



The Convergent Effect of International Collaboration between Young Leaders of Two Global Societies: Strengthening Microbiology Education and Training Practices Worldwide

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There has never been a more critical time than the present for young microbiologists to engage in continuous postgraduate education. Next-generation microbiologists need to integrate several scientific disciplines in the early stages of their careers to keep up with the ever-changing nature of microbiology (advent of high-throughput sequencing platforms, bioinformatics, complex omic, culture and systems-biology approaches) and to ensure timely response to the current global health and biodiversity threats. Here we propose that international collaboration of young experts would help to address the challenges in microbiology training and serve as a communication bridge between senior and early career scientists. To establish a one-of-a-kind collaboration, the Trainee Association (TAE) of the European Society of Clinical Microbiology and Infectious Diseases (ESCMID) and the Young Leaders Circle (YLC) of the American Society for Microbiology (ASM) have joined forces to adequately represent the interests of young members within the two largest societies in the field of microbiology. Through this partnership, both societies aim to promote continuous education for young scientists and the general public. Additionally, we intend to identify shared objectives and introduce joint activities that could lead to a beneficial exchange process for a long-lasting relationship. This partnership further contributes to advancing both the quality and quantity of education.

INTRODUCTION

In science and medicine, it is imperative to keep professionals up to date with the latest developments in their professional disciplines. A perpetually evolving landscape of postgraduate education around the world demands flexible approaches and a progressive framework to adequately address changing needs. Furthermore, microbiology as a discipline is facing pressing challenges due to current global

health and biodiversity threats, which in turn require next-generation microbiologists to be fully engaged in continuous postgraduate education in the early stages of their careers to adapt to these new changes. Current global health threats include antimicrobial resistance, natural disasters, food poisoning and insecurity, malnutrition, emerging zoonotic infections, as well as social conflicts and bioterrorism combined with shortages and misuse of antibiotics and vaccines.

The future demands that microbiology professionals have not only all-inclusive access to and involvement in post-graduate education addressing diverse educational needs, but also active engagement in the continuous development of professional skills while striving for meaningful scientific engagement of the general public (1).

Leading national and international societies contribute to the continuous professional development of individuals in their disciplines by organizing congresses and conferences,

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En la actualidad es crítico que los jóvenes microbiólogos se involucren en estudios de posgrado y formación continua. La próxima generación de microbiólogos necesita integrar varias disciplinas científicas durante las primeras etapas de sus carreras para mantenerse al día con la naturaleza siempre cambiante de la microbiología (por ejemplo, con el avvenimiento de las plataformas de secuenciación masiva, de las herramientas bioinformáticas, de las técnicas ómicas avanzadas, de cultivo y de biología de sistemas), y para asegurar una respuesta oportuna ante las amenazas mundiales actuales para la salud y la biodiversidad. Se propone que la colaboración internacional de jóvenes expertos ayudará a enfrentar los desafíos de la formación en microbiología y servirá como un puente de comunicación entre científicos experimentados y en etapas tempranas de sus carreras. Para establecer una colaboración única, la Asociación de Pasantes (TAE) de la Sociedad Europea de Microbiología Clínica y Enfermedades Infecciosas (ESCMID) y el Círculo de Jóvenes Líderes (YLC) de la Sociedad Americana de Microbiología (ASM) han conjuntado esfuerzos para representar adecuadamente los intereses de los jóvenes integrantes de las dos sociedades más numerosas en la disciplina de la microbiología. A través de esta colaboración, ambas sociedades tienen como objetivo promover la formación continua de jóvenes científicos y del público en general. Además, se tiene la intención de identificar objetivos compartidos y proponer actividades conjuntas que propicien un proceso de intercambio beneficioso para mantener una relación duradera. Esta colaboración contribuye a mejorar tanto la calidad como la cantidad de la educación.

webinars and educational courses, and by providing evidence-based educational materials including guidelines, expert opinions, books, journals, and e-learning platforms. The European Society of Clinical Microbiology and Infectious Diseases (ESCMID) and the American Society for Microbiology (ASM) are among the most influential international societies in the field of microbiology. Both organizations have significant numbers of young members including trainees and graduate students, and their interests are represented by proactive young steering committee members and leaders within their societies. An international collaboration of young experts who already hold teaching roles in their respective countries (with the inevitable exchange of know-how) could help to address challenges in continuous postgraduate education. Previous research has demonstrated how international collaboration can readily be translated into improved outcomes (2, 3), and similar steps may be replicated to broaden access to state-of-the-art microbiology education.

ASM's Young Leaders Circle—actively promoting early career microbiologists' voices and student chapters

The Ambassador Program of the ASM became one of its flagship ventures, putting forth International Young Ambassadors of Science and U.S. Young Ambassadors of Science who are specifically engaged with students and early-career scientists worldwide. As of 2018, there are 21 U.S. Young Ambassadors of Science and International Young Ambassadors of Science representing the ASM in 80 different countries, reflecting the global importance of the ASM for facilitating outreach, networking, collaboration, and professional development among the next generation of microbiology specialists (Table I). The ASM's Young Leaders Circle (YLC) is an advisory group stemming from the Young Ambassador program, whose members represent Oceania, Africa, Asia, Europe, and the Americas. Young Leaders Circle members and their roles are pivotal to empowering early-career microbiologists' voices, supporting education and professional development, global network-

ing, increasing gender diversity in the field of microbiology, and setting the priorities of the whole Young Ambassador program (Table I).

An exciting way Young Ambassadors aim to foster the next generation of microbiologists globally is by establishing academic collectives that bring undergraduate and graduate students, as well as postdoctoral researchers and professors, together to form ASM International Student Chapters (ISCs). The first ASM ISC was established in 2013 in Brazil, with a format largely adapted from U.S. Student Chapters that had been successfully implemented since the 1970s. While there are currently more than 100 ASM Student Chapters in the United States, 17 have been created by Young Ambassadors internationally, encompassing all five continents.

Any academic institution in any country can have its own ISC, although aims may vary depending on the needs of each place and community. However, in general, students and postdoctoral fellows engaged in ISC have the opportunity to develop essential skills outside the training curriculum, including teamwork, scientific writing, improvement of communication skills, participation in and organization of meetings, and expansion of personal and professional networks.

International Student Chapters also have an impact outside the university setting by promoting scientific literacy among the general population, including K–12 teachers (i.e., teachers involved in primary and secondary education) and students, through the implementation of public outreach activities. Many students participating in ISCs discover new vocations, and the acquisition of new knowledge (not exclusively related to science) is the main benefit of ISCs from the student point of view. Students are the leading figures in ISCs, responsible for the management of the group and the organization of the activities, while professors act as mentors or advisors. From the professor's point of view, ISCs represent an easy and effective way to keep students engaged and motivated outside the classroom. Especially in low- and middle-income countries, academic collectives like ISCs could have a fundamental role in education by encouraging and inspiring students to pursue a scientific career.

TABLE I.
Main accomplishments of the ASM's Young Leaders Circle and the Trainee Association of ESCMID.

Organization	Accomplishments
ASMYLC	<ul style="list-style-type: none"> Representation of student and postdoc members within the pool of 47,000 ASM members Representation of 80 International and 21 U.S. Young Ambassadors of Science (as of 2018) Participation in the selection of new Young Ambassadors and new YLC members every year Active participation in the ASM Membership Committee (as a YLC sub-committee), with consulting roles Advisory role in the selection of proposals sent to the Young Ambassador Project Fund for local and international projects Supporting and fostering development and maintenance of ASM International Student Chapters (ISCs) Invitation to local experts from the Careers in Microbial Sciences Speaker Program to speak within respective student Chapters Co-organization of Track Hub Session at ASM Microbe 2018 on Global Antimicrobial Resistance together with Ambassador Leadership Circle (ALC) Outreach activities and science exhibitions for students; providing ASM Best Talk and Best Poster prizes at local and national meetings Publishing biyearly newsletter (entitled "Your Leadership Communication: Your Pathway to the ASM Young Ambassador's World") covering topics pertinent to Young Ambassadors, as well as student and postdoc members of ASM Monthly social media activity highlighting Young Ambassador and young members' work in all fields/areas of microbiology
TAE	<ul style="list-style-type: none"> Representation of 2,500 young members within ESCMID (including participation in the Educational Subcommittee) Representation of European trainees at the annual meetings of the European Union of Medical Specialists (UEMS) Working with UEMS sections Medical Microbiology and Infectious Diseases on the development of a Europe-wide curriculum Organization of TAE Day at the European Congress of Clinical Microbiology and Infectious Diseases (ECCMID) Co-organization of ECCMID sessions on specific topics of undergraduate and postgraduate training in the field of infection, and on career development Co-organization of ESCMID postgraduate educational courses throughout the year Organization of the TAE Training Achievement Awards Publishing papers in international journals regarding the results of trainee surveys (e.g., supervision, mentoring, working conditions, training adequacy) Partnership with International Federation of Medical Students' Associations on antimicrobial resistance Collaboration with ESCMID Study Group on Antimicrobial Stewardship on the development of postgraduate curriculum on antimicrobial resistance and antimicrobial stewardship Monthly social media activity promoting evidence-based medicine through sharing a selection of relevant research articles on specific themes in the field of microbiology

This is why ASM's Young Leaders Circle started to actively promote ISCs, making them one of the salient features of the biannual newsletter, which is available not only to all Young Ambassadors but also to Country Ambassadors, ASM leaders, and the general public (Table I). Accordingly, the second issue of the newsletter published in 2017 conveyed practical step-by-step guidance on how to establish an ISC in Young Ambassadors' institutions, while the first issue of 2018 brought inspiring interviews with current ISC presidents from

Brazil and Pakistan to showcase opportunities to interested parties. This interview also highlighted how ISCs could be used to translate ASM K–12 lesson plans promoting science education among public school students in Rio de Janeiro. Such real-world examples are used as an inspiration to promote this idea to Young Ambassadors, with potentially tremendous benefits for microbiology education.

The ASM's Young Leaders Circle is also a platform that can support its former members' efforts to progress to

senior positions in the ASM up to the Board of Directors (BOD). This is a perfect avenue to actively work in promoting and strengthening education practices worldwide as the ASM BOD sets the strategic direction of the society—including policy matters.

Many awards that were exclusively for U.S.-based members are now open to the international community. Furthermore, last year, ASM approved a donation to the AAAS [American Association for the Advancement of Science] Puerto Rico support fund to help rebuild Puerto Rico's scientific infrastructure after the devastating hurricane Maria. ASM is literally always seeking to develop new programs and opportunities for its members (international or not). (Past member of ASM's YLC and past member of ASM's Board of Directors)

Trainee Association of ESCMID—taking training to new heights

The Trainee Association of the ESCMID (TAE) was established in 2009 with the aim of improving training in clinical microbiology and infectious diseases through representation of trainees and young medical specialists and their involvement in decision-making processes in regard to postgraduate training and educational courses (Table I). The TAE steering committee represents the interests of approximately 2,500 young scientist members within ESCMID, ranging from students and trainees to young medical specialists who have recently finished their training, providing an opportunity to harness an extended network of young professionals for international collaboration.

The TAE has performed several surveys among trainees and young medical specialists in the field of clinical microbiology and infectious diseases to assess their satisfaction, as well as concerns and challenges the trainees face. We observed considerable heterogeneity between training conditions in European countries and identified significant gaps in training (4). The majority of respondents considered their training programs to be insufficient. Furthermore, many respondents indicated the lack of scientific activities in their training programs as a fundamental area for improvement. E-learning is a preferred education tool for young professionals as it has several benefits, including the possibility of studying at one's own pace and at different sites. Although those who had used it much appreciated e-learning, most training programs and courses do not provide training through this learning modality. We also observed significant heterogeneity in working conditions, which determined the satisfaction of the perceived work-life balance (5). In another international cross-sectional survey, we mapped the supervision experiences of European clinical microbiology and infectious diseases trainees during their training. This survey showed that only a third of respondents have received constructive feedback from their supervisor on a

regular basis and a considerable proportion of trainees felt that they did not receive sufficient supervision (6).

To address issues that are of particular interest to young professionals, the TAE organizes a Trainees Day on the first day of the annual European Congress of Clinical Microbiology and Infectious Diseases (ECCMID). During this event, each year approximately 100 young professionals have the opportunity to informally talk to senior experts in the field of clinical microbiology and infectious diseases on career development and share experiences. According to the feedback we receive, this event is highly appreciated and regarded as beneficial for career development. Additionally, the TAE aims to co-organize congress sessions to ensure that the needs and interests of young professionals are sufficiently addressed at the annual congress.

Over the past years, we have co-organized several ECCMID sessions on undergraduate and postgraduate training in the field of infection, including in career development. We have also co-organized postgraduate education courses, which are given on several occasions throughout the year. We are fortunate to have senior leaders in the society who recognize and support activities proposed by younger members. They appreciate the fresh ideas and hard work brought by young leaders.

Making the entire list of initiatives I have been involved in during these three years would be boring: as an example, I could mention the organization of TAE day and of some scientific sessions at EC-CMID editions 2015/16/17, the conducting of two web surveys, participation in several committees. Among the many things done, I am particularly proud of the efforts related to turning the results from the first survey (on working conditions and training adequacy of CM and ID residents across Europe) into two published papers, to prove our willingness to have a tangible impact on the lives of European trainees. (Past Vice-President of TAE)

Another important aspect is to recognize and reward trainees for excellent educational achievements. Each year the TAE honors trainees for educational achievements by providing the TAE Training Achievement Award. In contrast to many research awards available in societies, which mainly focus on research achievements, these awards emphasize excellence in teaching in national and international settings, which is often not appreciated as much as research achievements.

In pursuit of increasing our network and reaching other health professionals, young scientists, and the general public, TAE actively uses social media channels including Facebook and Twitter. We recognize the importance, influence and potential of newer communication tools to the next generation of professionals, which can help to deliver continuous postgraduate education. By sharing the latest updates in the field, keynote articles, and useful resources, we hope to contribute to the continuous education of this younger

generation. We actively promote and advocate the use of newer education tools we believe will eventually be incorporated into education programs alongside conventional tools of teaching. Additionally, we aim to raise the awareness of the general public of global health issues through social media channels by providing accurate, simplified, and trustworthy information. In addition to daily social media activity, we run monthly themes promoting evidence-based medicine by sharing a selection of quality research articles on specific topics in the field of microbiology. Some of the themes we identified in 2018 were penicillin allergy and associated adverse clinical outcomes, appropriate use of antimicrobials, the threat of antimicrobial resistance, and the benefits of antimicrobial stewardship. Through our activities, we have approached over 1,000 followers on Twitter and 550 on Facebook, and we make approximately 100,000 monthly impressions.

Collaboration as a way to respond to ongoing challenges

Although the ASM YLC and ESCMID TAE (stemming from the most influential societies in the field) have already implemented successful projects and activities that have enriched the education of young professionals, both societies acknowledge the importance of collaboration. The ASM YLC and ESCMID TAE therefore officially started a partnership to provide diverse and even far-reaching content and to develop all-inclusive opportunities for students and trainees all around the globe.

In November 2017, the acting chair of the ASM YLC and the president of the ESCMID TAE signed a Letter of Intent describing the basic framework of the partnership between the young leaders of these societies. Through this partnership, we aim to identify shared objectives to promote a reciprocally useful exchange process and a long-lasting relationship. The young representatives of the two leading societies in the field strive to collaborate to yield a convergent effect by exchanging best practices, including the most successful projects and experiences. We aim to collaborate on various activities including, but not limited to, joint projects, joint scientific symposia, workshops and meetings, and the exchange of materials, know-how, and technical assistance. We also consider the possibilities of joint teaching awards, shared use of social media, the deployment of joint e-learning platforms, and cooperative publication activities.

The first fruit of the ASM YLC and ESCMID TAE collaboration is a joint workshop which has recently been accepted to the ASM Microbe 2019. This early-career ESCMID/ASM “how-to” workshop will incorporate sessions on career development and professional skills through a series of “how-to” lectures (e.g., “How to enhance your leadership potential,” “How to write a manuscript,” “How to influence change”) presented by young professionals and members of the ASM YLC and ESCMID TAE who have expertise in the field.

Building on this success, an example that hopefully will be initiated in the near future is a multiple-day course explicitly focusing on the development of professional and practical skills for career development within the field of microbiology. This basic format could be used by both societies and their members with slight adaptations depending on the location and the audience. This program will incorporate e-learning material and be sufficiently promoted through social media channels. Another example is a potential joint publication in the form of a newsletter that will aim to bridge clinical microbiology with other areas of microbiology, emphasizing the rising popularity of translational scientific endeavors. The aim is to connect young researchers in basic microbiology with trainees in clinical microbiology, to promote collaborative translational research projects and possibly provide an ideal opportunity to devise new ways of enriching training curricula.

In our opinion, such collective efforts are needed to respond to ongoing challenges in microbiology education, which is a lifelong endeavor. Young microbiologists need to recognize that they are expected to engage in education matters not only to ensure a continued flow of qualified scientists into the field of microbiology but also to strengthen public confidence. With the advent of high-throughput sequencing platforms, bioinformatics, and complex genomic approaches, there has never been a more critical time for young microbiologists to interface with education. With this collaboration underway, we hope to bring young expert voices to the table and actively participate in the development and improvement of educational programs and postgraduate training curricula.

CONCLUSION

The ESCMID TAE and ASM YLC represent the interests of young members within the two largest societies in the field of microbiology. Building on our notable successes in promoting education and research, together we aim to improve the training of the next generation of professionals—including (bio)medical students, graduate students, postdoctoral researchers, trainees, and young medical specialists in the field of microbiology. With our partnership, we hope to contribute to advancing both the quality and quantity of education, which would be a substantial investment for the future of microbiology.

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Association of ESCMID. L.E.S.-G. is Chair-Elect of the Young Leaders Circle of ASM and a Young Ambassador of Science to Mexico. D.S.Y.O. is the President of the Trainee Association of ESCMID. The authors declare that there are no conflicts of interest.

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