination of results for consideration in the creation of public policies.

Responsible for the activity:

Dr. Ivan Landires head of the Genetics and Public Health unit.

1.2. Microbiology and Public Health.

Healthcare-associated infections (HCAI) represent a serious public health problem, their prevalence is high and they are associated with increased morbidity and mortality. Among the microorganisms responsible for HCAI, bacteria are described as the most common pathogens, and the increase in the appearance of multidrug-resistant (MDR) strains constitutes a serious public health problem. Panama presented a hospital outbreak secondary to a nosocomial MDR bacterial species, *Klebsiella pneumoniae*, Carbapenemasas (KPC), causing the death of a large number of people. Little is known in Panama from the epidemiological point of view about the typing and genetic determination of the different bacterial clones and resistance mechanisms responsible for HCAI, which makes it almost impossible to determine the existing genetic diversity and the possible distribution and dispersion patterns.

Within the Microbiology and Public Health unit, bacterial strain typing projects will be developed using molecular biology tools and also the characterization of resistance genes to determine the current genetic diversity of strains of clinical isolates. In relation to this research axis, publications of great importance have been made such as:

1. Núñez-Samudio, V.; Pecchio, M.; Pimentel-Peralta, G.; Quintero, Y.; Herrera, M.; Landires, I. Molecular Epidemiology of *Escherichia coli* Clinical Isolates from Central Panama. *Antibiotics* **2021**, *10*, 899. <https://doi.org/10.3390/antibiotics10080899> ;
2. Núñez-Samudio, V.; Pimentel-Peralta, G.; Herrera, M.; Pecchio, M.; Quintero, J.; Landires, I. Molecular Genetic Epidemiology of an Emerging Antimicrobial- Resistant *Klebsiella pneumoniae* Clone (ST307) Obtained from Clinical Isolates in Central Panama. *Antibiotics* **2022**, *11*, 1817. <https://doi.org/10.3390/antibiotics11121817>

On the other hand, the microbiology unit also develops phenotypic and genotypic characterization projects of microorganisms isolated from production and companion animals, as well as from environmental samples and wild animals, in order to know the characteristics of these microorganisms associated with the dissemination of antibiotic resistance genes. Bacterial resistance worldwide has been the subject of many studies, mainly due to the role played by microorganisms in our environment and the ease with which they can acquire resistance; factors such as the inadequate use of antibiotics, the volumetric amount applied, cleaning methods, the use of agrochemicals, among others, are some variables that can induce bacterial resistance. The

realization of these studies will be unprecedented in the country, and their results will provide a diagnosis of the resistance profile of animal strains and environmental strains, which would contribute to the Public Health of the country in the concept of One Health. In this line of research we have recently published:

1. Núñez-Samudio, V.; Pimentel-Peralta, G.; De La Cruz, A.; Landires, I. Genetic Diversity and New Sequence Types of Escherichia coli Coharboring β -Lactamases and PMQR Genes Isolated from Domestic Dogs in Central Panama. *Genes* 2023, 14, 73. <https://doi.org/10.3390/genes14010073>).

General Objective:

- a. To determine bacterial typing and characterize the main mechanisms of antibiotic resistance through molecular epidemiology of the most prevalent bacterial species implicated in HCAI in hospitals in Panama.
- b. Phenotypic and genotypic characterization of microorganisms isolated from companion, production and wild animals and environmental samples.

Line of Action: The following is contemplated

1. Epidemiological surveys of punctual prevalence.
2. Determination of the susceptibility or resistance of strains isolated from companion animals, production animals, wild animals and environmental samples.
3. Molecular analysis of bacterial strains.
4. Characterization of antimicrobial resistance genes.
5. Typing of the most prevalent bacterial strains implicated in HCAI using molecular biology tools.
6. Determination of the clinical significance of resistant strains isolated from companion, production and wild animals and environmental samples.
7. Promotion and dissemination of results for consideration in the creation of public policies.

Responsible for the activity:

Dr. Virginia Núñez-Samudio head of the Microbiology and Public Health unit.

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1.3. **Environmental, global and planetary health.**

In this fourth axis we group the lines of research and interests that ICM has to contribute to the goal of a better world. All our research work that has to do with improving the quality of life of people in conjunction with the preservation and care of the environment fall into this fourth axis of action.

The Anthropocene has been proposed as the geological era characterized by human influence on the environment. Our impact as a human species on global and planetary environmental health is now recognized as a major environmental force. According to the World Health Organization, "environmental health relates to all the external physical, chemical and biological factors of a person. In other words, it encompasses environmental factors that can affect health and is based on the prevention of disease and the creation of environments conducive to health." Global Health is defined as a dynamic process of population health influenced by common determinants across geography, transcending state boundaries. Planetary Health interests us because we are certain that as humanity we must be alert to the threats to human health and the sustainability of our planet and civilization. Regarding the latter, researchers from the Las Tablas Instituto de Ciencias Médicas have recently published a communication for the prestigious journal The Lancet.: Landires I, Nuñez-Samudio V, Apraez-Ippolito G, Castro G. Planetary health: a new sociopolitical framework is urgently needed. Lancet. 2018;391(10126):1158. doi: [https://doi.org/10.1016/S0140-6736\(18\)30685-8](https://doi.org/10.1016/S0140-6736(18)30685-8)

General Objective:

- a. To develop studies that aim to raise the quality of life of people in equity, caring for the environment and working for the sustainability of our civilization and our planet.

Line of Action:

- 1) Public health.
- 2) Environmental health.
- 3) Global Health.
- 4) Planetary Health.

Responsible for the activity:

Dr. Virginia Núñez-Samudio, Microbiology and Public Health Unit.

Dr. Iván Landires, Genetics and Public Health Unit.

Dr. Rónel Solís, Social Sciences and Public Policy Unit.