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Commentary

Exploring Latin America one cell at a time

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Single-cell and spatial transcriptomics are revolutionizing science. Latin America's unique genetic diversity, environment, and endemic infectious diseases offer exceptional opportunities to deploy these technologies for societal and scientific impact. We highlight regional challenges and opportunities, offering recommendations to boost capacity, foster collaboration, and promote research equity.

Single-cell sequencing technologies have emerged as powerful tools for exploring the molecular landscape of tissues.[1] These technologies are foundational to global initiatives such as the Human Cell Atlas (HCA),[2] an ambitious international endeavor to map every cell in the human body, as well as specialized atlases like the Malaria Cell Atlas[3] and Fly Cell Atlas.[4] Latin America (LATAM) boasts substantial human diversity and a complex and unique genetic admixture, a direct consequence

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of its colonial history marked by forced labor, genocide, and migration. The region is home to some of the largest populations of Afro-descendants outside of Africa, as well as over 800 distinct Indigenous groups, totaling more than 45 million individuals.[5,6] Critically, these populations often possess unique genetic and environmental characteristics, yet they remain understudied, including in flagship research projects like the HCA initiative. Secondly, LATAM has many neglected tropical and vector-borne diseases, such as Zika, that are frequently overlooked by research funded in the global north, where most advanced single-cell and spatial genomics hubs are concentrated. Furthermore, although each rare disease affects only a small number of people, the cumulative impact in the region is substantial. An estimated 40–50 million individuals in LATAM are affected by one of these conditions,[7] yet opportunities to inform treatment and public health through single-cell analyses are lacking.

Beyond human health, single-cell technologies have applications in agriculture and conservation, including management of food staples such as maize, beans, and cassava, and in studies of the resilience of key species in Amazonian, Andean, and Antarctic ecosystems. These technologies may also inform the bioengineering of microorganisms for bioremediation in polluted environments, such as oil-contaminated mangroves or regions impacted by mining.[8,9]

Inequitable access to single-cell technologies not only hinders scientific progress but also perpetuates a global imbalance in biological innovation, particularly in LATAM where enormous discovery opportunities remain untapped.

Identifying community needs

The global trend in single-cell genomics research has shown remarkable growth with approximately 2,600 articles published on the topic between 2001 and 2019, with one-third of them published in 2019 alone.[10] Between 2020 and 2022, article numbers tripled.[11] Leading contributors include the United States of America (USA), China, and European countries, while LATAM countries remain underrepresented, with Brazil being the only country in the region among the top 30, primarily through collaborations with northern research institutions.[11]

These disparities were acknowledged even before they were formally quantified through initiatives that recognized the need to address them. One such effort was the expansion of the HCA initiative into LATAM, which has been instrumental in fostering the adoption and understanding of single-cell technologies across the region. Through a combination of workshops, training programs, and lectures, HCA LATAM has not only expanded technical expertise in the region but also built a collaborative community of researchers dedicated to advancing single-cell research. Additionally, organizations such as the Chan Zuckerberg Initiative (CZI) have supported these efforts through programs like the Ancestry Networks for the HCA. This program, launched in 2021, invested $27.9 million in projects aimed at closing gaps in genomic data, particularly for ancestrally diverse populations, in addition to supporting the long-term engagement of the LATAM community in the HCA. Three initiatives are dedicated to studying populations in LATAM. LatinCells (https://www.latincells.org/) and JAGUAR (https://jaguar.liigh.unam.mx/) aim to map the diversity of immune cells across several LATAM populations using complementary approaches: LatinCells focuses on underrepresented communities that are often in remote and rural regions, while JAGUAR centers on admixed urban populations. A third initiative shares similar goals but focuses specifically on Indigenous

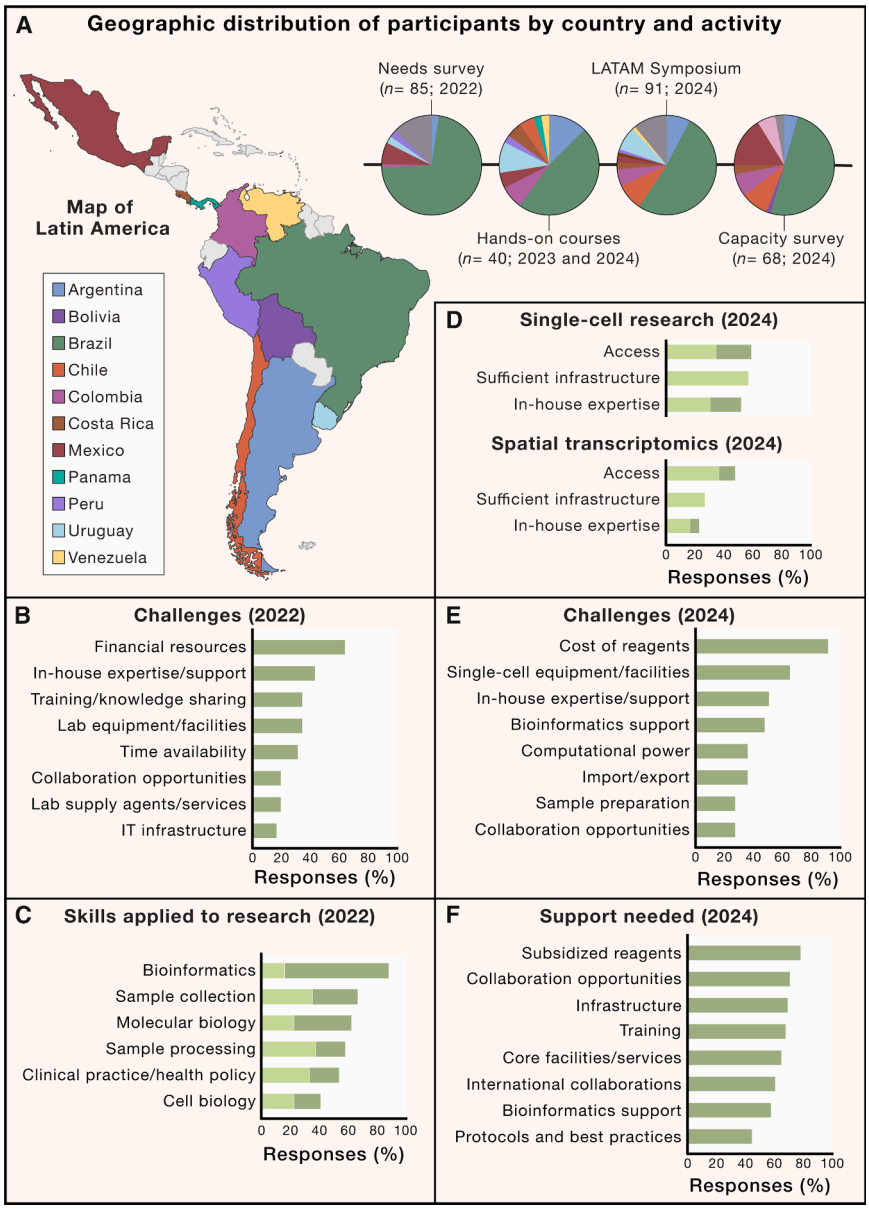

Figure 1. Mapping research capacity and needs in single-cell and spatial transcriptomics in Latin America.

(A) Map of Latin America, and pie charts highlighting countries represented by the initiatives described in the text. Gray areas on pie charts indicate participants from countries outside Latin America.

(B) Main challenges identified by the 85 cohorts of respondents in 2022.

(C) Most frequently cited skills that respondents apply in their research, based on the 2022 needs survey. Dark green indicates frequent use, light green, occasional use.

(D) Positive responses regarding access to the technologies, availability of sufficient infrastructure and in-house expertise, based on the 2024 capacity survey. Dark green indicates the fraction of those with access that do so through institutional core facilities (first bar) and of those with in-house expertise who have dedicated experts (third bar).

(E) Main challenges reported by 66 scientists and trainees across six Latin American countries, based on the 2024 capacity survey.

(F) Types of support that respondents believe would most benefit their work in single-cell or spatial transcriptomics, based on the 2024 survey.

populations in South America (http://luis-barreirolab.org/research/). These efforts aim to reveal how regional genetic diversity and environmental factors shape immune cell composition and function, immune responses, and disease susceptibility (https://chanzuckerberg.com/science/programs-resources/cell-science/ancestry-networks/).

To better understand the needs and map local capacity in support of advancing single-cell genomics research in the region, we launched a series of initiatives beginning with an online survey in 2022. Our primary goal was to engage scientists across Latin America and the Caribbean. However, despite our efforts, we were unable to reach participants from the Caribbean, and as a result, this region is not represented in the data presented here. This absence underscores a significant gap that warrants dedicated attention in future efforts.

The 2022 needs survey, disseminated through social media, email, and word of mouth, reached 85 scientists interested in single-cell genomics across six LATAM countries, predominantly from Brazil (Figure 1A, first pie chart). It revealed widespread interest in single-cell genomics applied to 15 biological fields, including oncology, immunology, population genetics, and neurosciences. Developmental biology, host-pathogens interactions, and plant sciences were also represented, aligning with global trends in single-cell genomics literature.[11]

The most pressing challenge faced by LATAM researchers at the time of the needs survey was the lack of funding, with approximately 65% of respondents highlighting this as their main barrier to progress, followed by limited in-house expertise and support, as well as insufficient learning opportunities (Figure 1B). To carry out single-cell analyses, many researchers reported sending samples or data to external laboratories or outsourcing to commercial service providers. Only about 6% of respondents indicated that they were able to perform the entire process locally.

These obstacles have resulted in a focus on data analysis rather than data generation, as accessing publicly available data was often seen as more feasible given resource limitations. Consistent with this, most respondents (89%) identified bioinformatics analysis as a key skill required for their research, although wet-lab techniques related to sample processing and preparation were also commonly mentioned (Figure 1C). Analysis of

existing datasets is often referred to as "low-cost" or "no-cost" science and allows researchers to contribute to the field and integrate into international collaborative networks[11] while focusing on enhancing training. But since data are not generated in-house, the approaches employed may not always align with a research team's specific interest, may restrict the scope of the scientific questions that can be explored, and rarely use the carefully collected materials held by local research teams that would be most impactful to their community.

Driven by strong interest and capacity gaps, several single-cell genomics training initiatives have emerged in the last five years, including programs supported by CZI, HCA LATAM, Royal Society (RS), Wellcome Connecting Science (WCS), and the Brazilian National Cancer Institute (INCA). Of note, in 2023 and 2024, two week-long hands-on courses covering both wet-lab and bioinformatics practices, organized by WCS in collaboration with INCA, brought together 40 participants from 10 LATAM countries (Figure 1A, second pie chart). In addition to creating a strong, long-lasting network, more than 90% of the participants reported increased confidence in planning and conducting single-cell experiments, as well as direct benefits to their research and careers, thus illustrating that well-positioned training interventions can be transformative.

The current landscape

Following up on the success of these initiatives, the 2024 "Single Cell LATAM Symposium: Connecting Communities and Advancing Research" in Rio de Janeiro, Brazil, served as a crucial gathering for the burgeoning community of researchers focused on single-cell research in LATAM (Figure 1A, third pie chart). In addition to the scientific component of the event, discussions focused on regional challenges and strategies to overcome them, including strategies to foster collaboration and recommendations to improve access and capacity in the region. Insights from this event informed the development of a second online survey (in 2024) to systematically assess the current landscape, capacity, and infrastructure for single-cell and spatial transcriptomics research in the region.

Sixty-eight scientists from across LATAM answered the capacity survey, half of them from Brazil (Figure 1A, fourth pie chart). In this survey, the data showed that human diseases remain a major topic of interest among scientists interested in using single-cell genomics. Research on cancer and the tumor microenvironment was a major field mentioned by researchers. Examples include studies on the influence of ethnicity and ancestry on immune responses, although many researchers reported working on other non-communicable diseases, such as obesity, which disproportionately affect populations in the region. The strong emphasis on non-communicable diseases likely reflects the growing health burden in LATAM where cancer and cardiovascular diseases are the leading causes of death, accounting for over 77% of mortality in Latin American and Caribbean countries.[12] Infectious diseases also featured prominently, especially those endemic to LATAM, such as Zika virus and dengue. Beyond human health, a smaller number of researchers were focused on topics such as microbial adaptation to extreme environments and the emergence of multi-drug-resistant microorganisms.

In 2024, 61% of the respondents declared they had access to single-cell sequencing and 48% to spatial transcriptomics. However, access through institutional core facilities remains limited: only two-fifths of those with access to single-cell technologies, and one-fifth of those with access to spatial technologies, do so through institutional core facilities (Figure 1D). Importantly, access was found to be strongly concentrated in Brazil, Chile, and Mexico. In Brazil, infrastructure is highly concentrated in the southern states, particularly in São Paulo and, to a lesser extent, in Rio de Janeiro, where collectively most of the country's research institutions and funding are located. This uneven distribution of resources mirrors broader regional disparities in research infrastructure across LATAM, limiting access for researchers in other parts of the country and the continent. Expanding access to single-cell technologies beyond major research hubs is crucial for fostering a more inclusive and equitable scientific community. Finally, skill in bioinformatics appears to be independent of having access to genomics infrastructure, with 53% and 24% of respondents reporting some kind of in-house expertise in single-cell and spatial transcriptomics data analyses (Figure 1D).

Challenges and barriers

When asked about the main barrier to performing single-cell genomics studies, 66% of the survey respondents agreed that the limited access to equipment and infrastructure was a main contributor. But most notably, 93% of them considered the high costs of reagents and consumables as prohibitive (Figure 1E), and subsidizing reagents and consumables was highlighted as an initiative that would be most beneficial (Figure 1F). Given these limitations, collaboration continues to play a pivotal role in enabling LATAM scientists to conduct single-cell genomics research, with 66% of them actively trying to enhance their capabilities through collaborative projects (Figure 1F). These collaborations primarily involve institutions in Brazil and the USA, who provide access to technologies, data analyses, and support for reagent acquisition and sequencing. They also serve as a mechanism to secure funding. However, differing rules and ethical standards across institutions and countries were reported as a significant barrier. Researchers noted that designing and obtaining approval for a study that aligns with the ethical guidelines of all participating institutions is both time-consuming and challenging. This often leads to substantial delays or, in some cases, even prevents collaboration. Some researchers expressed concerns about the extractive and transactional nature of some collaborations, including instances of "helicopter research," where researchers from high-income countries collect samples or data in LATAM, conduct analyses in their own institutions, and publish findings while limiting the involvement or recognition of local researchers.[13] Notably, retention of biological samples for unrelated projects, which do not always respect ethical regulations and institutional material transfer agreements, was also highlighted as a concern.

It was widely agreed by LATAM researchers that it is difficult to compete

for grants against investigators with immediate access to state-of-the-art genomics facilities, optimized protocols, and dedicated bioinformatics pipelines. In addition, a significant proportion of LATAM researchers who responded to the survey believe that the capacity of the single-cell and spatial genomics platforms available to perform their experiments is insufficient, highlighting their reliance on external facilities (Figure 1D). Poor or inadequate internet capacity, which is problematic when attempting to upload or download big datasets, and limited computer storage space further exacerbates the infrastructure challenges (Figure 1E). This systemic disadvantage not only stifles creativity but also directly affects investigators' publication track record, as the time-intensive nature of overcoming these barriers delays project completion and publications, limiting competitiveness in the global grant arena.

In addition to limited access to sufficient infrastructure and funding, scientists in LATAM face other barriers related to research costs. The prices of reagents and consumables imposed by distributors are sometimes doubled. In many cases, the cost of reagents required to generate single-cell RNA libraries (excluding sequencing expenses) can be equivalent to a lab's annual budget, while sequencing costs are also high due to taxes, meaning it is often cheaper to outsource to facilities or companies outside LATAM. This practice reduces the local return on investment and the development of in-house expertise and research capacity. Additionally, it often incurs additional challenges such as customs fees and time delays that can significantly increase overall project expenses. These challenges are even more pronounced in remote regions, where limited connectivity and inadequate conditions for sample collection and storage further amplify them. Other issues faced by LATAM researchers include inadequate public awareness of the importance of this type of research, which results in low levels of engagement and support, and isolation, particularly when they are the sole specialists in their institution or country, with this cycle of logistical challenges resulting in frustration and contributing to the well-known brain drain from the region. Finally, political instability and science policy reversals pose significant threats to research continuity. Funding cuts have severely impacted research budgets in the last few years.[14] Threats to academic freedom and scientific autonomy, as well as the impact of nationalistic policies on international collaborations, further exacerbate these challenges.

Given the interwoven nature of the barriers and challenges, it is not surprising that the top support needs highlighted by local scientists are subsidies of reagents and consumables, collaboration opportunities (both local and international), access to advanced equipment and technologies, and access to specialized training (Figure 1F). Despite these obstacles, researchers are eager to enhance their capabilities, particularly in data analyses, sample diversification, and increased throughput.

Recommendations to increase the potential for impact

Despite recent single-cell genomics-focused events supported by WCS, CZI, RS, and HCA LATAM, limited access to training remains an important concern for local researchers, as is retaining expertise in the region. Given the nascent nature of this research field, we believe that the most promising pathways to impact are 3-fold (Figure 2).

Equity-focused funding

Subsidizing the costs of equipment, reagents, and consumables for LATAM-based researchers is critically important. Additionally, funding can also support cross-border collaborations, which have been shown to enhance access to equipment, computational capabilities, and training. Moreover, given that global north countries already benefit from established infrastructure and expertise, and that funding for single-cell and spatial transcriptomics research is highly competitive in this region, there is a clear need for dedicated funding mechanisms specifically aimed at LATAM-based researchers. These funding initiatives should rethink traditional notions of merit, focus on the potential for impact, and incorporate this focus into their call guidelines, award processes, and selection criteria.

Of note, equity-focused funding and support should also consider where in LATAM there is the most need. Given that southern Brazil is more advanced when it comes to research, attention should be given to other, less advanced regions and countries. Special support is needed for centers in remote and poorly connected areas and for historically marginalized ethnic groups. Additional criteria could include considerations such as the percentage of a country's GDP (gross domestic product: the total value of all goods and services a country produces in a specific period) allocated to science, as this can serve as a proxy for the maximum funding typically obtainable through local grants. Such an approach would help ensure that support is directed to countries where research funding is disproportionately low relative to both national economic capacity and scientific potential.

Community-based infrastructure

Funding should focus on building, retaining, and leveraging regional capacity. One strategy would be to invest in the development of nation-wide and continental facilities and biobanks that operate at scale and have a viable business model. By fostering coordinated infrastructure, shared protocols, and standardized governance, alliances among LATAM biobanks and facilities can enable resource sharing, reduce duplication of efforts, and negotiate better prices for reagents, consumables, and services through collective procurement. Biobank networks can also support decentralized sample collection while centralizing processing and storage in well-equipped hubs, making advanced analyses like single-cell transcriptomics more accessible to researchers in remote or under-resourced areas. This would increase access to needed equipment, offer affordable services, and reduce the risks of shipping materials abroad, better supporting research innovation and discovery in LATAM. It is important, however, that such standardization of facilities and biobanks does not restrict scientific creativity or limit the diversity of research questions that scientists can explore. Collectively, infrastructure platforms would ensure the region's researchers feel a sense of ownership and belonging in the global scientific landscape. This approach would allow regional scientists to focus on bold, high-impact questions without the prohibitive startup costs and logistical

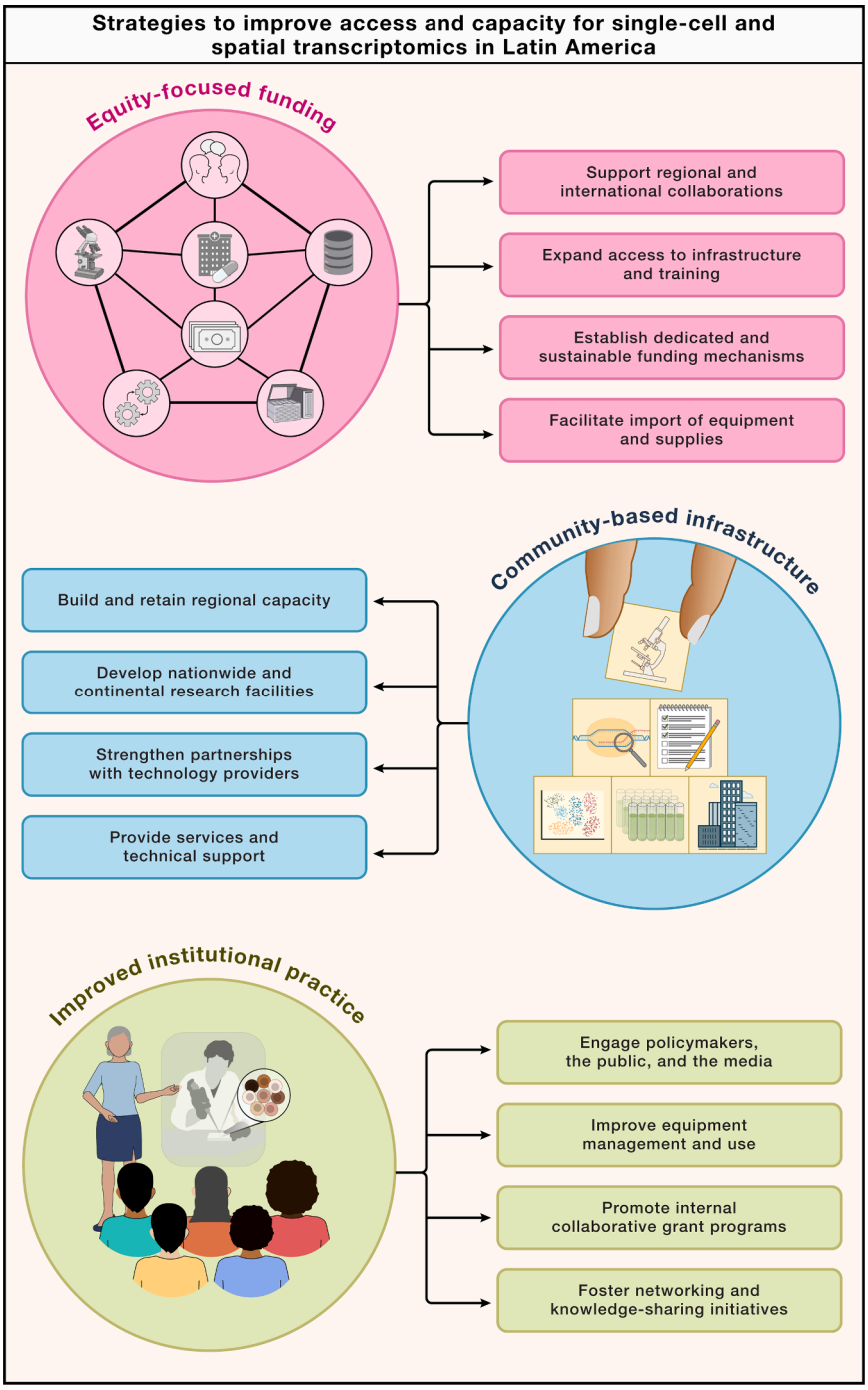

Figure 2. Recommendations to increase the potential for impact in Latin America.
This figure presents three key pathways to maximize impact, based on the early-stage development of the field in the region. These recommendations reflect recurring themes and priorities identified through surveys, interviews, and the initiatives discussed in the text.

hurdles. Examples of similar initiatives include the Latin American Bioimaging Hub (https://labi.lat/about-us/).

These facilities or hubs could also continue building capacity in the region by training LATAM researchers and sharing expertise that would expedite and optimize project development. Specialized training programs focused on single-cell and spatial transcriptomics data generation and analysis should include ethics guidelines and best practices, emphasizing the use of FAIR (findable, accessible, interoperable and reusable) principles.

Improved institutional practice

Improvements at the institutional level could also be pursued. For example, the promotion of internal collaborative grants can ensure that more researchers have access and the means to use single-cell facilities, reducing downtimes and operating costs. Institutions could also work toward streamlining inter-institutional collaborations and agreements, which would significantly advance scientific development in the region.

Additionally, institutions should also play a role in raising awareness and fostering understanding of the significance of single-cell and spatial transcriptomics research among policymakers and the public by nucleating key decision makers across the sector.

Conclusions

Single-cell and spatial transcriptomics present transformative opportunities for LATAM, offering insights into the region's unique genetic diversity, environmental adaptations, and pressing health challenges. However, despite growing interest among researchers, significant barriers, including limited funding, high costs, and uneven access to infrastructure, hinder the widespread adoption of these technologies. The concentration of resources in a few countries or within one country's wealthiest regions, coupled with logistical and political challenges, further exacerbates disparities, leaving much of LATAM's scientific potential untapped. However, equity-focused funding, an emphasis on building and maintaining community-based infrastructure, and working on improving institutional practice hold the keys for unleashing the impact of these technologies across LATAM. Although our data did not include respondents from Caribbean countries, we believe that similar challenges requiring similar recommendations, possibly with region-specific adaptations, could be beneficial there as well. However, meaningful impact in the Caribbean will require direct engagement with local scientists in future discussions.

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DECLARATION OF INTERESTS

The authors declare no competing interests.

REFERENCES

1. Vandereyken, K., Sifrim, A., Thienpont, B., and Voet, T. (2023). Methods and applications for single-cell and spatial multi-omics. Nat. Rev. Genet. *24*, 494–515. https://doi.org/10.1038/s41576-023-00580-2.
2. Rozenblatt-Rosen, O., Stubbington, M.J.T., Regev, A., and Teichmann, S.A. (2017). The Human Cell Atlas: from vision to reality. Nature *550*, 451–453. https://doi.org/10.1038/550451a.
3. Howick, V.M., Russell, A.J.C., Andrews, T., Heaton, H., Reid, A.J., Natarajan, K., Butungi, H., Metcalf, T., Verzier, L.H., Rayner, J.C., et al. (2019). The Malaria Cell Atlas: Single parasite transcriptomes across the complete *Plasmodium* life cycle. Science *365*, eaaw2619. https://doi.org/10.1126/science.aaw2619.
4. Li, H., Janssens, J., De Waegeneer, M., Kolluru, S.S., Davie, K., Gardeux, V., Saelens, W., David, F.P.A., Brbić, M., Spanier, K., et al. (2022). Fly Cell Atlas: A single-nucleus transcriptomic atlas of the adult fruit fly. Science *375*, eabk2432. https://doi.org/10.1126/science.abk2432.
5. Freire, G.D. Diaz-Bonilla, C. Schwartz Orellana, S. Soler Lopez, J. Carbonari, F. (2018). Afro-descendants in Latin America: Toward a Framework of Inclusion. World Bank http://hdl.handle.net/10986/30201.
6. World Bank Group (2015). Indigenous Latin America in the Twenty-First Century: The First Decade. http://hdl.handle.net/10986/23751.
7. Dias, A.G., Daher, A., Barrera Ortiz, L., Carreño-Moreno, S., Hafez H, S.R., Jansen, A. M., Rico-Restrepo, M., and Chaparro-Diaz, L. (2023). Rarecare: A policy perspective on the burden of rare diseases on caregivers in Latin America. Front. Public Health *11*, 1127713. https://doi.org/10.3389/fpubh.2023.1127713.
8. Lan, F., Saba, J., Ross, T.D., Zhou, Z., Krauska, K., Anantharaman, K., Landick, R., and Venturelli, O.S. (2024). Massively parallel single-cell sequencing of diverse microbial populations. Nat. Methods *21*, 228–235. https://doi.org/10.1038/s41592-023-02157-7.
9. Tripathi, R.K., and Wilkins, O. (2021). Single cell gene regulatory networks in plants: Opportunities for enhancing climate change stress resilience. Plant Cell Environ. *44*, 2006–2017. https://doi.org/10.1111/pce.14012.
10. Wang, Q., Yang, K.-L., Zhang, Z., Wang, Z., Li, C., Li, L., Tian, J.-H., Ye, Y.-J., Wang, S., and Jiang, K.-W. (2021). Characterization of Global Research Trends and Prospects on Single-Cell Sequencing Technology: Bibliometric Analysis. J. Med. Internet Res. *23*, e25789. https://doi.org/10.2196/25789.
11. Chen, L., Wan, Y., Yang, T., Zhang, Q., Zeng, Y., Zheng, S., Ling, Z., Xiao, Y., Wan, Q., Liu, R., et al. (2023). Bibliometric and visual analysis of single-cell sequencing from 2010 to 2022. Front. Genet. *14*, 1285599. https://doi.org/10.3389/fgene.2023.1285599.
12. OECD/The World Bank (2023). Health at a Glance: Latin America and the Caribbean 2023 (OECD Publishing) https://doi.org/10.1787/532b0e2d-en.
13. Adame, F. (2021). Meaningful collaborations can end 'helicopter research' (Nature) https://doi.org/10.1038/d41586-021-01795-1.
14. Lazcano, A. (2025). When state support for science fails. Science *388*, 233. https://doi.org/10.1126/science.adx9924.