Credit: Bruno Santos

Going home: the challenges and rewards of genetics research in Mexico

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"Can you triple-check that? Are you absolutely sure?"

I will never forget the excitement that day at the lab. After years of investigating the genetic basis of the aggressive skin cancer melanoma, it finally clicked: some people are at higher risk of the disease because they carry a single change in a gene that functions to protect telomeres[1]. The genetic variants that we found were soon added to gene panels testing for cancer predisposition, and patients wrote to us who were relieved to know the reason for their diagnosis. I was living a scientific fairy tale. The research community that I was part of back in 2015, fueled by multidisciplinary collaborations among brilliant clinicians, tenacious scientists and courageous patients, provided fertile ground for such life-changing discoveries to take place. Training at the Wellcome Sanger Institute in Cambridge, United Kingdom, meant that I benefited hugely from the environment of a city bustling with biotech start-ups and frequent science-related events. It was easy to concentrate on learning and advancing my own science.

However, soon after, I was approached with a tempting offer to set up my own research group. Rafael Palacios, a recognized leader in genomics in Mexico, was starting a new institute focused on human genomics, the International Laboratory for Human Genome Research (LIIGH), based at the National Autonomous University of Mexico (UNAM), at its Juriquilla campus, in the central city of Queretaro. Back in 2003, Palacios and other well-known Mexican scientists had started the Undergraduate Program in Genome Sciences (LCG) at UNAM, which has gained international recognition for its multidisciplinary training in genetics, molecular biology, computer science, mathematics and programming. Part of the operating model of the unique program at LCG-UNAM is to encourage students to continue their training at some of the best universities in the world and then bring their expertise back into the country. LIIGH-UNAM was the natural continuation of this project: formed in collaboration with the Cold Spring Harbor Laboratory in the United States, LIIGH opened its doors and welcomed back young Mexican scientists who had trained abroad and were willing to return home, as well as young foreign researchers who were interested in leading genetic studies in the country. LIIGH-UNAM would support any area of genetics research that a creative and talented scientist wanted to develop, as part of newly established research programs in population genetics, genome regulation, disease genetics and systems biology. This was a novel and attractive idea, not only for Mexico but also by international standards.

The decision to move back home was very appealing but still took substantial thought. Mexico is a beautiful, if complicated country: rich in customs and traditions, and home to considerable biological and genetic diversity, but held back by constantly changing government policies and sometimes inefficient systems of administration. Nevertheless, I felt that this position offered an unparalleled opportunity to investigate the genetics of an understudied population in a way that did not echo 'colonial science'—the historically common practice in which scientists from wealthy countries conduct research on patients or samples from developing countries without making an investment in capacity building or inviting input from local researchers[2,3]. I could contribute to my country's scientific efforts in collaboration with local scientists and research groups. The proximity to family and friends also played an important role, but overall, it was the feeling that any scientific contribution I made would be more impactful in an environment with less established infrastructure and research funding, and where scientific activity and role models are scarce. However, not all of my peers agreed—while some were very supportive of my decision, others told me I would "fade into mediocrity" or that all I could aspire to was to be a "big fish in a small pond." These dismissive reactions made me realize that I would also be fighting against a pervasive form of unconscious bias that considers science conducted in developing countries to be of lesser quality. Nonetheless, I moved back home at the end of 2015 and started work soon after.

Being a principal investigator is not something I prepared for during my scientific and technical training. The change in responsibilities upon taking this role came as a shock to me, and this was worsened by the large bureaucratic and administrative load that I was expected to cover. In Mexico, a large fraction of the management of organizations is still paper based. For researchers in developed countries, it might be hard to imagine this load: writing formal letters to higher-ups; tracking grant deposits and making sure they arrive where and when they are needed; having to write cumbersome and sometimes repetitive reports; and going through many performance evaluations, each requiring substantial preparation. (However, a silver lining of the COVID-19 pandemic is that it has prompted the implementation and upgrading of many university electronic systems that should hopefully ease the bureaucratic burden in due time.) Many of us are also expected to teach undergraduate and/or graduate courses. These activities all have an appreciable impact on our time available to think deeply about research, and they contribute to the science development gap that manifests in low- and middle-income countries.

After arriving, I soon realized that I needed to prepare my laboratory if I aimed to perform the kind of research that I was accustomed to during my years of training abroad. Basic equipment was already installed and working, but there was a need to set up more specialized infrastructure from scratch: finding space to perform specific studies such as histopathological analyses, purchasing essential equipment for the animal house and building up our

high-performance computing system. At the Wellcome Sanger Institute, analysis pipelines were already set up and running, and were maintained by a large and highly skilled team, but here we had to build up our own computational workflows from scratch. This job was brilliantly directed by a small highly collaborative team including scientists and technicians. Additionally, I discovered that reagents are generally more expensive in developing countries because of transportation costs and import tariffs, and the delivery wait times often stretch to months. Planning experiments carefully to optimize spending and maximize reagent utility became of utmost importance.

Establishing crucial local collaborations also took time. In my experience abroad, the medical and research communities often work together closely and harmoniously, are aligned in their goals, and exchange information and resources frequently. When I arrived in Mexico, I initially found establishing productive collaborations more difficult, sometimes because hospitals already had research units. Because these research units were the preferred recipients of any collected tissue, samples often were set aside for clinical studies rather than basic research. Sometimes, clinicians had a different set of research priorities and were wary of establishing partnerships because of their past experiences with colonial science. All in all, this means that there is still a large disconnect between the medical and basic research communities. Although it took the first 2 years of my appointment, I did succeed in making a number of fruitful collaborations. I am thankful to Rodrigo Roldán Marín, who immediately welcomed me into the Mexican medical research community. I am also grateful to Alfredo Hidalgo Miranda, who has shared his expertise and laboratory resources, and Patrícia Possik, Héctor Martínez Said, Dorian García Ortega and Alethia Álvarez Cano, with whom I have been working to decipher the genetic architecture of acral lentiginous melanoma, a type of skin cancer. I have learned that in Mexico, collaborations involve carefully thought-out projects and tend to be multidisciplinary, because we seek to maximize the utility of precious medical and biological data.

The scientific funding environment in Mexico is also complicated. Public spending on research and development falls below 1% of the national gross domestic product, a percentage much lower than that of developed countries such as the United States, the United Kingdom and Canada[4]. The main funding agency in the country is the National Council for Science and Technology (CONACyT), a governmental organization. Nevertheless, the number of grants approved and the funds assigned to each project are relatively small (approximately 15% of the submitted grants were funded in the last 'Frontier Science' call, with an average of less than US$ 40,000 per year allocated to each successful investigator within a team[5] (https://youtu.be/WlFMKpxYyyY). In contrast, as a trainee in the United Kingdom, I had access to what seemed like unlimited funds: at least in my experience, any experiment was within reach; my PhD thesis alone included the analysis of genomic data from nearly 200 individuals. However, without the science philanthropy and the charitable foundations that exist in other countries, finding local funds to perform science is comparatively difficult. This difficulty is exacerbated by a somewhat unstable political environment, with the government proposing reforms to evaluation systems, public trusts and funding policies, without clarity or inviting input from working scientists. Fortunately, we in developing countries are eligible for many international opportunities; I have been lucky to access funding not only from CONACyT but also from the Wellcome Trust, the Medical Research Council, the Newton Fund/Academy of Medical Sciences, the Melanoma Research Alliance, the Wellcome Sanger Institute and the William Guy Forbeck Research Foundation. This has enabled my research group and our science to develop. I will be forever thankful to these organizations for opening their doors to international applicants and trusting in our science: it really makes all the difference in the world.

The scientist training pipeline in Mexico has solid foundations, although it needs more support at more advanced levels. The entry requirements for training programs are stringent and rigorous, so students must be knowledgeable, dedicated and focused. Masters- and doctoral-level students in the public system are funded by CONACyT, as long as they are admitted into one of a number of designated research programs. However, governmental support for postdocs is much more limited and is usually awarded for only 1 year; renewal for a second year must be applied for and is not always granted. University fellowships exist, but there are not nearly enough to cover demand. Therefore, in my experience, funds from abroad need to be secured to be able to hire postdocs for the whole duration of a project.

In a country with only approximately 315 researchers per million people[6], promoting the development of science and technology, and inspiring future generations to pursue careers in STEM is crucial. There is a lot of work to do: national and international surveys show that even though Mexicans perform below average on international standardized science and math tests, they also support governmental spending on science, and students report high levels of science engagement (for example, expectations of a having a science-related occupation or being motivated to learn science)[7,8]. These contrasting observations may perhaps indicate the existence of a willingness to learn about science but unequal access to educational opportunities and/or qualified teachers. We now have an opportunity to change this situation by strengthening local research networks, engaging in mentoring and science communication opportunities, and promoting public and private investment in science. We need to show by example that young people do not have to leave the country to perform groundbreaking science, and that they have a home here, should they wish to stay.

But the most enriching asset in working in Mexico is the people I interact with—I am lucky to work with highly skilled and motivated scientists every day. My colleagues at LIIGH-UNAM have built an exciting, enriching, multidisciplinary community of biologists, computational scientists, statisticians and clinicians, connected by alliances and collaborations with researchers in the rest of the world. Several programs exist for mentoring young students and those from disadvantaged backgrounds, and I have found participating in these programs immensely gratifying.

I deeply admire the scientists who came before me and paved the way for me to work here. I have also been very lucky to have been welcomed into the international melanoma genetics research community, principally by Julia Newton Bishop, Mark Iles and Tim Bishop, who have meaningfully helped me advance my research in Mexico. I am also indebted to David Adams, my PhD supervisor, who continues to be a guide as I embark on this adventure, and Rafael Palacios, for welcoming me back home to such an exciting scientific environment. Opportunities are wide and open, and the future is bright. I am happy here, and as things stand, I would not go anywhere else. ❐

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Competing interests

The author declares no competing interests.