INTRODUCTION

The news that some U.S. nursing programs are eliminating microbiology courses from their curriculum comes as a shock to many. The scope of this ill-advised pursuit is not yet well defined, but it is occurring. A comprehensive survey of U.S. nursing programs is needed to determine the extent of the issue, but based on committee members’ communications, this action currently seems confined to a handful of nursing associate degree programs (ASN programs). So far, there have not been reports of baccalaureate level nursing (BSN) programs cutting microbiology. The American Society for Microbiology (ASM) maintains that this development is worth countermanding because microbiology is an essential part of a healthcare worker’s training.

MICROBIOLOGY IS AN ESSENTIAL COURSE IN ALLIED HEALTH AND NURSING PROGRAMS

To improve patient outcomes, the U.S. Department of Health and Human Services launched a major HAI reduction initiative. In 2016, new HAI reduction targets were released (reduction targets can be viewed at https://health.gov/hcq/prevent-hai-measures.asp) (3). While these targets are ambitious, they are feasible because 55% to 70% of all HAIs are likely preventable using non-drug interventions (4). That said, meeting these targets will require that nurses and allied health practitioners have a firm understanding of proper aseptic practices, an appreciation of infectious disease pathophysiology, a mastery of the basic principles of epidemiology and infection control, and a solid introduction to antimicrobial drug stewardship. Introductory microbiology courses deliver this essential education. A recent survey of registered nurses shows that they consider a broad array of medical microbiology topics as strongly relevant to their careers (5).
According to the U.S. Department of Labor and Statistics, there are over 3 million registered nurses in the U.S.—making them the largest segment of our healthcare workforce. It’s difficult to envision how cutting microbiology from the training of the largest segment of the American healthcare team would improve patient outcomes and reduce medical errors when the greatest threats to patient wellbeing directly relate to microbiology concepts. Additionally, proper communication is central to improving patient outcomes; a lack of bioscience understanding, including inadequate microbiology knowledge, is linked to nurses having decreased clinical confidence in communicating information to patients and infiel professionals (6).

**OVERVIEW OF MICROBIOLOGY IN NURSING DEGREE PROGRAMS**

The National League of Nursing Biennial Survey of Schools of Nursing, states that, in 2014, there were 1,869 nursing programs in the United States (1,092 associate degree programs, 710 bachelor’s programs, and 67 diploma programs) (7). These programs are managed at an institutional level, and their curricula are based on a collection of learning outcomes recommended by individual state nursing boards and the Accreditation Commission for Education in Nursing (ACEN). Accrediting bodies do not require specific courses in nursing program curricula. Instead they evaluate the curriculum to ensure it “supports the achievement of the end-of-program student learning outcomes and program outcomes and is consistent with safe practice in contemporary healthcare environments” (8). Because there is not an oversight agency mandating which courses should be in each nursing program, degree requirements vary from one school to another.

Despite federal initiatives to decrease time to graduation, there is only anecdotal information regarding what courses are included in a “typical” nursing degree. For example, there are no data on what proportion of nursing programs at each degree level require microbiology. However, a recent survey of registered nurses (RNs) confirms that an introductory microbiology course is the rule rather than the exception in nursing education. Most of the surveyed RNs (77%) had a formal microbiology course either as a prerequisite to their nursing program or within the program itself; half took a microbiology course that included a laboratory component (5). Similarly, microbiology is common in a number of allied health programs (e.g., physician assistant, dental hygiene, physical therapy, etc.). Due to scope considerations, this paper mainly focuses on microbiology in nursing programs because this is where there is evidence of microbiology courses being cut from curricula. Although an introductory microbiology course may be required as a prerequisite for admission into a nursing program or offered as a course within the degree program, there are no data to substantiate which approach is most common. The autonomy that we see in nursing program curricula is also seen in microbiology courses. While ASM has disseminated curriculum guidelines for undergraduate microbiology courses, there is not an enforced standard curriculum nor are there standard listed prerequisites for majors or nonmajors microbiology courses. Furthermore, until now, ASM has not presented guidelines with a focus on microbiology courses for nursing and allied health students.

**THE PROBLEM’S ETOLOGY**

Given the clear links between microbiology and competencies that nurses and allied health professionals need in their careers, ASM’s Committee on Microbiology in Nursing and Allied Health sought to understand why some ASN programs would remove microbiology courses from their curriculum. It was determined that three postsecondary education developments have placed microbiology courses under threat for removal from ASN programs. The first is curriculum alignment to learning outcomes and reporting learning outcome attainment to accrediting agencies. The second is a cap of 60 credit hours for associate degrees and 120 hours for bachelor’s degrees. The third is streamlining course sequencing to ensure that two-year associate degrees and four-year bachelor’s degrees are attainable in the time frame they are said to cover.

**Factor I: Aligning Curriculum to Learning Outcomes**

This first development is rooted in Margaret Spellings’s tenure as the U.S. Secretary of Education. Spellings formed the Commission on the Future of Higher Education to explore how well postsecondary institutions were preparing graduates for the 21st-century workplace. The commission’s 2006 report questioned whether students graduate from college with the competencies that postsecondary institutions state they value and teach (9). This spawned the learning outcomes tidal wave that has now fully immersed the U.S. education system from pre-K through graduate programs. All accrediting agencies now require that institutions draft program and course learning outcomes and report on the degree to which students are meeting each outcome.

As mentioned earlier, an important part of nursing program accreditation is based on how well the curriculum supports student attainment of learning outcomes. To this end, most state nursing boards and the ACEN ask nursing programs to list their program learning outcomes and then specifically note which courses support those outcomes. Ultimately, courses lacking learning outcomes that directly support program outcomes are considered irrelevant and are cut from the program.

While this simplified approach seems logical, it has pitfalls. The most obvious pitfall is that the process is highly dependent on learning outcome wording. If course learning outcomes fail to parallel the language in program learning outcomes, then it becomes difficult for someone on the outside looking in to see how the outcomes correspond.
This can easily lead a reviewer to erroneously conclude that a particular course does not feed the general program teaching and learning goals.

Unfortunately, this may be precisely what resulted in microbiology being cut from some ASN programs. The American Society for Microbiology’s 2012 general microbiology curriculum guidelines are not overtly clinical (10). This is not because microbiology lacks strong clinical applications but rather because the guidelines were intentionally worded to emphasize themes that align with the Vision and Change initiative (11).

The American Society for Microbiology’s 2012 curriculum guidelines were drafted to help microbiology faculty align courses with broad biological science themes. The problem is the guidelines are so broad that anyone who is not a microbiologist would likely struggle to see how these guidelines relate to nursing and allied health. The glaring absence of words like disease, illness, infection control, and pathogen could easily lead a non-microbiologist to wrongly conclude that microbiology is, at its core, non-clinical.

To resolve any confusion regarding microbiology’s link to clinical curricula, we hereby present Microbiology in Nursing and Allied Health (MINAH) Undergraduate Curriculum Guidelines (Appendix 1). These guidelines are recommendations for topics that should be emphasized in microbiology courses that train nursing and allied health students. Because laboratory skills are an invaluable link between theory and practice, the committee also recommends that programs protect the laboratory component of microbiology courses that train allied health and nursing students. Accordingly, recommended laboratory skills are included in the MINAH guidelines. A comprehensive description of how these guidelines were developed is provided in Appendix 2. The committee also mapped MINAH curricular guidelines with nursing licensure (NCLEX) competencies and the previously existing ASM general guidelines; these crosslinks are noted in the finalized guidelines presented in Appendix 1. As the committee was finalizing its drafting of these guidelines, Durrant et al. published a study that ranked content that nurses found to be the most relevant to their careers. In particular, practicing nurses who participated in the study found infection control, hospital-acquired infections, disease transmission, and the collection and handling of patient specimens to be the most relevant to their careers (5). The committee confirms that the MINAH guidelines are well aligned to that study’s findings.

**Factor 2: Credit Hour Caps**

Capping program credit hours ties back to the traditional view that fulltime students will take 30 credit hours per year. The credit hour cap must include all prerequisites so there are no “hidden” credit hours (12–14). This means if chemistry is a prerequisite for microbiology then it must be counted toward the total program credit hours—even if the program does not directly require chemistry.

Most states have capped bachelor’s degree programs at 120 credit hours and associate degree programs at 60 credit hours (15). The 2012 National Survey of Degree Programs by Complete College America was partially responsible for spurring this action. The survey revealed that while 69 percent of baccalaureate degree programs surveyed had a median requirement of 120 credit hours, “not a single one of the 104 associate degree programs [had] a median requirement of 60.” Associate in Science (AS) and Associate in Applied Science (AAS) programs were the most likely to creep above the 60 credit hour mark. Health professions degrees, including ASN programs that train registered nurses (RNs), were among the biggest credit creep offenders. The 89 nursing programs surveyed required an average of 71.7 credit hours for ASN degree completion (range of 60 to 96 credit hours; median of 72 credit hours) (16).

To return to the 60 credit hour model, many ASN programs have had to eliminate courses from their curriculum. In fairness, just because a course is cut, it does not mean all of the content has been stripped from a degree program. It is possible, and even likely, that programs that have eliminated microbiology as a full course have infused some of the content into nursing practice courses as a sort of “just in time” microbiology crash course. That said, it is impossible for such a model to deliver the same depth and breadth of content that a full microbiology course delivers and it grossly underestimates the relevance that microbiology has in protecting patients, the public, and care providers themselves. Furthermore, the microbiology laboratory curriculum rigorously incorporates hands-on practice of proper aseptic techniques, best practices for record keeping, and biosafety hazard management before students are in contact with patients and could do serious harm. Eliminating microbiology courses (lab and/or lecture courses) from ASN programs neglects the fact that baccalaureate nursing programs usually require a microbiology course with lab for admission. As such, ASN programs that cut microbiology are making it harder for their students to realize a seamless transition into baccalaureate nursing programs. This directly contradicts the Institute of Medicine’s recommendation that, “Academic nurse leaders across all schools of nursing should work together to increase the proportion of nurses with a baccalaureate degree from 50 to 80 percent by 2020” (17).

**Factor 3: Course Sequencing**

Making degree programs fit into the timeframe we say they can be completed in sounds simple; however, it is often complicated by prerequisites. In technical fields like nursing, courses tend to be sequential—building on each other as the student progresses through the program. For example, if microbiology requires Anatomy and Physiology I as a prerequisite, then the course sequencing has added at least another year of study to the program because students must complete Anatomy and Physiology I before taking Anatomy and Physiology II. If the school is small and can’t
sustainably offer each course every semester, then timely course progression is difficult.

The two most obvious solutions to the problem are to either cut prerequisites from microbiology or cut microbiology itself—and in doing, all of its prerequisite course baggage. Unlike 15 years ago, when introductory microbiology courses for both majors and nonmajors had at least one prerequisite, most nonmajors courses now lack prerequisites. While cutting prerequisites is not ideal from a pedagogy standpoint, it is certainly less drastic than completely cutting microbiology courses from nursing and allied health curricula.

At some institutions, especially at smaller schools, microbiology courses are often designed to train science majors alongside nonmajors such as allied health and nursing students. These “mixed majors” courses often deliver course content at the level that majors need. This in turn necessitates adding prerequisites so students are ready to tackle the more advanced content being presented. It is then difficult to cut prerequisites without adversely impacting majors and, simultaneously, it is impossible to retain prerequisites without adversely impacting nonmajors. As such, ASM’s committee on microbiology in nursing and allied health recommends that, whenever possible, institutions should split majors from nonmajors so that the specific teaching and learning needs of each group can be optimally addressed.

In support of differentiated curricula for majors versus nonmajors, and in recognition that these groups have different educational needs and backgrounds, ASM has recently published a microbiology concept inventory for majors (the MCI) along with the microbiology in health sciences concept inventory (the MHSCI). Seitz et al. (18) and Stevens et al. (19) show a need for differentiated majors versus nonmajors curriculum and differentiated concept tracking. The MINAH guidelines presented herein support this curriculum differentiation effort. If it is impossible to move away from a mixed-majors course, then curriculum differentiation within the course could serve the best interests of each student group. The “specific tracks within a course” approach has been successfully used at smaller colleges. For example, honors students in a course may get extra higher-level work that aligns with their ambitions to earn an honors diploma while non-honors students would not get that differentiated work. This strategy could be modified to differentiate majors versus nonmajors curriculum.

RECOMMENDATIONS AND NEXT STEPS

This paper is a resource to enhance communication with stakeholders to make it clear that microbiology is an essential course for training all nurses and allied health professionals. Faculty teaching microbiology to these students are encouraged to implement ASM’s Microbiology in Nursing and Allied Health (MINAH) Undergraduate Curriculum Guidelines and share these guidelines with other stakeholders such as nursing faculty colleagues, students, accrediting bodies, program administrators, and policy makers. Cutting microbiology is ill advised and counterproductive to reaching important national initiatives to limit medical errors, improve patient safety, reduce HAIs, and improve antimicrobial stewardship. As such, we strongly recommend retaining microbiology in nursing and allied health curricula. To help faculty advocate for retaining microbiology in these programs, the committee has developed a resource toolkit, which is accessible at https://www.asm.org/index.php/in-the-classroom#curriculum-guidelines.

Whenever possible, institutions should offer microbiology courses specifically for nursing and allied health as opposed to mixed majors. This allows for more prudent prerequisite inclusion or exclusion as needed to support student learning while balancing course progression and helping nursing and allied health programs operate within credit caps. It also makes sense because course learning outcomes can then be clearly articulated with the specific programs served.

While preparing the MINAH curriculum guidelines, the committee realized there is a need for a number of follow-up studies. The following data are not represented in the current literature and would be useful for this cause: 1) the number of nursing programs that require a microbiology course (with or without a lab component); 2) the percentage of programs that require microbiology as a prerequisite for admission versus deliver the course within the nursing program; 3) the percentage of institutions that offer separated majors versus nonmajors microbiology courses; and 4) the most common prerequisites for majors microbiology versus nonmajors microbiology.

SUPPLEMENTAL MATERIALS

Appendix 1: Microbiology in nursing and allied health (MINAH) undergraduate curriculum guidelines
Appendix 2: Development process for the ASM microbiology in nursing and allied health (MINAH) curriculum guidelines
Appendix 3: Alphabetical listing of the microbiology in nursing and allied health (MINAH) curriculum guidelines committee members

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