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Where Do We Go from Here? A Forward-Thinking Vision for Physiology Undergraduate Education

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This paper is a summary of the special collection of papers in *Advances in Physiology Education* dedicated to the Physiology Majors Interest Group (P-MIG). P-MIG is a new and vibrant community (1, 2) of educators and administrators who are united by the common goal of creating physiology courses, curricula and programs that will prepare our students for the future. It is an independent consortium that welcomes anyone interested in physiology education at the level of the undergraduate degree in physiology and physiology-related fields. As demonstrated by this special collection of papers of *Advances in Physiology Education*, P-MIG has already made substantial progress in three areas: 1) developing curricular guidelines based on core concepts in physiology (8, 10, 13, 17, 18, 22), 2) developing guidelines for professional skills for our students and surveying advising practices (7, 9, 19), and 3) using survey data to learn about physiology educators and physiology (3, 16, 21).

Curricular Guidelines for Physiology Programs

One of the key missions of P-MIG is writing curricular guidelines for degree programs in physiology around the world. Many disciplines have degree programs guidelines set and maintained by the relevant professional society (e.g. (2)), but physiology degree programs do not. To address this, P-MIG has spent several years locating institutions with physiology and physiology-related degree programs, collecting data about the characteristics and course requirements (for details about institutions and degree programs, see (16, 18)). As shown in this special collection, programs vary from a series of physiology courses within a general major such as Biological Sciences to well-defined physiology-specific majors. Thus, guidelines developed by P-MIG will need to be broadly applicable to programs of small and large size and with subtle local differences in degree focus.

P-MIG will facilitate this process since one of its strengths is that it brings together faculty and administrators from multiple institution types (research intensive, state-funded, private, liberal arts, community colleges, etc.) and academic societies (American Physiological Society (APS), Human Anatomy & Physiology Society (HAPS), Association of Chairs of Departments of Physiology, American College of Sports Medicine).

Our efforts in curriculum mapping build Michael and colleagues (14, 15) who identified 15 core concepts that faculty identified as the most important for their physiology courses. P-MIG members have followed-up with surveys of faculty and programs to assess both the breadth and depth of coverage of these core concepts. Based on the survey results (18), the P-MIG Curriculum Committee found that the core concepts of physiology were robustly represented across physiology curricula and identified the five most commonly taught core concepts (Interdependence, Homeostasis, Structure Function, Scientific Reasoning, Cell-cell Communication). However, this ranking differed slightly from the original surveys, illustrating that the Core Concepts of Physiology are broadly applicable general models, but that programmatic guidelines should not be limited to a specific subset of core concepts. Thus, flexibility will be essential for shaping curricula to meet the needs of different student populations. Future work will be needed to expand the number of participating faculty and institutions and reduce barriers to attendance (especially cost; see (3)) while continuing to follow previously surveyed institutions as they revise their curricula.

The process of surveying curricula has already led to two very important outcomes. The first was that institutions with physiology-related majors (see (Anderson et al., 2020) in this issue for a description of types of institutions) who responded to the survey gained a broad overview of their curricula. This allowed them to identify strengths and weaknesses, and also to examine the alignment of their courses across their program.. The latter aspect is critical for the process of developing curricular guidelines. To facilitate this process, Shaltry (Shaltry, 2020) has developed an electronic curriculum mapping system (e-CMS). The e-CMS is a database that brings together information about assessments, teaching and learning activities, and learning objectives within courses, across programs and between institutions. When coupled with physiology core concepts, it will be a powerful way for institutions to self-assess their own programs, as well as share best practices.

The P-MIG community is uniquely qualified for future pilot testing e-CMS across multiple programs and communicating best practices for alignment. Communication will occur through P-MIG's website and annual conference, other physiology conferences such as HAPS and APS, and possibly advising organization such as National Association of Advisors for Health Professions (NAAHP).

The second outcome of the core concept surveys was that it helped to prioritize the concepts should be “unpacked” into smaller units. This unpacking provides additional information and insights that can be used to assess levels of student understanding and mapped within a course, curriculum or program. Four core concepts have already been unpacked (flow down gradients, homeostasis, cell-cell communication, and cell membrane) and two are in progress (mass balance

and structure/function) (13). These are not meant to be comprehensive for all physiology courses, nor are they meant to be prescriptive, rather they serve as scaffolds that can be adapted to the needs of a course or program. Crosswhite and Anderson (8), for example, interviewed faculty from four very different institutions who implemented the core concepts in a physiology course, demonstrating the flexibility and application of the core concepts at the course level.

As recommendations are made for physiology programs at universities, those programs must recognize and work with community colleges whose students transfer into their programs.

Approximately 40% of U.S. undergraduates are enrolled in a community college (1) and many of these students transfer into university after completing their two-years of study. Although some community colleges and 4-year institutions have partnered to align their courses (for example (6, 20)), many students still face obstacles when transferring (12) due to lack of course equivalency between 2-year and 4-year institutions. Community colleges also have a higher percentage of underrepresented students (~55%) than 4-year institutions (~45%)(11). A solution might be to develop physiology program curriculum that could be completed in two years by students with an associate degree from a community college (i.e. a 2+2 program). Thus, it will be important for P-MIG to partner and engage with faculty in community colleges so that P-MIG's recommendations going forward will take into consideration transferring students. This will ensure that transfer students will succeed in physiology programs and will also increase the diversity students in 4-year university programs and beyond.

Curricular Guidelines for Professional Skills and Advising

Although understanding core concepts is central to a physiology program, for future employment, students need to develop professional skills such as the ability to communicate effectively. In addition, most students who take physiology courses intend to enter a healthcare profession (16). Many of those students aspire to become doctors, but the number of students applying to medical school far exceeds the number of available spots (19). Students may not be aware of the tremendous growth in other healthcare careers (e.g. physician's assistants, occupational therapists), thus, they also require knowledgeable advisors and clear way to access help (19). To address this, P-MIG members conducted surveys and workshops to build a consensus list of professional skills that all physiology majors should have acquired upon graduation (9), how different institutions approach student advising (5), and student perceptions of their education (16).

The P-MIG Professional Skills Committee surveyed faculty and iteratively assembled a list of 13 professional skills that faculty think that students should develop over the course of their undergraduate degree (9). The list was organized into four broad categories: critical thinking, effective communication, socially and scientifically responsible conduct, and laboratory proficiency (9), which were consistent with recommendations from other organizations (e.g. Vision and Change (5)) and American Medical Association (4). An interesting finding of French et al (9) was that for some skills a high percentage of faculty rated them as “highly important”, but a lower percentage rated their students as “highly proficient” in those skills (see French et al. Table 1). This suggests a need for greater alignment within programs. The P-MIG Professional Skills Committee is beginning to develop and validate new professional skills rubrics. Because this is happening in parallel with the work of the P-MIG Curriculum Committee, P-MIG

members have an unprecedented opportunity to help institutions align both physiology content and professional skills across their curricula. Members will be able to pilot implementing new rubrics with new tools (e.g. eCMS (17)) at diverse institutions, and eventually disseminate best practices.

Along with Professional Skills, P-MIG members are concerned with how to advise students. It is essential that faculty and advisors help students to explore the many options in healthcare outside of the most familiar careers, such as medical doctor, physician assistant, and physical therapist. The P-MIG Advising Committee is developing guidelines for advising objectives for physiology students, while being mindful that programs will need to achieve these objectives in different ways. There are a variety of models of advising that fit institution size, resources, and mission. Across these models, most students surveyed reported being satisfied with the advising they receive (7), but longitudinal data are needed to understand how the advising affected their career trajectories. We need to find better ways to track and survey our graduates to continue to improve the training we offer at the undergraduate level by soliciting feedback from alumni.

The annual P-MIG meeting is already a venue where faculty and administrators have reported benefitting from discussions about student advising (Anderson et al., 2020), so we seek to expand these conversations beyond a single meeting. As we continue to develop best practices, we will work to connect the physiology education community with professional societies dedicated to advising, either generally (e.g. National Academic Advising Association, NAAA) or specific to the health professions (NAAHP).

Planning for the future

When complete, P-MIG recommendations for core concepts, professional skills, and advising (7–9) provide essential structure for the development and improvement of undergraduate physiology programs. P-MIG can support educators in the curriculum evaluation and assessment process, ultimately leading to development and improvement of curricula, resulting in enhanced student learning (10). Evaluation of the implementation of the recommendations within the curriculum can be conducted at individual institutions, with initial efforts already showing promise (8, 13, 18). Dissemination of results will occur through P-MIG’s website, presentations at annual meetings (i.e. P-MIG, APS) and publications (e.g. *Advances in Physiology Education*, *Cell Biology Education: Life Sciences Education*, *The Advisor*). Currently, P-MIG is the only organization to collect and analyze curricular data from undergraduate physiology programs across institutions (16, 18), and these efforts provide valuable resources for educators seeking to start a new program. Even if an institution does not have a physiology-specific major, guidelines for physiology core concepts can be used for aligning a subset of courses within a major, and guidelines for professional skills transcend content and are applicable to any STEM major.

Given the global diversity of physiology programs and prediction of large student demographic shifts, it is essential for P-MIG to be vigilant arbiters of how these recommendations impact various learners. Doing this will require the current P-MIG membership to recruit more diverse members. Although the institutions represented at the annual meetings are highly varied, including Hispanic Serving Institutions (UC Irvine, University of Arizona), the attendees (~83% Caucasian, (3)) do not yet reflect the broad diversity of students (~45% non-Caucasian, (11)). To address this, a fledgling P-MIG Communication Committee can help elevate the profile of P-

MIG to other societies or organizations who engage in undergraduate education research (e.g. Society for Biology Education Research), undergraduate advising (e.g. NAAA, NAAHP) and undergraduate STEM diversity (e.g. Society for the Advancement of Chicanos and Native Americans in Science, Annual Biomedical Research Conference for Minority Students), as well as individual programs, especially smaller institutions that may not have a specific physiology degree. Most of the attendees at the annual conference have been instructors/lecturers (presumably non-tenure track) or assistant professors (3). Clearly, instructional faculty are at the core of our organization, but institutional change requires input from all faculty at all ranks. A question for future discussion is how to motivate Associate and Full Professors who sit on the curricular committees for their institutions to engage with P-MIG.

Once there is an understanding of how programs implement the recommendations regarding curricula and advising, efforts can shift to the effectiveness of the implementation, including assessment of learning in diverse student populations. These data and expertise provide the necessary foundation for a consultation model, that could perhaps be modeled after PULSE (Partnership of Undergraduate Life Science Educators, pulsecommunity.org). Using materials and rubrics developed by the curriculum and professional skills committees, knowledgeable physiology educators could assist with developing and improving programs that align with recommendations (10, 22).

As manuscripts for this collection were going through the revise and resubmit process, Covid-19 became a global pandemic. At the same time, academia has become more aware of racial injustice and the need to change physiology education and institutional culture to be more

inclusive and strive for equity." These current events have brought to the forefront the critical importance of cross-cultural collaboration and the need to train diverse researchers and health professionals. P-MIG is a young organization, but it already has international membership. Developing a common language of curriculum, professional skills and advising will facilitate multinational exchanges. Tackling projects of this magnitude take time. Creating robust guidelines for curriculum, professional skills and advising is an iterative process in which drafts will be sent out to colleagues at diverse institutions for feedback and revision over the course of one or two years . The next phase of developing programmatic rubrics is also an iterative multi-year, multi-institution endeavor. Our vision is that commonalities and partnerships will facilitate a globally cooperative STEM workforce.

This paper is published as part of a special collection from P-MIG, a grass-roots organization that has formed to help develop programmatic guidelines and serve those engaged in undergraduate physiology or physiology-related programs. To find out more about this collective, or get involved, please visit our website (<https://www.physiologymajors.org>) and consider joining our listserv.

References

1. American Association of Community Colleges. Fast Facts 2020 [Online]. [date unknown]. <https://www.aacc.nche.edu/research-trends/fast-facts/>. Last accessed 9/2020
2. American Kinesiology Association. The Undergraduate Core [Online]. 2009. <http://www.americankinesiology.org/SubPages/Pages/The%20Undergraduate%20Core>. Last accessed 9/2020

3. Anderson LC, Rogers J, Stanescu CI, French MB, VanRyn VS, Wehrwein EA. Physiology Educators Find Community in the Physiology Majors Interest Group. *Advances in Physiology Education* Vol: pgs, 2020.
4. Association of American Medical Colleges. The core competencies for entering medical students [Online]. 2017. <https://students-residents.aamc.org/applying-medical-school/article/core-competencies>. Last accessed 9/2020
5. Brewer C, Smith D, editors. Vision and Change in Undergraduate Education: a call to action. AAAS: 2011.
6. California Career Resource Network. *Transferring from a California Community College*: [date unknown]. <https://www.calcareercenter.org/Home/Content?contentID=179>. Last accessed 9/2020
7. Crecelius AR, Crosswhite PL. Advising Physiology Students: Perceptions from the Programs. *Advances in Physiology Education* Vol: pgs, 2020
8. Crosswhite PL, Anderson LC. Physiology Core Concepts in the Classroom: Reflections from Faculty. *Advances in Physiology Education* Vol: pgs, 2020.
9. French MB, Choate J, Zubek J, Bryner RB, Johnson KMS, Luttrell MJ. Professional skills for physiology majors: Defining and refining. *Advances in Physiology Education* Vol: pgs, 2020.
10. Johnson KMS. Putting the guidelines to work: Moving from physiology undergraduate curricular guidelines to program development and improvement. *Advances in Physiology Education* Vol: pgs, 2020.
11. Ma J, Baum S. Trends in Community Colleges: Enrollment, Prices, Student Debt, and Completion [Online]. College Board Research: 2016. <https://research.collegeboard.org/pdf/trends-community-colleges-research-brief.pdf>. Last accessed 9/2020
12. McFarland J, Pape-Lindstrom P. The pipeline of physiology courses in community colleges: to university, medical school, and beyond. *Advances in Physiology Education* 40: 473–476, 2016.
13. McFarland JL, Michael JA. 10 years later: Reflections on core concepts for undergraduate physiology. *Advances in Physiology Education* Vol: pgs, 2020
14. Michael J, McFarland J. The core principles (“big ideas”) of physiology: results of faculty surveys. *Advances in Physiology Education* 35: 336–341, 2011.
15. Michael J, Modell H, McFarland J, Cliff W. The “core principles” of physiology: what should students understand? *Advances in Physiology Education* 33: 10–16, 2009.

16. Rogers J, McFarland JL, Stanescu CI, Crosswhite PL, Crecelius AR. The 2019 P-MIG Student Survey and Capturing the Undergraduate Perspective of Physiology Programming. *Advances in Physiology Education* Vol: pgs, 2020.
17. Shaltry C. A New Model for Organizing Curriculum Alignment Initiatives. *Advances in Physiology Education* Vol: pgs, 2020.
18. Stanescu CI, Wehrwein EA, Anderson LC, Rogers J. Evaluation of Core Concepts of Physiology in Physiology Undergraduate Curricula: Results from Faculty and Student Surveys. *Advances in Physiology Education* Vol: pgs, 2020.
19. Steele KJ, VanRyn VS, Stanescu CI, Rogers J, Wehrwein EA. Student career aspirations, employment paths, and perceptions on career preparation in undergraduate physiology degree programs. *Advances in Physiology Education* Vol: pgs, 2020.
20. Washington State Board for Community and Technical Colleges. *Transfer Degrees*: [date unknown]. <https://www.sbctc.edu/becoming-a-student/right-degree-you/types-of-degrees.aspx>. Last accessed 9/2020
21. Wehrwein E, Poteracki J, Halliwill J. A brief history of the Physiology Majors Interest Group (P-MIG). *Advances in Physiology Education* Vol: pgs, 2020.
22. Wehrwein EA, Stanescu CI, Anderson LC, Crecelius AR, Halliwill J, Rogers J. The case for coordinating efforts to establish program-level curricular guidelines and strengthen physiology undergraduate degree programs. *Advances in Physiology Education* Vol: pgs, 2020.