

# Microbiology in Nursing and Allied Health (MINAH) Undergraduate Curriculum Guidelines

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These recommended curriculum guidelines for undergraduate microbiology in nursing and allied health curricula are aligned to ASM's 2012 Curriculum Guidelines for undergraduate microbiology (<https://www.asm.org/index.php/guidelines/curriculum-guidelines>) as well as the test plan for the National Council Licensure Examination for Registered Nurses published in 2016 (NCLEX-RN; [https://www.ncsbn.org/RN\\_Test\\_Plan\\_2016\\_Final.pdf](https://www.ncsbn.org/RN_Test_Plan_2016_Final.pdf)).

## Part 1: Concepts & Statements

### *Impact of Microorganism in Health and Disease*

- 1. The microbiome consists of diverse cellular and acellular microbes that impact human health; a dysbiosis (imbalance) in the microbiome that changes the level, location, or diversity of the normal microbiota may lead to disease.**

*ASM Recommended Curriculum Guideline: 23*

*NCLEX-RN Alignment: Basic Care & Comfort; Physiological Adaptation*

- 2. Microorganisms are ubiquitous and live in diverse and dynamic ecosystems, including the human body.**
  - a. Microorganisms have different characteristics that place them in different taxonomic groups. An understanding of these groups supports infection management and informs the patient care plan.
  - b. Knowing where microbes thrive and what parts of the human body microbes colonize is important in infection control and for diagnosing infectious diseases.

*ASM Recommended Curriculum Guideline: 20*

*NCLEX-RN Alignment: Pharmacological & Parenteral Therapies; Safety & Infection Control*

- 3. Most bacteria in nature live in biofilm communities.**
  - a. Biofilm production presents unique challenges to healthcare such as providing a continuously available pathogen source for renewed infections and conferring resistance to antimicrobial agents.
  - b. Biofilms often form on implanted medical devices, introducing a unique challenge to infection control in healthcare settings.

*ASM Recommended Curriculum Guideline: 21*

*NCLEX-RN Alignment: Pharmacological & Parenteral Therapies; Reduction of Risk Potential*

- 4. Microbes interact with human hosts in beneficial, neutral, or detrimental ways.**
- Pathogens can be prokaryotic, eukaryotic, or acellular and primarily include bacteria, viruses, fungi, helminths, protozoa, and prions. A general understanding of these diverse groups is essential to guide healthcare practices and promote communication among professionals in such settings.
  - To best protect themselves and care for their patients, nurses should understand the microbiological and epidemiological features of pathogenic agents (e.g. etiological agent, reservoir, transmission patterns, incubation period, risk factors, potential complications, treatments, etc.)
  - Host factors, such as age and overall health and life habits, impact infectious disease development.
  - In humans, normal microbiota includes neutral and beneficial microbes (e.g. gut microbiota produce vitamins that humans cannot make and gut microbes compete with potential pathogens to limit their growth); also, microbes in probiotics are increasingly recognized as beneficial in a number of health applications.

*ASM Recommended Curriculum Guideline: 23*

*NCLEX-RN Alignment: Pharmacological & Parenteral Therapies; Safety & Infection Control; Health Promotion & Maintenance; Basic Care & Comfort; Physiological Adaptation*

**5. Humans use microorganisms and their products to make pharmaceuticals.**

*ASM Recommended Curriculum Guideline: 26*

*NCLEX-RN Alignment: Health Promotion & Maintenance*

**Microbial Pathogenicity**

- 6. Pathogens have diverse virulence factors that influence their pathogenesis and impact treatment options and clinical management.**
- Understanding adhesion factors, enzymatic factors, endospores, pathogen strategies to evade immune responses, endotoxins, exotoxins, and the nature of toxigenic bacterial strains is central to developing effective patient care plans for toxemia and sepsis/septic shock.
  - Understanding pathogenesis mechanisms allows healthcare workers to identify, properly treat, and reduce infectious disease transmission.
  - Bacteriophages can impact bacterial pathogenicity. For example, lysogenic bacteriophages can perform specialized transduction, which can confer new genetic traits to bacteria while lytic bacteriophages serve as vehicles for generalized transduction of new genetic traits.

*ASM Recommended Curriculum Guidelines: 8, 9, 10, 23*

*NCLEX-RN Alignment: Health Promotion & Maintenance; Safety & Infection Control*

- 7. Pathogens are continuously evolving and virulence is not a static property. Understanding mechanisms that impact pathogen evolution (i.e. vertical and horizontal genetic variation, mutations, recombination, etc.) is central to limiting pathogen evolution.**

- a. Gene transfer events such as transduction, transformation, and conjugation help bacteria gain new virulence factors, including the ability to make toxins and acquire antimicrobial resistance.

*ASM Recommended Curriculum Guidelines: 2, 3, 15*

*NCLEX-RN Alignment: Safety & Infection Control*

### **Identifying and Managing Infectious Diseases**

#### **8. Koch's postulates can be used to identify the etiological agent of certain infectious diseases.**

*ASM Recommended Curriculum Guideline: 23*

*NCLEX-RN Alignment: Management of Care*

#### **9. A variety of methods are used to identify infectious agents.**

- a. Serology and other diverse molecular methods are used to diagnose infections and identify causative infectious agents.
- b. Staining and biochemical test media are useful for identifying bacterial pathogens.

*ASM Recommended Curriculum Guideline: 34*

*NCLEX-RN Alignment: Physiological Adaptation*

#### **10. Vaccines are safe and effective methods to prevent disease.**

- a. Vaccines allow the host immune system to acquire memory against a particular pathogen.
- b. Vaccines are produced through a variety of methods, come in different formulations, and have different recommended schedules of administration that are designed to optimize immunization efficacy.
- c. Vaccines promote herd immunity and protect at risk populations that cannot be vaccinated. Understanding immune responses (especially the nature of immunological memory) helps nurses and other healthcare providers understand how vaccines work.
- d. Nurses and other allied health workers must be able to intelligibly speak about vaccines to all stakeholders.

*ASM Recommended Curriculum Guideline: 31*

*NCLEX-RN Alignment: Reduction of Risk Potential; Communication & Documentation; Physiological Adaptation*

### **Healthcare Associated Infections and Epidemiology**

#### **11. Healthcare associated infections (HAIs, nosocomial) are costly and often have a poorer prognosis than community acquired infections.**

- a. HAIs can be limited by standard/universal precautions, transmission precautions, surgical asepsis, and biosafety level precautions. These precautions are central to safely managing patients and safely collecting/analyzing patient samples.

*ASM Recommended Curriculum Guidelines: 23, 37*

*NCLEX-RN Alignment: Safety & Infection Control; Health Promotion & Maintenance; Therapeutic Environment*

**12. Tracking and reducing the incidence of healthcare acquired infections is a collaborative effort that saves lives.**

- a. Epidemiologists including those at state health departments, the Centers for Disease Control & Prevention (CDC), and the World Health Organization (WHO) use a variety of surveillance techniques to monitor certain infectious diseases. Being familiar with emerging and reemerging infectious agents is essential if healthcare teams are to be prepared to manage potential outbreaks.
- b. An understanding of nationally notifiable diseases is essential for compliance with reporting protocols.

*ASM Recommended Curriculum Guidelines: 23, 37*

*NCLEX-RN Alignment: Safety & Infection Control; Health Promotion & Maintenance; Therapeutic Environment*

**13. There are numerous strategies (i.e. quarantine, vector control, patient education) to break the epidemiological triangle and prevent disease transmission.**

*ASM Recommended Curriculum Guideline: 23*

*NCLEX-RN Alignment: Safety & Infection Control; Behavioral Intervention; Therapeutic Communication*

**Controlling Microbial Growth to Limit Disease**

**14. A microbe's survival and growth in a given environment depends on its metabolic characteristics.**

- a. Understanding a pathogen's metabolic features (e.g. aerobic versus anaerobic metabolism or ability to break down certain nutrients) is essential for recognizing where they can thrive and their potential for introduction into humans.

*ASM Recommended Curriculum Guidelines: 11, 13*

*NCLEX-RN Alignment: Physiological Adaptation; Basic Care & Comfort*

**15. Microbial growth is controlled using physical, chemical, mechanical, and biological means.**

- a. Physical and chemical methods are used to limit microbial growth in clinical settings. These are essential to reduce the incidence of healthcare associated infections (HAIs) and promote a safe and effective healthcare environment.
- b. The human body relies on specific and nonspecific immune defenses as forms of biological control against pathogens, but patients in healthcare settings are often immune suppressed or immune compromised.

- c. An understanding of microbial control (sterilization and disinfection methods) is essential to understand how critical, semi-critical, and non-critical equipment should be managed as well as how to properly prepare patient body sites for medical procedures like injections and surgery.

*ASM Recommended Curriculum Guidelines: 7, 8,14*

*NCLEX-RN Alignment: Pharmacological & Parenteral Therapies; Health Promotion & Maintenance; Physiological Adaptation; Basic Care & Comfort*

**16. Antimicrobial compounds combat bacteria, fungi, helminths, protozoans, and viruses.**

- a. Understanding structural and functional features of microbes allows us to develop new antimicrobial drugs and assess drug specificity mechanisms to limit adverse drug effects.
- b. The type of antimicrobial drug used to treat a particular pathogen depends on patient and microbe features.

*ASM Recommended Curriculum Guidelines: 14, 15*

*NCLEX-RN Alignment: Safety & Infection Control*

**17. Proper stewardship of antimicrobial drugs is essential to limit antimicrobial resistance.**

- a. Testing for resistance, tracking resistance, only prescribing antimicrobials when needed, and compliance with drug dosing regimens are aspects of antimicrobial drug stewardship.
- b. Improving antimicrobial drug stewardship requires that healthcare workers know when antimicrobial drugs are useful, recognize what microbes these drugs treat, and understand why prescription compliance is essential to combat antibiotic resistance.

*ASM Recommended Curriculum Guidelines: 14, 15*

*NCLEX-RN Alignment: Pharmacological & Parenteral Therapies; Safety & Infection Control; Psychosocial Integrity*

## **Part 2: Competencies and Skills**

### **Scientific Process and Critical Thinking Skills**

**18. Applying the process of science is relevant to nursing.**

- a. Understanding the process of science (making observations, drawing conclusions, appreciating the roles of theories and laws in science) is central to science literacy and fundamental to nursing practices.
- b. Analyzing and interpreting results from a variety of microbiological tests and applying analytical reasoning to solve problems are central to nursing practices.

*ASM Recommended Curriculum Guideline: 28*

*NCLEX-RN Alignment: Nursing Process*

**19. Using quantitative reasoning ties into nursing practice.**

- a. Nurses should be competent in drawing conclusions from charts and graphs related to patient medical history.

- b. Nurses should understand the metric system and scientific notation (e.g. milli ( $10^{-3}$ ), micro ( $10^{-6}$ ) and nano ( $10^{-9}$ ) scales) as this terminology is used in patient medical history (e.g. lymphocyte counts) and is used in calculating dosage for medications.
- c. Nurses should appreciate that microbe levels impact disease development and prognosis (i.e. lethal dose-50 and infectious dose-50 as parameters that impact morbidity and mortality).

*ASM Recommended Curriculum Guideline: 29*

*NCLEX-RN Alignment: Pharmacological & Parenteral Therapies; Reduction of Risk Potential*

**20. The ability to communicate and collaborate with other disciplines is important for a cross disciplinary healthcare team.**

- a. Microbiology is central to the top three threats in healthcare: healthcare associated infections, antibiotic resistance, and emerging diseases. Nurses and other allied health care workers should be able to effectively communicate about microbiology related topics in written and oral formats. Furthermore, nurses are often called upon to explain concepts that physicians mention to patients.
- b. Nurses must work effectively as individuals and in groups.

*ASM Recommended Curriculum Guideline: 30*

*NCLEX-RN Alignment: Communication & Documentation; Management of Care*

**21. Understanding the relationship between science and society improves clinical practice and promotes the human aspect of medicine.**

- a. Nurses should be able to identify and discuss ethical issues in microbiology, especially with regard to vaccines and antimicrobial drug stewardship.

*ASM Recommended Curriculum Guideline: 31*

*NCLEX-RN Alignment: Management of Care; Communication & Documentation; Psychosocial Integrity*

**Microbiology Laboratory Skills**

**22. Aseptic technique is central to collecting clinical samples and to protecting healthcare providers and patients.**

- a. Microbiology laboratory curricula cover aseptic methods as well as biosafety measures (correct handling and storage of patients' samples, proper handwashing, best practices for handling and disposal of sharps and other biological hazards, etc.). These competencies are central to protecting patients and healthcare providers.
- b. When applicable, specimen samples should be properly prepared for examination using microscopy (bright field and, if possible, phase contrast). Microscopy can lead to presumptive identification of certain pathogens (i.e. *Trichomonas vaginalis* and yeast infections).

*ASM Recommended Curriculum Guidelines: 32, 34*

*NCLEX-RN Alignment: Management of Care, Safety & Infection Control;*

*Health Promotion & Maintenance; Psychosocial Integrity;*

*Basic Care and Comfort*

**23. Microbiological and molecular lab techniques are key to identifying pathogens and implementing effective treatment options.**

- a. To effectively explain how diagnostics work and their strengths and limitations, nurses will benefit from an exposure to lab equipment and methods.
- b. Clinical microbiology techniques include using appropriate methods to enrich for and isolate microorganisms from clinical samples. Nurses are the main healthcare providers who collect such samples for analysis and they should understand how their work at the patient level can impact the accuracy of clinical microbiology tests.
- c. Nurses should understand how microbes are identified (e.g. the use of selective/differential media, rapid test kits, and molecular and serological methods).
- d. General staining procedures as well as differential staining procedures like the Gram stain and acid-fast stain are important in diagnosis. Nurses should understand the clinical implications that staining results have on diagnosis and treatment options.
- e. Understanding how pathogens are enumerated in a patient sample (for example, through direct count, viable plate count, and spectrophotometric methods) ties into how infections are treated and patient prognosis.

*ASM Recommended Curriculum Guidelines: 33, 34, 35, 36*

*NCLEX-RN Alignment: Management of Care*

**24. All healthcare providers must understand protective procedures for handling infectious materials to prevent the spread of disease.**

- a. Understanding biosafety levels and emergency procedures is central to safe nursing.
- b. Understanding proper biomedical waste management is important to reduce risk of pathogen exposure and limit infections.
- c. Properly employing personal protective equipment is a standard part of the microbiology laboratory curriculum.

*ASM Recommended Curriculum Guideline: 37*

*NCLEX-RN Alignment: Safety & Infection Control; Physiological Adaptation; Reduction of Risk Potential; Basic Care & Comfort*

**25. The ability to document and report on experimental protocols, results and conclusions is key to patient treatment.**

- a. Nurses must accurately label specimens and keep records.
- b. In the microbiology lab nurses learn how to properly label specimens, correctly maintain records/complete paper work (which may be considered legal documentation), and use flow charts to solve a problem or direct their action.

*ASM Recommended Curriculum Guideline: 38*

*NCLEX-RN Alignment: Communication & Documentation*