GLOBAL BIOIMAGING INTERNATIONAL SURVEY REVEALS TRAINING NEEDS FOR CORE FACILITY IMAGING SCIENTISTS

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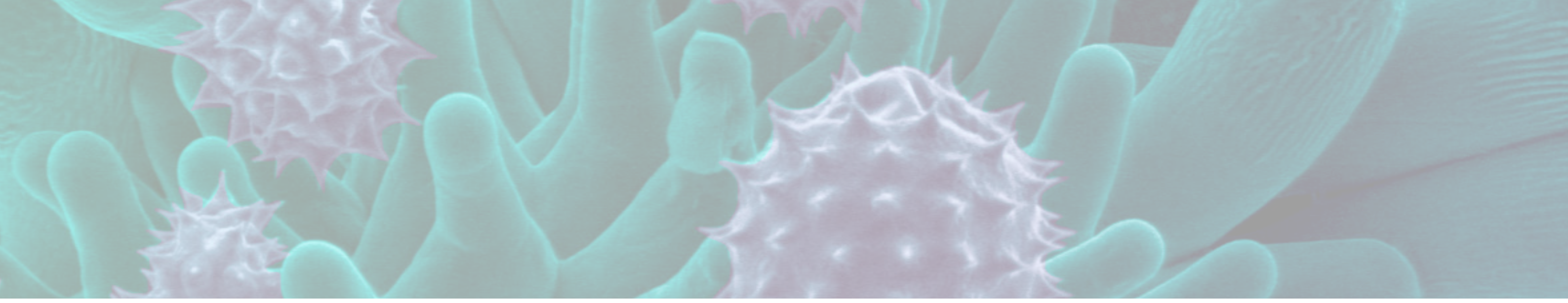

GLOBAL BIOIMAGING PUBLICATIONS PART 3.2: TRAINING SURVEY

GLOBAL BIOIMAGING INTERNATIONAL SURVEY REVEALS TRAINING NEEDS FOR CORE FACILITY IMAGING SCIENTISTS

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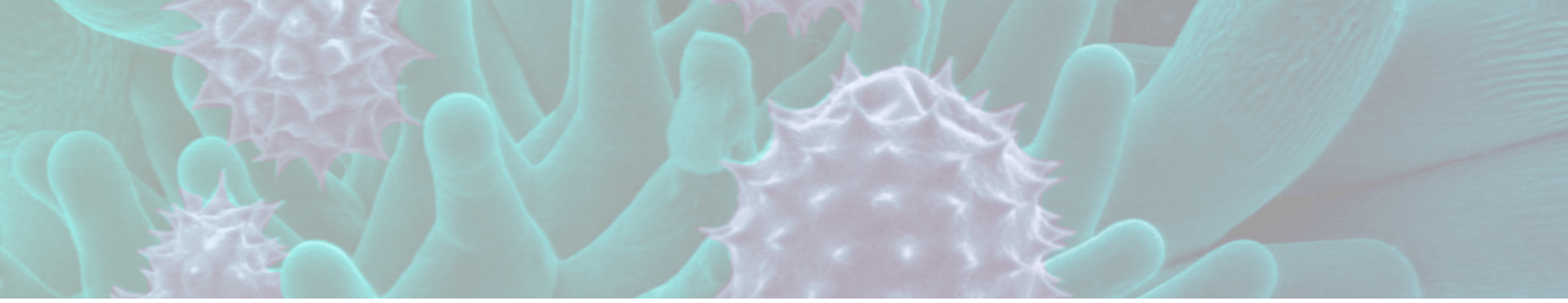

Global BioImaging International Survey Reveals Training Needs for Core Facility Imaging Scientists

INTRODUCTION

The backbone of any imaging facility is its highly skilled staff members - core facility imaging scientists[1,2], who play a pivotal role in running and managing imaging core facilities. Core facility imaging scientists have a role in many activities including facility management, scientific mentoring (e.g. experimental design, data interpretation, manuscript preparation), teaching (e.g. training facility users, teaching at courses and workshops), gaining and maintaining technical skills (e.g. about diverse microscopy and image processing techniques), administering (e.g. management of personnel, infrastructure and funds), and networking, to name a few. The large skill set required by core facility imaging scientists necessitates continuous learning and skill development. Hence, professional development is critical to running and managing an imaging core facility successfully. Assessing which skills core facility imaging scientists need the most is important to enable tailoring of training activities such as courses and workshops to a target audience. To this end, Global BioImaging[3] conducted an international survey and the results obtained are presented in this publication.

SURVEY METHODOLOGY

The survey was designed by the Global BioImaging working group, "Training Core Facility Imaging Scientists,"[4] to gather anonymous feedback from core facility imaging scientists regarding their perceived training requirements and challenges faced in their roles. Respondents were asked to highlight areas where they felt additional training would be beneficial. The target audience of this survey included imaging facility managers and staff, project managers in imaging infrastructures and networks, and other individuals working in or closely associated with imaging facilities. The survey was disseminated via an email to representatives of 13 Global BioImaging partner organizations who shared it within their communities, ensuring a broad and diverse scope of participation. Additionally, the survey was shared with other regional imaging networks and initiatives to further extend its reach and secure a more comprehensive global representation. The survey consisted of multiple-choice questions (one response option can be selected; gender, respondents' main role and primary background, and learning format preference), multiple-response questions (multiple response options can be selected; network affiliation, fields of expertise, technologies provided, general skills, soft skills, and management skills) and open-ended questions (scientific skills, urgent training needs, and whenever the "Other" option was provided). For questions focused on training needs in soft skills and management skills, the participants were instructed to choose up to three responses per question.

1 http://www.imagingscientist.com/
2 https://onlinelibrary.wiley.com/doi/10.1111/jmi.13307
3 https://globalbioimaging.org/
4 https://globalbioimaging.org/working-groups

KEY FINDINGS

Areas for skill development

The survey identified a number of areas where there is a high demand for training. Time management emerged as the soft skill where training was most requested. In the area of management skills, project management, and budgeting received the most interest.

Demand for soft skill

Among soft skills, the highest demand in training was in the following soft skills: time management, conflict management, communication, decision making, and organizational skills. Even though the survey was conducted at the end of the COVID-19 pandemic, time management was still the most sought-after skill.

Preferred learning format

The survey also indicated a strong preference for in-person courses over online training. Online workshops, webinars, and online self-paced resources such as e-learning platforms and online resources were generally seen as a good supplement but not a replacement for in-person training. Most likely, the choice behind selecting in-person courses offer opportunities to network with the participants and the faculty, something that online events may not provide adequately.

Implications

The results of this survey can be used to tailor the curriculum of courses and training programs offered by organizations involved in professional development of core facility imaging scientists.

RESULTS

The results of the survey are reported in two parts: 1) background of survey respondents that includes their regional representation, affiliation to an imaging network, gender distribution, respondents' main role, and their fields of expertise; 2) training needs of survey respondents with regards to different types of skills including general skills, soft and management skills, scientific skills, urgent needs in training, as well as preferred learning format.

PART 1: BACKGROUND OF SURVEY RESPONDENT

Regional representation & affiliation with imaging networks

To ensure the global reach of the survey, respondents were asked to indicate their country of residence. In addition, respondents were asked if their imaging facility is affiliated with one or more Global BioImaging partner organizations.

In total, there were 151 responses with participants based in 30 countries (Table 1). At a time of the survey, all eleven Global BioImaging partner organizations were represented including Advanced BioImaging Support (ABiS)[5] in Japan, the African BioImaging Consortium[6], BioImaging North America (BINA)[7], Canada BioImaging[8], Euro-BioImaging ERIC[9] in Europe, Microscopy Australia[10] and the National Imaging Facility (NIF)[11] in Australia, the National Laboratory for Advanced Microscopy (LNMA)[12] in Mexico, National Microscopy System in Argentina[13], Latin America Bioimaging (LABI)[14], South Africa BioImaging (SABI)[15], the India BioImaging Consortium, and SingaScope[16] in Singapore (Figure 1). Participants from recently onboarded Global BioImaging partner organizations including African BioImaging Consortium (ABIC)[17] and National Microscopy System[18] in Argentina as well as other imaging networks and initiatives including the Biomedical Science Research and Training Centre (BioRTC)[19] and Biomedical Imaging Organization for South East Europe (BIO-SEE)[20] also participated in the survey contributing to even wider participation.

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10 https://micro.org.au/
11 https://anif.org.au/
12 https://lnma.unam.mx/wp/
13 https://www.argentina.gob.ar/ciencia/sistemasnacionales/microscopia
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20 https://bio-see.net/

Argentina	14	Denmark	1	Nigeria	14
Armenia	1	Ethiopia	1	Portugal	1
Australia	26	Finland	2	Rwanda	1
Belgium	3	France	3	Singapore	7
Brazil	2	Germany	4	South Africa	4
Cameroon	1	India	2	Sudan	1
Canada	2	Ireland	4	Sweden	1
Chile	1	Japan	17	United Kingdom	8
Costa Rica	1	Mexico	6	Uruguay	4
Czech Republic	2	Netherlands	1	United States	16

Table 1. Regional representation of survey respondents.

The respondents of the survey indicated affiliation with a broad range of imaging infrastructures and networks, demonstrating a geographically diverse landscape (Figure 1). A significant portion of respondents, just over one quarter, indicated that their facility is not affiliated with any imaging infrastructure or network. Among those that are affiliated, Latin America Bioimaging had the highest representation with Advanced BioImaging Support (Japan), BioImaging North America (BINA), and Euro-BioImaging ERIC followed closely. Microscopy Australia and National Imaging Facility (Australia) were also well-represented, making up just under 10% of respondents. A smaller number of responses came from SingaScope (Singapore), National Laboratory for Advanced Microscopy (Mexico), and South Africa BioImaging. "Other" affiliations constituted almost 15% of respondents, illustrating the diversity of networks that participated in this survey beyond the current Global BioImaging partners.

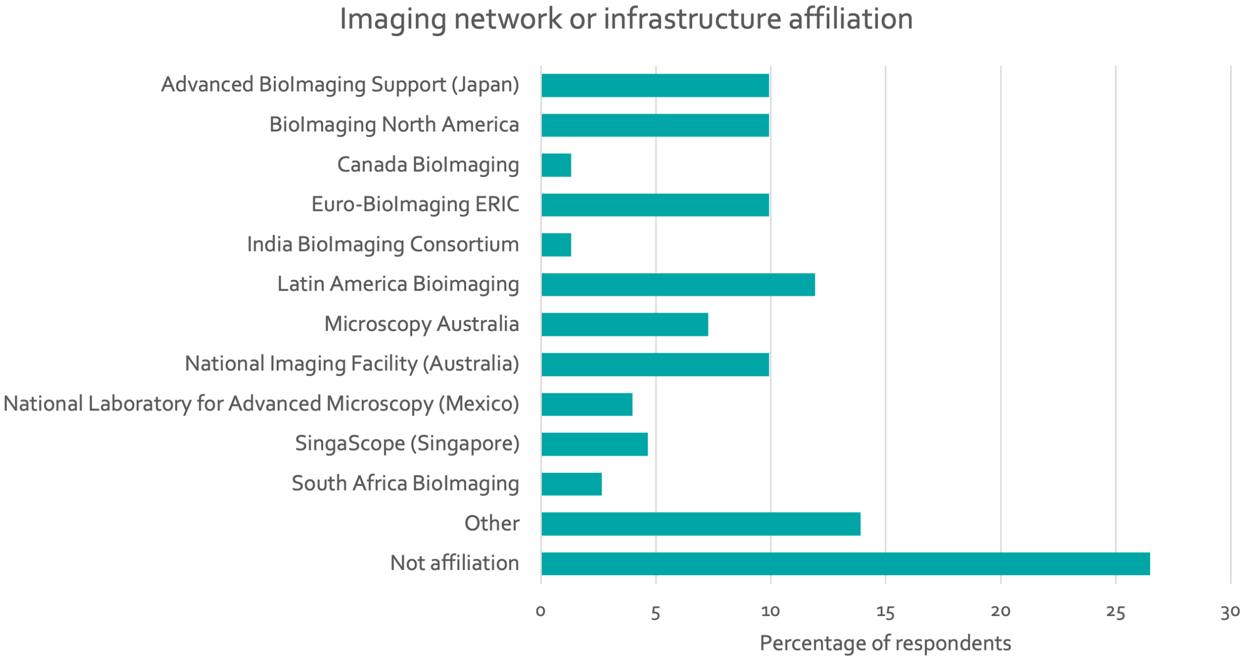

Figure 1. Reported affiliation with imaging networks and infrastructures that are partnered with Global BioImaging.

Respondents’ gender distribution

In order to ensure gender balance among the respondents, they were asked to indicate their gender. The gender distribution among those who participated in the survey was primarily split between male and female respondents, with 58% or 87 individuals and 41% or 62 individuals, respectively (Figure 2). A small fraction of respondents chose the “Prefer not to say” option. This distribution shows a relatively good gender balance among the respondents of the survey.

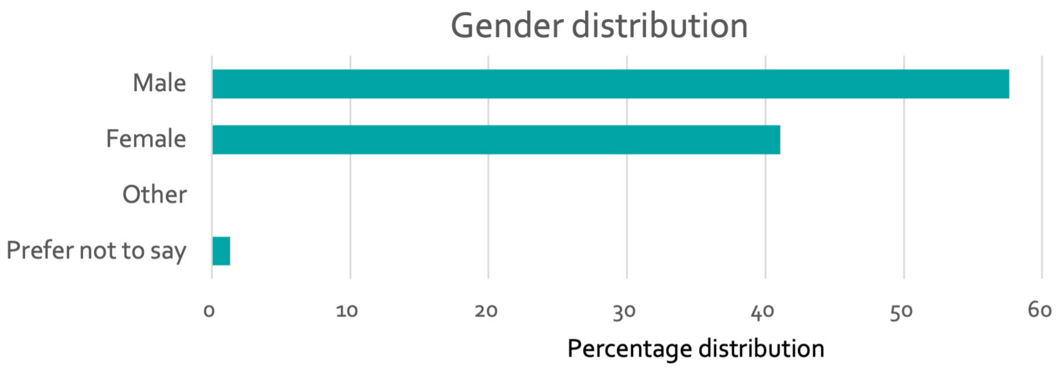

Figure 2. Gender distribution of survey repondents.

Respondents’ main role

Almost three quarters of respondents of this survey are working in imaging cores (Figure 3). The majority of the respondents were imaging core facility staff, making up just over two fifths of the respondents. Those in leadership positions, head or deputy head of an imaging facility, constituted one third of respondents. Research infrastructure managers and image analysts comprised around 5% of total responses. Additionally, a single research network manager participated in the survey. “Other” roles made up just over 15% of the responses, accounting for 25 individuals. Responses as part of “Other” option varied among the participants and included roles such as but not limited to research scientist, research fellow, and research assistant.

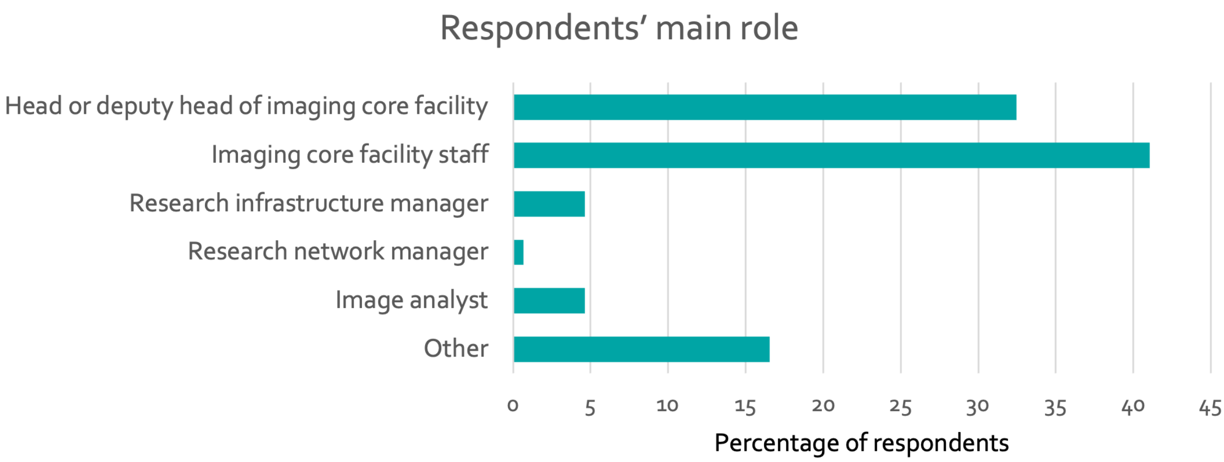

Figure 3. Main roles of survey respondents within an imaging facility.

Respondents' fields of expertise and imaging technologies provided

To gauge a better understanding of respondents, they were asked to provide their fields of expertise as well as imaging technologies that are provided in their imaging cores.

Respondents were asked to indicate their field of experience by selecting as many relevant options as required (Figure 4). Three quarters of participants selected light microscopy as their field of expertise mirroring the results above. This was followed by an image analysis field, with half of the respondents indicating expertise in this area. Electron microscopy and data management followed with just over 15% indicating their expertise in these areas. Preclinical imaging (11% of respondents), materials science (7% of respondents), and software development (9% of respondents) were the areas of least expertise among the respondents. Just over 10% of respondents indicated expertise in other fields of specialization. These included imaging methods such as atomic force microscopy, fluorescence lifetime imaging microscopy, medical imaging, image data visualization, and hardware development.

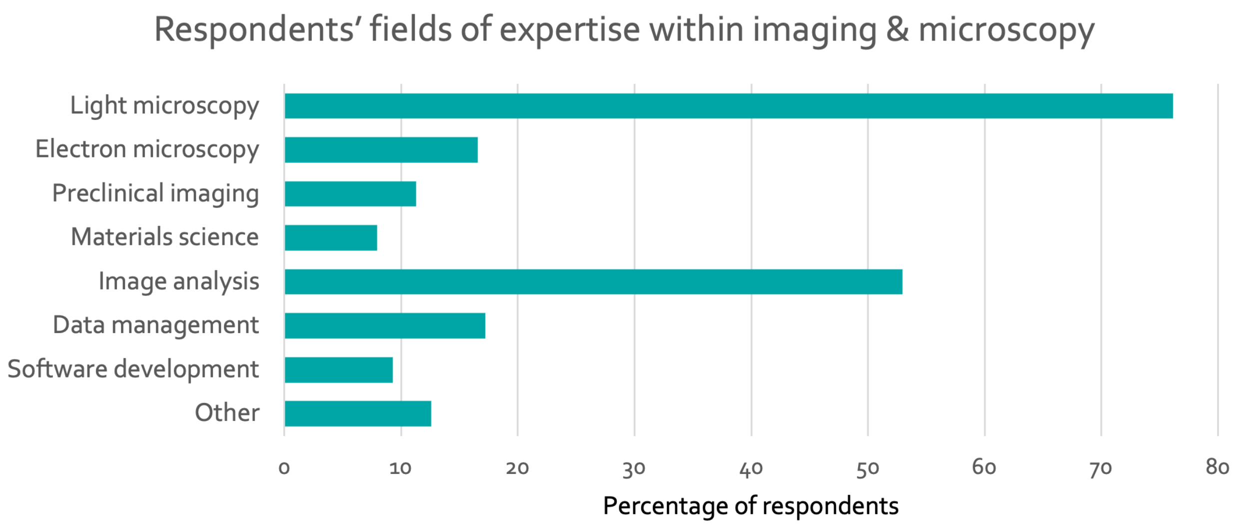

Figure 4. Fields of expertise within imaging and microscopy indicated by survey respondents.

In addition to their expertise, survey respondents were asked to select which technologies are provided in their imaging facilities. In case their facility provides technologies from more than one imaging field, respondents were able to select multiple options. The vast majority of the respondents reported providing access to light microscopy technologies and about a third provided electron microscopy technologies in their imaging facilities (Figure 5). Preclinical and medical imaging together also formed just over a third of the responses. Just under a fifth of the respondents choose "Other" and specified access to technologies such as atomic force microscopy, scanning probe microscopy, flow cytometry, data storage and image analysis. This distribution is likely to reflect the distribution of members within the imaging communities that were used to disseminate the survey.

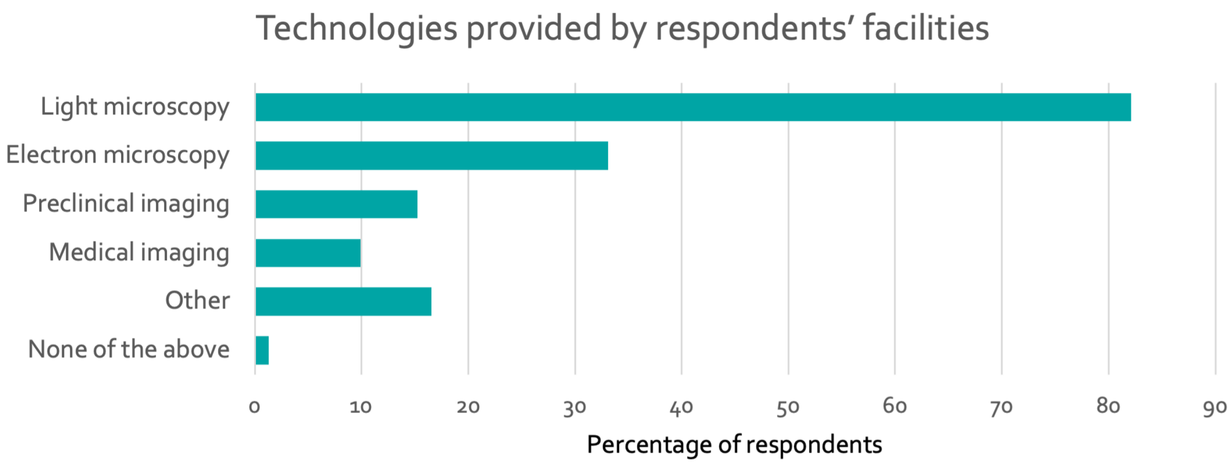

Figure 5. Imaging technologies provided within the imaging facilities where survey participants.

Respondents' primary background

The primary background of the majority of respondents is the field of natural sciences, particularly biological science, constituting half of the respondents (Figure 6). One fifth of respondents were from the medical and health sciences. Physical sciences made up just over 10%, followed by a smaller portion in engineering and technologyn and chemical sciences. One respondent had a materials science background. Additional disciplines not listed in the provided options were captured in the "Other" category, making up 5% of the respondents, highlighting the wide-ranging expertise that contributes to the imaging sciences field. Agriculture, biophysics, computer science, earth science, mathematics, and pedagogy were among the answers in the "Other" category.

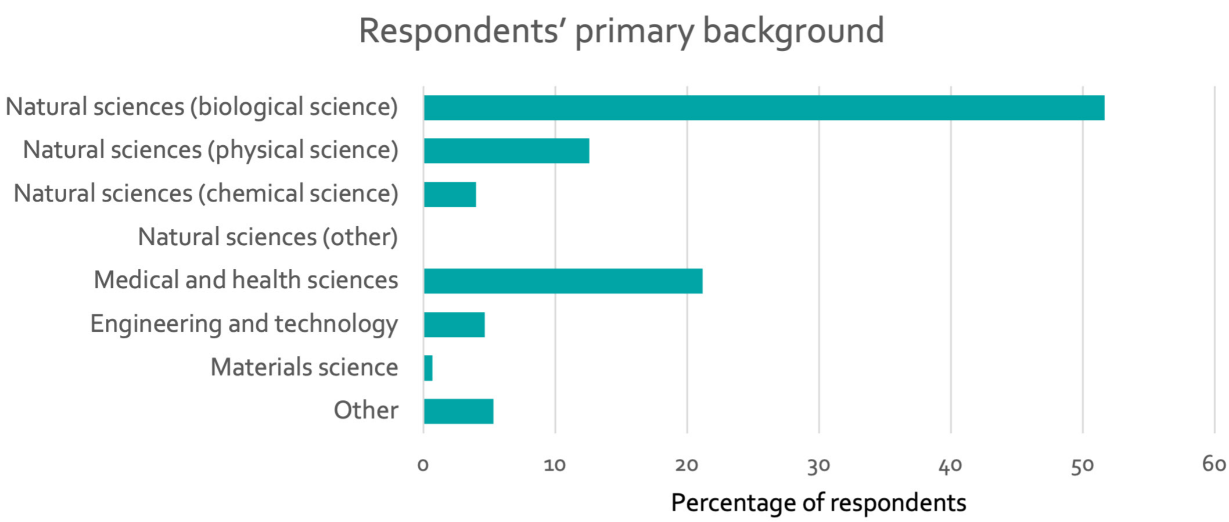

Figure 6. Primary background of survey respondents.

PART 2: TRAINING NEEDS

General skills that respondents would like to improve

In order to gain an overview of the training required, respondents were asked to select general skills that they would like to improve (Table 2). The options provided to respondents were deemed to be the most optimal considering the large number of tasks that core facility imaging scientists have to perform. This includes research activities (imaging as a service, scientific consultation, etc.), technical proficiency to operate complex equipment and software, management skills and soft skills, image analysis and data management skills given that image data is the primary output of imaging facilities. Additionally, teaching skills that were presented as a stand-alone option given that teaching is one of the central activities within an imaging facility (teaching facility users, teaching at a course or workshop, etc.).

The most sought-after area for improvement was in image analysis skills, with three quarters of participants indicating a strong interest in enhancing their skill set in this area, specifically understanding concepts, software usage, and macro writing (Figure 7). Technical skills, including instrument operation and software usage, were another high-priority skill set chosen by almost 60% percent of respondents. A similar number of respondents indicated that they wanted to improve their management skills and data management skills. Other skills such as soft skills and teaching skills received slightly less interest. Soft skills like teamwork, communication, and leadership were requested by just under two fifths of the respondents and a third of the respondents indicated a need to improve their teaching skills.

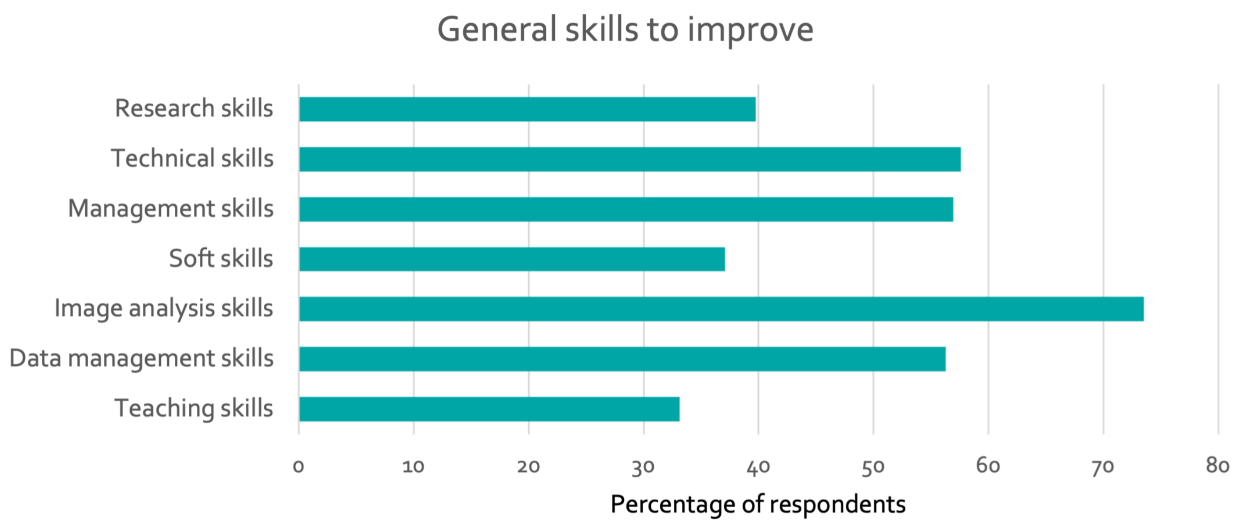

Figure 7. General skills indicated by survey respondents where improvements were required.

Soft skills that respondents would like to improve

Soft skills are defined as skills heavily influenced by personal and interpersonal attributes. These attributes are qualities and behaviour that have an impact on an individual's interactions with others. Soft skills enhance an individual's ability to communicate with others, work effectively within a team, navigate a plethora of social interactions, and contribute effectively to an organization.

Respondents were asked to select up to 3 soft skills that they would like to improve. At the top of the list was time management skills requested by over two fifth of respondents (Figure 8). Conflict management followed closely, with just under a third of participants expressing an interest to learn how to handle conflict situations better. Decision-making, communication skills, and organizational abilities were also high on the list. Skills including critical thinking, problem-solving, persuasion, and teamwork gathered slightly less attention from the participants ranging from just over one fifth of the responses to 15% of responses. A small number of participants selected "Other" option and indicated that they would like to improve all of the soft skills and also to assist their staff with time management.

Skill category	Examples of skills
Research skills	Study design, finding metrics for assessing data, data collection, data analysis, interpretation of results
Technical skills	Instrument operation, software usage
Management skills	Project management , decision-making
Soft skills	Teamwork , communication, leadership
Image analysis skills	Image analysis concepts , image analysis software usage, macro writing
Data management skills	Image data management , database software usage
Teaching skills	Curriculum design, training users on instruments, teaching courses

Table 2. Types of general skills provided as options for selection.

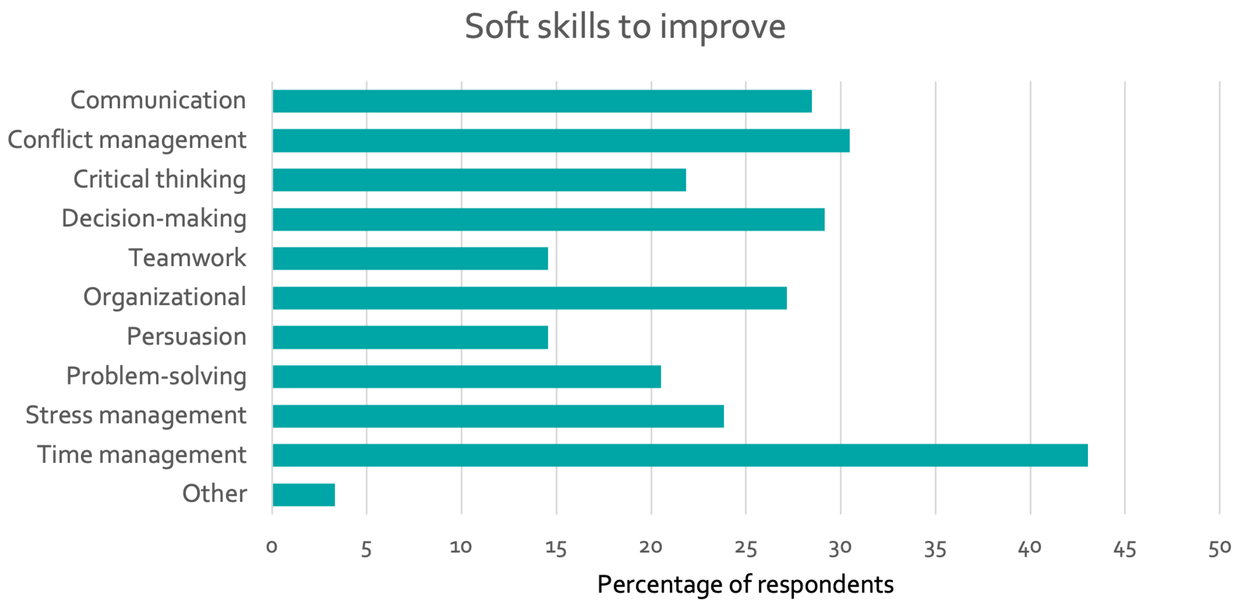

Figure 8. Soft skills indicated by survey respondents where improvements were required.

Management skills that respondents would like to improve

Management skills are a set of abilities that are required to lead effectively, coordinate, manage resources, and plan effectively.

Respondents were asked to select up to 3 management skills that they would like to improve. Project management was at the top of the list, with just under two fifths of the respondents expressing an interest in improving this area. Project management was followed by budgeting which was selected by just under a third of respondents. Strategic thinking, public speaking/presentation, and networking were chosen by a quarter of the respondents. Other skills, such as delegation, diplomacy, evaluating employee performance, providing feedback, report/business case writing, and training employees scored slightly less but were, nonetheless, highly visible in the responses. “Other” responses included grant writing, procurement, and staying connected with imaging facility directors and management to share solutions and improvements.

Certain skills such as delegation, evaluating employee performance, giving feedback, and diplomacy are inherent to leadership roles that include head of an imaging facility. However, only two thirds of the respondents who indicated a need for training in delegation skills and evaluating employee performance were head of an imaging facility. The ratio between those in leadership roles and others (e.g. imaging core facility staff) decreased even further for a need for training in giving feedback and diplomacy indicating that certain activities traditionally associated with leadership roles may be taken up within other roles. As expected, a need for training in how to train employees was spread across several roles including head of an imaging facility with one fifth of responses, imaging facility staff with two fifths of responses and the rest spread across other roles possibly indicating that training employees is not inherent to a leadership role but is undertaken by all roles within an imaging facility.

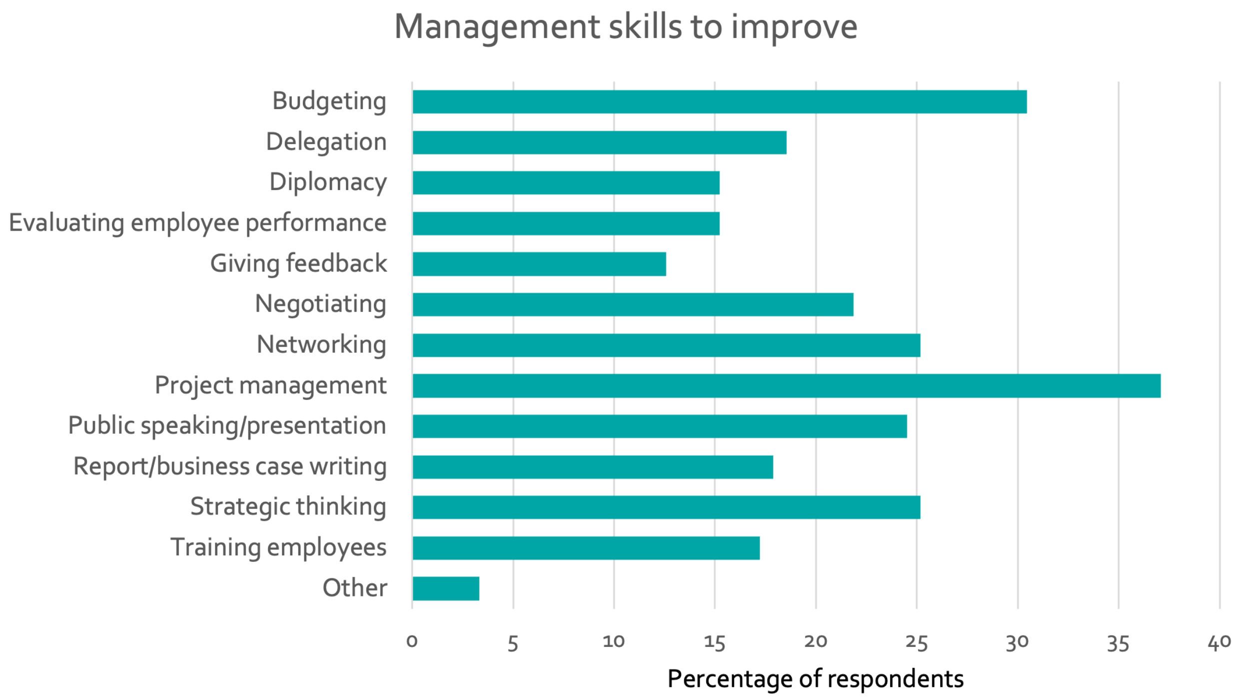

Figure 9. Management skills indicated by survey respondents where improvements were required.

Scientific skills that respondents would like to improve

Scientific skills are defined as abilities required to conduct scientific research. The skills listed by survey respondents in this open-ended question contain a broad range of areas in imaging and research. Skills in areas of data analysis and image analysis were frequently mentioned. There were several mentions of machine learning as applied to image analysis. Software skills and coding featured prominently in the open-ended responses. Statistics appeared to be a common area of interest. Other areas where training was sought included various microscopy methods such as confocal and electron microscopy, as well as flow cytometry and immunohistochemistry.

Alongside these scientific skills, respondents also expressed an interest in improving areas such as experiment design, manuscript writing, and grant writing, which are crucial for both disseminating research and securing funding. Several soft skills including communication, decision-making, and time management were also mentioned further indicating the importance and prevalence of these skills within the scientific research. Finally, several respondents indicated an interest in training to keep up-to-date with the latest innovations in the imaging field and best practices and guidelines for research.

Urgent training needs

The main goal behind asking this open-ended question was to ascertain the training needs at this very moment. The main training needs expressed by the respondents can be broadly categorized into technical skills, data management, and facility management. Within technical skills, a strong emphasis was placed on training in various advanced microscopy techniques, for example, scanning electron microscopy, confocal microscopy, and specialized techniques like correlative light and electron microscopy, super-resolution methods, and light sheet microscopy. Data management and image analysis are other critical areas where urgent training was indicated, with mentions of big data visualization and specialized data analysis software, including gaining knowledge with specific software tools such as Fiji, Imaris, Imod, and Amira. Interest in specific courses aimed at biologists who are new to advanced imaging techniques or coding was also indicated. Training for equipment operation and troubleshooting, as well as maintenance of equipment in imaging core facilities, are seen as essential for running the facilities efficiently. Respondents also expressed a need for training in financial skills such as budgeting, fundraising, guidance in securing funding and overall sustainability of the imaging cores, underlying the financial challenges faced by many imaging facilities.

Preferred format of events and training

To determine a preferred learning format, participants were asked to choose one of the three available options (favoring the format, neutral stance, or not favoring the format) for each learning format. Four distinct learning formats were provided and were defined as the following: in-person courses with a duration of 2-5 days, online workshops with a duration of 2-4 hours, online seminars (webinars) with a duration of 1 hour, and finally, online self-paced resources that include e-learning platforms and online resources such as MyScope[21] developed by Microscopy Australia[22], Microtutor[23], Global BioImaging Virtual Training Platform[24], Udemy[25], edX[26], Coursera[27], and many others.

The preferred learning format indicated by the respondents was in-person courses, with three quarters of respondents favoring this format (74% respondents favoring this format, 19% neutral and 7% not favoring it) (Figure 10). Online formats, including online workshops, webinars, and self-paced resources (e-learning platforms and educational resources), scored less with the respondents compared to in-person courses. These were favored by a maximum of two fifth of the respondents (39% favored online workshops and 41% favored online seminars). Only one third of respondents favored online self-paced resources. However, it is important to mention that at least two thirds of the respondents indicated a positive or neutral stance with respect to online format, hence the online format still constitutes an important avenue for training. One of the possibilities why the online formats scored less than in-person format was due to fatigue associated with online events and interactions via video conferencing platforms post COVID-19 pandemic.

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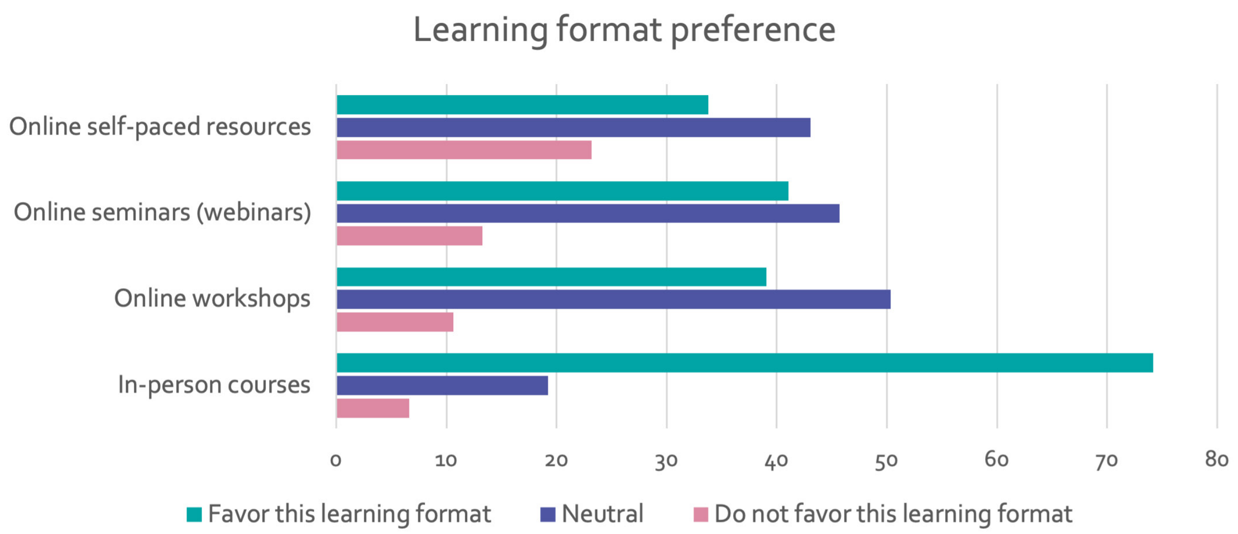


Figure 10. Preference for the learning format and type of training events.

CONCLUSION

The Global BioImaging survey provides a resource for understanding the current training needs of core facility imaging scientists from all over the world. The diverse roles among the respondents contributed to a well-rounded understanding of training needs in the field. By addressing the training needs in this survey, the imaging community can ensure that those who work in imaging core facilities are prepared to deal with current challenges and future advancements.

The findings underscore several critical areas of focus. The survey results indicated an emphasis on time management, conflict management, communication, and organizational effectiveness skills. On the managerial side, project management and budgeting emerged as critical skills for this group. Interestingly, while scientific and general skills such as image analysis, microscopy methods, and software proficiency were highlighted, there was a noticeable demand for guidance on staying up-to-date with innovations in the imaging field. The survey also reflected a strong inclination towards in-person learning experiences over purely online formats, suggesting a preference for hands-on training and in-person interactions.

Given the insights from the survey, the following suggestions are presented for consideration:

- Priority set for in-person workshops, with the top ranked skills from the survey addressed first
- Complementing workshops with carefully curated online material including webinars and tutorials when relevant
- Emphasis on integrating networking opportunities for in-person training
- Importance of periodically updating training material, ensuring its alignment with the ever-changing realm of imaging
- Incorporate a robust feedback mechanism post-training, enabling constant refinement of training material

By carefully addressing the training needs revealed from this survey and others[28] such as the survey conducted by the Core Technologies for Life Science association (CTLS)[29], the imaging community can make sure that experts in imaging facilities are ready for today's challenges and future developments. This forward-thinking strategy will strengthen the community, setting it on a path for continued success and innovation.

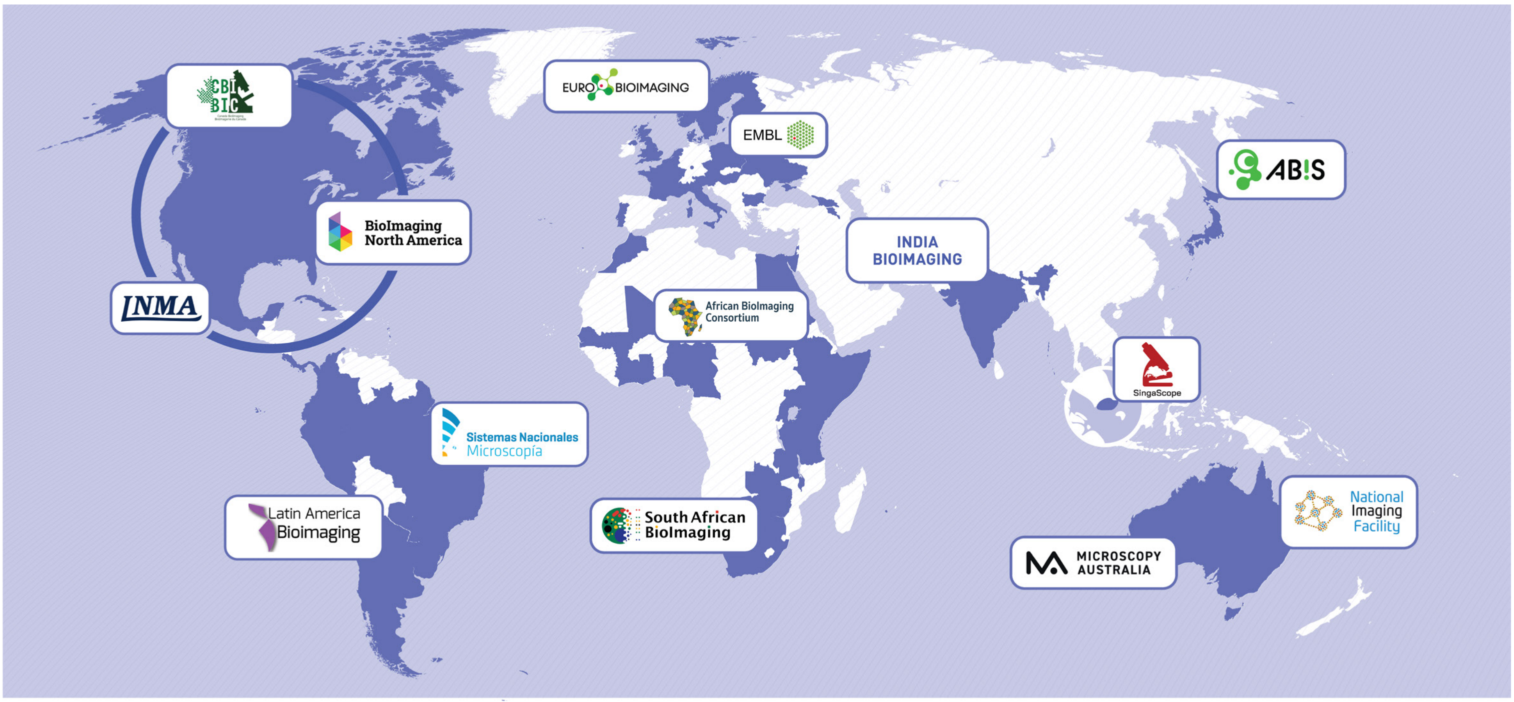
CHAN ZUCKERBERG INITIATIVE

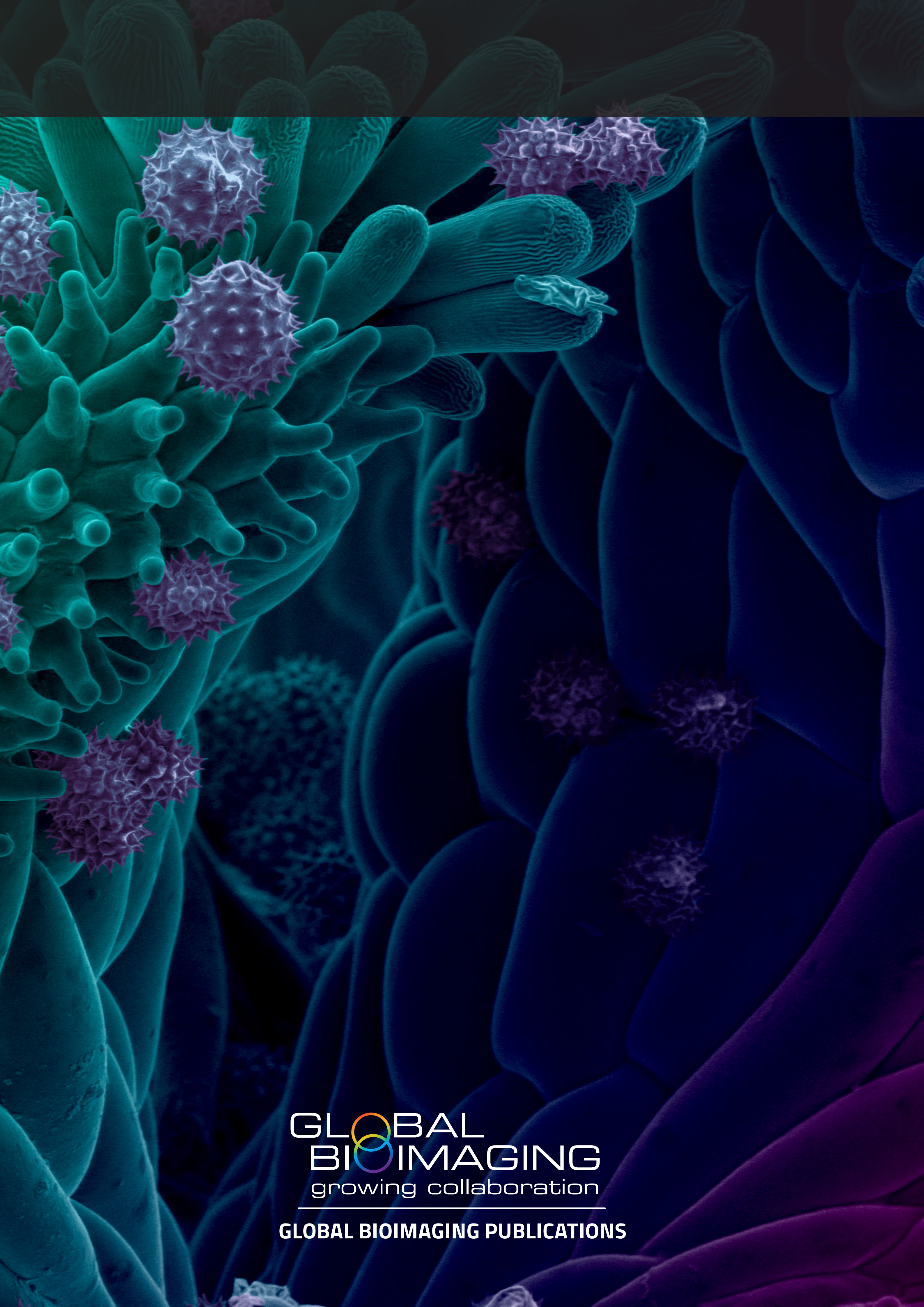
28 https://pubmed.ncbi.nlm.nih.gov/33304201/
29 https://ctls-org.eu/

GLOBAL BIOIMAGING

Global BioImaging (GBI) is an international, open network of imaging infrastructures and communities, which was initiated in 2015 by Euro-BioImaging and partners in India and Australia with the mission to cooperate internationally and propose solutions to the challenges faced by the imaging community globally. Furthermore, the partners support each other to build a strong case towards the funders that imaging technologies and research infrastructures are key in the advancement of life and health sciences; and GBI activities aim to build capacity internationally, leveraging on each other's strengths and capabilities.

Initially supported by a European "Horizon 2020" grant from the European Commission, since January 2020 GBI is funded by the Chan Zuckerberg Initiative and now includes 13 partners and 62 countries around the globe: Advanced BioImaging Support (ABiS) in Japan, BioImaging North America (BINA), Canada BioImaging, Euro-BioImaging ERIC in Europe, the India BioImaging Consortium, Microscopy Australia, Latin America Bioimaging, the National Imaging Facility (NIF) in Australia, National Laboratory for Advanced Microscopy (LNMA) in Mexico, South Africa BioImaging, SingaScope in Singapore, National Microscopy System in Argentina, and African BioImaging Consortium (ABIC).





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