https://doi.org/10.1038/s41592-025-02690-7

Challenges of microscopy technology dissemination to resource-constrained communities

Jesse S. Aaron, Caron A. Jacobs, Leonel Malacrida, Antje Keppler, Paul French, Daniel A. Fletcher, Christopher Wood, Claire M. Brown, Graham D. Wright, Satoshi Ogawa, Mahmoud Maina & Teng-Leong Chew

Discussions at a recent conference on microscopy technology dissemination spotlighted the importance of setting technology adoption capable of producing scientific outcome as the end goal. This Comment examines current global efforts in microscopy dissemination and summarizes the challenges and paths forward.

There is palpable momentum in the global effort to disseminate microscopy technologies and expertise, especially to underserved scientific communities. This impetus is propelled by the confluence of several factors. These include (i) the rapid development of low-cost, open-source microscopes enabled by 3D printing technologies, advances in consumer electronics and increasing availability of affordable high-performance optical components, (ii) powerful open-source software, including machine learning approaches to enhance microscope performance, and (iii) increasing appreciation that technology distribution and access cannot continue to sideline research in under-resourced communities, where frontline battles against disease and global impacts of climate change are waged.

With the attention of international funders pivoting toward open-access microscopy research infrastructure and local expertise enhancement[1], microscopy dissemination is a prominent topic in the global scientific dialog. Although 'technology sharing plans' are now commonly mandatory for technology development grant applications, sharing is not synonymous with dissemination. Technology development is only as successful as its ability to address unmet needs. Developers do not need further incentives to make their technology publicly available. A more important question is whether mere technology sharing will translate into successful uptake and implementation. In fact, asking for a sharing plan is likely to invite perfunctory promises of technology sharing with little realistic chance of broad adoption. A technology can only reach target adopters by recognizing and overcoming the numerous barriers to ultimate uptake[2]. This requires considerable investment, coordination and effort to bring to fruition, as noted previously[1,2].

Research technology uptake in resource-limited environments must be deliberately fostered by a multipronged strategy. This includes stimulating demand through creating awareness, building accessibility, developing local multidisciplinary technical expertise, incentivizing continued utilization of technology for scientific output, addressing local scientific and medical needs, motivating governments of low- and middle-income countries to lower regulatory, visa and tax barriers, and encouraging capability sharing and investment of local resources to develop capabilities. Because of the interdependency of each aforementioned element, failure to implement any one effectively can limit the ultimate impact of a technology. There have been numerous programs aimed at disseminating imaging technologies to resource-constrained regions. While necessary, dissemination alone is insufficient to cement broad uptake of microscopy by resource-challenged scientists.

In May 2024, global imaging leaders held a conference entitled "Microscopy Technology Dissemination to Underserved Communities" at Howard Hughes Medical Institute's Janelia Research Campus. During this meeting, the problems hindering effective adoption of microscopy were examined from the perspectives of tool developers, imaging communities, publishers and funders. This Comment captures the conclusions from these discussions and outlines the necessary steps to bridge technology dissemination and scientific output.

Microscopy dissemination

Imaging scientists and funders across the globe have built unprecedented momentum in microscopy technology dissemination over the past decade. These efforts form the necessary multipronged strategy for successful technology dissemination (Fig. 1). Key among these are the formation of open-access platforms that offer access to imaging technologies, expertise and other necessary infrastructure where none may otherwise exist; regional and global imaging networks that provide easy inter-institutional access where technology is already available; and imaging user communities that can act as a galvanizing force to advance microscopy-related issues among various stakeholders. In fact, the continued formation of regional and global imaging communities shows no sign of deceleration (Table 1). Microscopy workshops and train-the-trainer programs are being offered at such a rate that it is impossible to keep pace. Capacity-building and open-access platforms (Table 1) continue to be created to provide national and continental accessibility to microscopy tools.

While vital, open-access platforms remain largely inaccessible to scientists in under-resourced regions. This gap, however, can be filled by exchange programs to build researchers' expertise, creative instrument distribution efforts[3], open-access programs, and frugal microscopes that can be easily disseminated or locally manufactured[4–8]. These solutions are further propelled by many open-source machine learning tools[9–11] designed to enhance the performance of optical

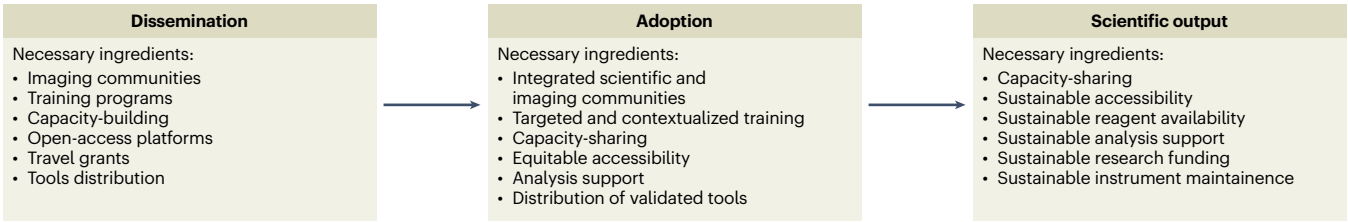

Fig. 1 | Technology uptake is a stepwise process that includes dissemination and adoption, leading to scientific output. While the underlying principles in the dissemination phase are similar to that in the adoption phase, there are key differences in the approach that are necessary to transition the disseminative groundwork to successful technology adoption. These changes in approach must also be sufficiently sustained to support scientific output.

Table 1 | Examples of various global microscopy dissemination efforts

Microscopy platform example	**Regional representation**	**Website**
France BioImaging	National platform	http://france-bioimaging.org
Microscopy Australia	National platform	http://micro.org.au
SingaScope	National platform	http://singascope.sg
ABiS	National platform	https://www.nibb.ac.jp/abis
Euro-Bioimaging	Continental platform	http://www.eurobioimaging.eu
Africa Microscopy Initiative	Continental platform	http://www.microscopy.africa
Microscopy community example	**Regional representation**	**Website**
Canada BioImaging	National network	https://www.canadabioimaging.org
South Africa BioImaging	National network	http://www.sabioimaging.org
Wambian	Regional network	http://www.wambian.org
African BioImaging Consortium	Continental network	http://www.africanbioimaging.org
Imaging Southeast Asia	Regional network	http://www.imagingsea.org
Latin American BioImaging	Continental network	http://labi.lat
BioImaging North America	Continental network	http://www.bioimagingnorthamerica.org
Global BioImaging	Global network of networks	http://globalbioimaging.org
Opportunity example	**Support type**	**Website**
Imaging Africa	Continental workshops	http://www.imagingafrica.org
SWIFT Awards	Continental microscopy access	http://www.africanbioimaging.org/swift
AMI Imaging Centre	Continental microscopy access	http://www.center.microscopy.africa
AMI PEER program	Continental microscope distribution	http://www.equipment.microscopy.africa
openScopes	Global dissemination of capability	http://www.openScopes.com
Imaging4All	Global microscopy access	http://globalbioimaging.org/i4a

instruments, even under suboptimal conditions. But perhaps the most consequential effort is the formation of imaging networks, many of them self-tasked with the explicit mission of technology dissemination. These organizations (Table 1) have pioneered key initiatives toward developing imaging capacity, training programs, image analysis support and community-building. They have further connected biologists with regional and global imaging centers through travel grants.

Despite these investments, many efforts have struggled to produce wider microscopy adoption in under-resourced scientific communities. Researchers in these communities are still experiencing barriers that slow microscopy-driven discoveries. There will always be a considerable time lag between technology adoption and scientific output, even under the best circumstances[12]. Indeed, most promising technologies need to go through a period of 'teething pain' where appropriate pairing with biological applications, protocol development and data handling pipelines must occur[2]. However, these hurdles do not account for the apparent lack of microscopy technology uptake. In other words, we have not been able to successfully cross the finish line of technology adoption yet (Fig. 1). This prompts the question of whether there has been a miscalculated step.

As we have previously discussed, the adoption barriers arrayed against microscopy are numerous and enormous[2,3]. In addition, the nature of these barriers varies widely across regions owing to uneven local governmental research support. Consequently, recent efforts to overcome these myriad barriers have likewise varied in their emphasis on the ultimate goal: technology adoption to facilitate scientific

output. The overt focus on dissemination first has meant that "adoption" and "scientific output" have hardly made it into the lexicon of strategic dialogs yet. In fact, the terms "adoption" and "scientific output" have not been clearly defined in the context of microscopy uptake. Here, we define adoption as the recognition of microscopy by biologists as an indispensable research tool, whereby imaging-centric approaches are well incorporated into their research and well leveraged to address key questions. By contrast, microscopy-driven scientific output in resource-constrained settings must be defined more broadly than conventional bibliometric measurement. It should include rigorous, peer-reviewed scientific discoveries enabled by microscopy; deployable, quantitative evaluations such as point-of-care diagnosis or rapid field sample assessment for agricultural, ecological and environmental work; and local adaptation and development of imaging capabilities to address local priorities. While also important, here we have excluded the adoption of microscopy for educational purposes and focus solely on research and field work applications. These definitions and boundaries allow us to focus on the root causes of — and solutions to — the lagging adoption of imaging techniques to enable scientific output.

Microscopy adoption

Role of microscopy trainers in contextualizing teaching. The complexity of modern biological studies — which rely on a cadre of rapidly evolving technologies in molecular biology, biochemistry, genomics, flow cytometry, mass spectroscopy, proteomics and others — requires most life scientists to be versatile jacks-of-all-trades. This, however, can limit their capacity to gain intimate familiarity with the full technical details and operational principles of modern, complex microscopes. Likewise, the explosive growth of analytical software, including machine learning, in microscopy has further brought many life scientists to even less familiar territories. In recognition of this, in-person, virtual, and even self-driven training programs for imaging and analysis, as well as resources steering researchers to such platforms, have proliferated. Despite increased accessibility to training, the rate of technology adoption by resource-constrained scientists remains disproportionately low.

It is often underappreciated that the appeal of microscopy lies in its effectiveness in solving experimental challenges. Yet few training courses have endeavored to directly relate microscopy techniques to experimental questions, opting instead to focus predominantly on theoretical instruction[13]. A training course that is not tailored to a target audience serves more to alienate attendees than to inspire them[13,14]. To effectively reveal the power of microscopy, training programs should always spotlight science over technology. Therefore, curricula must emphasize how biologically informative results can be attained through rational, quantitative microscopy-based experimental design[15], rather than obtuse optical physics-based lectures with little biological context, which can overwhelm learners. Contextualization of curricula to underserved communities further demands that the tools being introduced are topic-specific, locally relevant and taught by local scientists wherever possible, as exemplified by the Imaging Africa satellite workshops[3], as well as those conducted at the BioRTC[16].

Role of imaging communities in creating integrated scientific networks. Various imaging communities have fostered strong alliances to promote seamless exchange of experience, expertise, tools, best practices and training curricula. Such cooperation occurs at the national, regional, continental and global levels. The important next step is to routinely include in this dialog other scientific communities that could catalyze microscopy use. Efforts by Latin America Bioimaging (LABI)[17] to engage with regional structural biology community (Centro de Biología Estructural del Mercosur, CEBEM) and medical imaging community (Symposium on Medical Information Processing and Analysis, SIPAIM) demonstrate an important early success. Especially important are those that represent research fields with key microscopy users, including cell and developmental biology, infectious disease, cancer biology, histopathology and neuroscience. One way to bolster awareness of microscopy would be to feature prominent scientists who use microscopy at key scientific meetings. Additionally, there are also major international biomedical research networks, such as the Institut Pasteur and Fondation Mérieux, that should be key allies for translating microscopy adoption to scientific output. Forming scientifically integrated networks will constitute a virtuous cycle, promoting microscopy uptake and expediting scientific output.

Role of tool developers in validating their inventions. Microscopy centers with state-of-the-art instruments and technical expertise must serve as the centerpieces to anchor such integrated, collaborative partnerships[1]. In fact, it is especially crucial that such shared infrastructure is available in resource-limited regions[18]. However, such flagship platforms must be complemented by a more distributed approach. The cadre of do-it-yourself, frugal microscopes can fill this gap to push uptake throughout these communities.

One advantage of frugal microscopes is their customizability for local needs. Their low cost further lowers the entry barrier. Unfortunately, frugality has often supplanted performance as the driving design priority. This misplaced priority can create fertile ground for technologies that overpromise and underdeliver, especially when teaching microscopes are touted as research instruments[19]. Ill-advised adoption of these inappropriately promoted instruments can hamper scientific output for several reasons. First, scientists who are already resource-constrained may have only one opportunity to acquire a single microscope. A microscope that fails to support rigorous and quantitative science not only squanders limited resources, but it also handicaps the very scientist who most needs it and who can least weather scientific setbacks. Second, such underdelivery further fuels the incorrect belief that microscopy is not a worthwhile technique and/or is a high-end tool reserved for affluent regions. However, the most devastating outcome of relying on underperforming microscopes is when the resulting flaws in data quality fail to withstand peer review. This can further perpetuate the already pervasive and biased perception in the Global North that resource-constrained communities can only produce subpar science.

On the contrary, developers of most advanced microscopes not only delineate what their instruments are best suited to address, they are also careful to document their limitations. This unwavering sense of accountability should be equally emphasized when developing low-cost microscopes to foster the necessary trust. However, thorough validation involves more than just technical characterization. The instrument must be vetted for the applications and the environments in which it will be deployed. The Squid[20], Octopi[5], LoaScope[21,22] and openFrame[23] systems provide exemplar case studies in this regard. These efforts did not merely provide inexpensive microscope designs but are coupled with targeted and persistent campaigns to pair their unique capabilities with local scientific needs. These initiatives also not only served to validate their instruments[24], but also helped shape the environment and well-matched applications that sustain their long-term adoption.

It is common to see distinct differences in the priority and urgency placed on various public health needs between the Global North and South. Parasitic infections and other neglected diseases, for example, have benefitted immensely from well-validated and easily disseminable systems such as the Octopi[5] and LoaScope[21,22]. Likewise, addressing the increasing threats of climate change to food security is an unmet need that can similarly benefit from advances in frugal microscopy[25]. However, many researchers with limited resources view open-source tools as too technically demanding to adopt, preferring to rely on commercially supported systems. This is indeed an untapped market for manufacturers, such as Thorlabs, who have successfully lowered their manufacturing costs for research-grade microscopes. Likewise, open-source microscopes that have transitioned to commercial production, such as openScope and Cephla, have witnessed further increases in adoption. However, dissemination and commercialization, while necessary, are tedious and time-consuming. They require strategic acumen and stamina that most tool developers may not have the luxury to commit. Without the explicit vision and support of initial stakeholders who fund such technology development, newly developed tools can languish rather than empower their target users. Such outcomes are ultimately self-defeating for developers, funders and researchers alike.

Role of funders in incentivizing sustained microscopy use. It is encouraging that many funders are increasingly aware and supportive of open-source tools that can be easily deployed. But the effectiveness of a technology is ultimately measured by its uptake. Funders who also support a comprehensive strategy for validating, disseminating and adopting new technologies in their portfolios will maximize their return on investment. To expect a resource-constrained scientist to blindly accept the transformative power of microscopy severely underestimates the risk and investment inherent in such an undertaking. This barrier calls for careful de-risking, which must include well-validated and curated instruments, committed image analysis support, availability of tailored imaging-related reagents, and trained technical personnel[2]. Together, these factors should exist within a multidisciplinary culture where local physicists and engineers work with biologists to develop and apply local capabilities. Devoid of such a multidisciplinary ecosystem, a nascent technology is left to fend for itself. This 'attrition' approach will prematurely cripple enabling technologies.

Leveraging frugal microscopy is only part of a broader strategy for increasing utilization of imaging technologies. Access to more advanced microscopy techniques must complement these efforts to fully empower researchers. However, advanced instrumentation can be cost-prohibitive and service contracts are typically unaffordable, if they are even available, in most resource-limited settings. Early recognition of the value of capacity sharing was demonstrated with the formation of various open-access platforms, such as the Advanced Imaging Center at Janelia[26,27], Euro-BioImaging[28] and the European Molecular Biology Laboratory Imaging Centre[29]. This strategy has started to gain footing in more resource-constrained environments with the advent of platforms in the Global South, such as the Africa Microscopy Initiative (AMI)[3] and the Advanced Bioimaging Unit (UBA) in Latin America[30], among others. While these platforms are predominantly supported by international funders, national and local governments must recognize the need to fund regional core facilities to provide a continuum of access to imaging technologies for researchers at every level[18]. A stellar example of this is BioRTC[31] — supported by the Yobe state government in Nigeria — which is now a key training and access hub in West Africa. This local access to robust, research-grade imaging technology is essential to allow scientists to explore imaging in their own settings and to develop their work to leverage other advanced instruments available in continental hubs.

Discussion

The impact of global microscopy technology dissemination will be indelible. Together, these efforts have created a solid, long-term foundation for training, accessibility, infrastructure and networking that will empower underserved scientific communities. In fact, the community has evolved from individual initiatives to a global movement, reaching a point of maturation. The focal point of this paper is therefore not whether these platforms should be built, but rather how to ensure biologists take advantage of them. The global microscopy community has united in recognition of the need to set our sights on crossing the finish line of technology uptake, ensuring that microscopy technologies will be widely adopted to generate scientific output.

Travel restrictions, prohibitive importation taxes, difficulty in sample shipment, and faltering scientific funding support collectively constitute headwinds hampering technology uptake. However, it remains important, albeit dispiriting at times, to examine how global programs have fallen short in creating demand for microscopy in underserved regions. In fact, the need has not kept pace with both technology development and the fervor around dissemination efforts. This lack of headway permeates the entire microscopy adoption landscape, from early exploration of imaging techniques to the sustained utilization of the technology. Despite its unique ability to span large biological length scales and its versatility in driving both quantitative and exploratory science[15], modern quantitative microscopy remains largely a novelty unfamiliar to scientists in resource-limited regions. Historically, this is a chasm caused by its prohibitive cost. The concept of using a microscope to tackle an experimental question has rarely seemed feasible to many scientists. Their preconception that microscopy is a costly technique has hardly been dispelled by the increasing availability of low-cost microscopes for three key reasons: lagging appreciation of the power of modern, quantitative microscopy, lack of awareness of affordable microscopy solutions, and lack of documented performance verification and limitations for many custom microscopes. Until these issues are resolved, this hesitancy will persist, to the detriment of researchers themselves.

We emphasize that these issues must be tackled in parallel. First, microscopy workshops must be tailored to local needs, including customizing the curriculum for local research interests, emphasizing instrumentation available to the attendees' communities, and highlighting successful local pilot studies. Microscopy communities must reach out to their regional scientific societies and articulate how modern imaging techniques that are accessible to them can tackle unanswered questions. Second, it is essential that low-cost microscopes are appropriately curated, validated and de-risked so that their capabilities can be better matched to specific needs. Failure to do so can lead to confusion and entrenched disaffection toward microscopy among end users. Third, the global imaging community must establish standards against which the performance of low-cost research-grade microscopes can be evaluated and verified. This will allow various systems to be rigorously compared, facilitating informed choice by end users.

While these measures can persuade life science communities of the power of microscopy, long-term adoption and subsequent scientific output demand significantly more than just increased awareness.

Successfully convincing a researcher to try a new technology does not automatically translate into enduring adoption. An effective strategy needs to include both long-term accessibility and the necessary continued ancillary support. In the case of light microscopy, this includes easy access to local microscopy expertise, image analysis and imaging reagents, as well as the ability to maintain, adapt and upgrade instruments.

Lastly, funding organizations should not mistake the promise of tool sharing for widespread adoption. Technology dissemination relies on teams who know how to formulate and implement effective strategies. Tool developers may not necessarily be the best dissemination experts (and vice versa). Their creativity and energy can oftentimes be better spent on development[26] while tasking dissemination and training to microscopy networks and imaging scientists working in core facilities. More importantly, dissemination requires substantial, committed investment. While international funders are keen on seeding initial funds to kick-start dissemination efforts, long-term sustainability must also be the responsibility of local and regional funders — who require a clear return on investment. Supporting their national scientists to explore unfamiliar tools and their long-term utilization can directly enable scientific output. Funders should recognize that their investments increase their national scientific competitiveness, which will translate to 'brain-gain' and better health research, ultimately underpinning the prosperity and well-being of their people.

The road to technology uptake is paved with the foundation of dissemination. In that regard, the global imaging community has done an exceptional job, not only in building the necessary groundwork, but also in setting an excellent example of how communities with disparate resources can unite in a purpose. The rapid alignment of missions from imaging networks, tool builders and funders is a testament to that shared vision. It firmly positions the community on the cusp of success. If there were ever a question of whether lagging technology adoption rates have been the result of a misstep, the answer would be a resounding no. In fact, without dissemination, we cannot begin to explore technology adoption. However, there is indeed a missing next step. The global imaging community has not yet set technology uptake to facilitate scientific output as the final goal. If we continue to ignore this blind spot, this missed step can spiral into a missed opportunity. Imaging networks, however, are robust. With careful retooling of our approach and messaging, we have the necessary platforms and collective resolve to rapidly pivot and meet the only success metric that matters: scientific output.

Jesse S. Aaron[1], Caron A. Jacobs[2], Leonel Malacrida[3,4], Antje Keppler[5], Paul French[6], Daniel A. Fletcher[7], Christopher Wood[8], Claire M. Brown[9,10], Graham D. Wright[11], Satoshi Ogawa[12], Mahmoud Maina[13,14] & Teng-Leong Chew[1] ✉

[1]Advanced Imaging Center and Integrative Imaging, Howard Hughes Medical Institute Janelia Research Campus, Ashburn, VA, USA. [2]Department of Pathology and Institute of Infectious Disease and Molecular Medicine, University of Cape Town, Cape Town, South Africa. [3]Advanced Bioimaging Unit, Institut Pasteur de Montevideo and Universidad de la República, Montevideo, Uruguay. [4]Unidad Académica de Fisiopatología, Hospital de Clínicas, Facultad de Medicina, Universidad de la República, Montevideo, Uruguay. [5]Euro-BioImaging Bio-Hub, European Molecular Biology Laboratory, Heidelberg, Germany. [6]Physics Department, Imperial College London, London, UK. [7]Bioengineering Department, University of California, Berkeley, Berkeley, CA, USA. [8]Laboratorio Nacional de Microscopía Avanzada, Instituto de Biotecnología, Universidad Nacional Autónoma de México, Mexico City, Mexico. [9]Advanced BioImaging Facility (ABIF), McGill University, Montreal, Quebec, Canada. [10]Department of Physiology, McGill University, Montreal, Quebec, Canada. [11]Research Support Centre, Agency for Science, Technology & Research (A*STAR), Singapore, Singapore. [12]Optical Imaging Platform, Jeffrey Cheah School of Medicine and Health Sciences, Monash University Malaysia, Selangor, Malaysia. [13]Biomedical Science Research and Training Centre, Yobe State University, Damaturu, Nigeria. [14]Sussex Neuroscience, School of Life Sciences, University of Sussex, Brighton, UK.
✉e-mail: chewt@janelia.hhmi.org

Published online: 06 May 2025

References

1. Colón-Ramos, D. A., La Riviere, P., Shroff, H. & Oldenbourg, R. *Nat. Methods* **16**, 667–669 (2019).
2. Aaron, J. & Chew, T. L. *J. Microsc.* https://doi.org/10.1111/jmi.13400 (2025).
3. Reiche, M. A. et al. *Nat. Cell Biol.* **25**, 1387–1393 (2023).
4. McDermott, S. et al. *Optics Express* **30**, 26377–26395 (2022).
5. Li, H., Soto-Montoya, H., Voisin, M., Fuentes Valenzuela, L. & Prakash, M. Preprint at *bioRxiv* https://doi.org/10.1101/684423 (2019).
6. Diederich, B. et al. *Nat. Commun.* https://doi.org/10.1038/s41467-020-19447-9 (2020).
7. Power, R. M. & Huisken, J. *Nat. Methods* **16**, 1069–1073 (2019).
8. Hohlbein, J. et al. *Nat. Methods* **19**, 1020–1025 (2022).
9. Ounkomol, C., Seshamani, S., Maleckar, M. M., Collman, F. & Johnson, G. R. *Nat. Methods* **15**, 917–920 (2018).
10. Weigert, M. et al. *Nat. Methods* **15**, 1090–1097 (2018).
11. Krull, A., Vičar, T., Prakash, M., Lalit, M. & Jug, F. *Front. Comput. Sci.* https://doi.org/10.3389/fcomp.2020.00005 (2020).
12. Betzig, E. *Nat. Methods* https://doi.org/10.1038/s41592-024-02379-3 (2024).
13. Reiche, M. A. et al. *Nat. Methods* **18**, 847–855 (2021).
14. Imreh, G., Hu, J. & Le Guyader, S. *J. Microsc.* **294**, 295–307 (2024).
15. Wait, E. C., Reiche, M. A. & Chew, T. L. *J. Cell Sci.* **133**, jcs250027 (2020).
16. Isah, M. B. et al. *Eur. J. Neurosci.* **59**, 1681–1695 (2024).
17. De Niz, M. et al. *J. Microsc.* **294**, 420–439 (2024).
18. Rahmoon, M. A., Hobson, C. M., Aaron, J. S., Balasubramanian, H. & Chew, T. L. *J. Microsc.* **294**, 440–447 (2024).
19. Salido, J., Bueno, G., Ruiz-Santaquiteria, J. & Cristobal, G. *Microsc. Res. Tech.* **85**, 3270–3283 (2022).
20. Li, H. et al. Preprint at *bioRxiv* https://doi.org/10.1101/2020.12.28.424613 (2020).
21. Switz, N. A., D'Ambrosio, M. V. & Fletcher, D. A. *PLoS One* **9**, e95330 (2014).
22. D'Ambrosio, M. V. et al. *Sci. Transl. Med.* **7**, 286re4 (2015).
23. Lightley, J. et al. *J. Microsc.* **292**, 64–77 (2023).
24. Bharadwaj, A. et al. *Curr. Sci.* https://doi.org/10.18520/cs/v126/i2/244-254 (2024).
25. Gallegos-Cerda, S. D., Hernández-Varela, J. D., Arredondo-Tamayo, B. & Chanona Pérez, J. J. *Revista Interdisciplinaria Nanociencias Nanotecnología* **16**, 1e–33e (2022).
26. Chew, T.-L., Soell, A., George, R. & Betzig, E. *Opt. Photonics News* https://doi.org/10.1364/OPN.28.7.000042 (2017).
27. Cartwright, H. N., Hobson, C. M., Chew, T., Reiche, M. A. & Aaron, J. S. *J. Microsc.* https://doi.org/10.1111/jmi.13176 (2023).
28. Pfander, C. et al. https://doi.org/10.1016/j.isci.2022.103800 (2022).
29. Zimmermann, T. *J. Microsc.* **294**, 255–267 (2024).
30. De Niz, M. Enhancing global access: interview with CZI grantee Leonel Malacrida. *FocalPlane* https://doi.org/10.1242/focalplane.18365 (2024).
31. Maina, M. *Lancet* https://doi.org/10.1016/S1474-4422(23)00320-4 (2023).

Acknowledgements

We thank V. Cao and V. Ghukasyan (Chan-Zuckerberg Initiative), L. Martino (Wellcome Trust) and A. Rennegarbe (Bill and Melinda Gates Foundation) for their critical reading of and invaluable input to this manuscript. The global imaging community would also like to extend our utmost gratitude for these institutions' generous support of microscopy outreach and capacity-building efforts.

Author contributions

J.S.A and T.-L.C. conceived, wrote and revised the manuscript. C.A.J., L.M., A.K., P.F., D.A.F., D.W., C.A.B., G.D.W., S.O. and M.M. wrote and revised the manuscript.

Competing interests

The authors declare no competing interest.

Additional information

Peer review information *Nature Methods* thanks John Eriksson, Jeremy Woodward and the other, anonymous, reviewer(s) for their contribution to the peer review of this work.