

# DEN5127 Infectious Diseases

Spring 2021

## Course Description:

Providing the foundation knowledge of etiologic agents responsible for infectious diseases important to the general practice of dentistry. Oral infectious diseases are emphasized. The course includes content on microbiology, virology, periodontology, and cariology, as well as systemic and oral diseases with both classical descriptive content and modern molecular biological aspects such as recombinant technology to create new vaccines.

## I. General Information

### Course Director:

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Phone: (352) 273-6672  
Course Credits: 4  
Semester: Spring

### Contributing Faculty

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## Support Staff

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## II. Course Goals

The goal of this course is to give dental students a fundamental understanding and knowledge of microbiology and how it relates to disease processes. Extensive emphasis will be placed on the role of the microbiota in health and in the infectious disease processes associated with cariology and periodontology. The virology section will cover information regarding viral infections (e.g. hepatitis and HIV-1) that may be encountered by the dental practitioner.

## III. Course Overview

This course consists of four modules that provide instruction in basic microbiology, oral fungi, periodontology, antibiotics, cariology, and virology. Emphasis is placed on bacterial pathogens that cause disease in various regions of the human host including the oral cavity.

Attendance is not mandatory, however, students are encouraged to attend as teaching faculty are not responsible for any recording technology failures.

The course directors are thrilled to teach this course and would like to get to know this class better. Please, feel free to send a picture of your pet or favorite animal to Dr. Abranches (jabranches@dental.ufl.edu). She will be more than happy to share with you a photo of her dog, Mr. Zico, upon request.

## IV. Course Outline

### **A. Introduction to microbiology**

1. Function and structural differences between prokaryotes and eucaryotes
2. Classification of bacteria
3. Introduction to bacterial pathogenesis
4. Overview of host-pathogen interactions
5. Principles of Sterilization and disinfection
6. Human Microbiome
7. Intestinal diseases: mechanisms and causative agents

8. Sexually transmitted diseases
9. Respiratory pathogens: Haemophilus, Bordetella, Legionella
10. Diseases caused by Streptococci and Staphylococci
11. Spore-forming bacteria: Clostridia and Bacillus
12. Opportunistic nosocomial pathogens
13. Mycobacteria
14. Biofilms

## **B. Fungi**

1. Candida
2. Other fungi affecting the oral cavity, nares, and upper respiratory tract

## **C. Periodontal diseases**

1. Host-pathogen interactions in the oral cavity
2. Biology of the subgingival plaque
3. Periodontal diseases
  - a. Gingivitis
  - b. Periodontitis
4. Periodontal pathogens
  - a. Aggregatibacter actinomycetemcomitans
  - b. 'Red' complex bacteria
  - c. 'Orange' complex bacteria
5. Oral health and systemic diseases
  - a. Cardiovascular disease and oral risk factors
  - b. Diabetes
  - c. Low birth weight babies

6. Endodontic infections

## **D. Antibiotics**

1. Mechanisms of action
2. Mechanisms of antibiotic resistance
3. Antibiotic resistance in bacterial biofilms
4. Use of antibiotics in dental medicine

5. Antibiotic prophylaxis

### **E. Cariology**

1. Supragingival plaque formation

2. Etiology of caries

3. Streptococcus mutans and other caries associated bacteria

### **F. Virology**

1. Introduction

2. Viral infections

3. DNA viruses

4. RNA viruses

5. Retroviruses

6. HIV

7. Hepatitis

## **V. Course Material**

Lecture handouts

Additional Resource:

Dental Lib Guide: <http://guides.uflib.ufl.edu/dental>

# VI. Course Objectives

## 1. INTRODUCTION TO BACTERIOLOGY

### 1. Structure and function/pathogenesis

- § Describe the difference between prokaryotic and eukaryotic cells
- § Review the shapes, sizes, and arrangements of bacterial cells.
- § Differentiate the gross differences between the cell-wall architecture of Gram-positive and Gram-negative organisms.
- § Categorize the biochemical structure of peptidoglycan. Describe the gross biochemical structure of lipopolysaccharide and its roles as an antigen (immunogen) and endotoxin.
- § Describe the roles in disease of the following bacterial virulence factors: capsules (or slime layers), lipopolysaccharides, exotoxins, and hydrolytic enzymes.

### 2. Host-Pathogen interactions

- § Review how host detects and responds to infections
- § Differentiate between innate and adaptive immune mechanisms in the oral cavity.
- § Describe mechanisms used by bacteria to evade host defense

### 3. Principles of sterilization and disinfection

- § Differentiate between sterilization and disinfection
- § Methods of sterilization
- § Methods of disinfection

### 4. Human Microbiome.

- § Describe microbial composition of healthy sites in the body and changes that happen during disease.

### 5. Enteric diseases

- § Describe the physiology, ecology, and pathogenic potential of *Escherichia coli* and list its mechanisms of disease.
- § Describe the nature of diseases caused by enteropathogenic, enterotoxinigenic, enterohemolytic, and enteroinvasive *E. coli* strains and the biologic activities of relevant exotoxins.
- § Describe the mechanism of disease (dysentery) caused by *Shigella dysenteriae*, the mode of action of shiga-like toxin, and the epidemiology and treatment of dysentery.
- § Describe the mechanisms of diseases caused by salmonella: typhoid fever (*S. typhi*), gastroenteritis (*S. enteritidis*), and septicemia; their symptoms, epidemiology, and treatment.
- § Cite the mechanisms of disease of *Vibrio cholerae*, the mode of action of cholera toxin, and treatment.

### 6. Respiratory pathogens

- § Describe how *Haemophilus influenzae* causes disease and what diseases it may cause.

- § Describe *H. influenzae* disease process in causing meningitis in children
- § Describe role of capsule of *H. influenzae* type b in disease process
- § Describe the major virulence factors of *Bordetella pertussis* and the role each plays in the mechanisms of the disease
- § Cite the particular environment associated with *Legionella pneumophila*.
- 7. Streptococci and Staphylococci
  - § Describe the morphological, staining, and general metabolic characteristics of streptococci.
  - § Describe the roles of virulence factors in bacterial disease and learn the importance of bacterial clonality in pathogenesis.
  - § Describe the suppurative streptococcal diseases: pharyngitis, scarlet fever, erysipelas, impetigo, etc.
  - § Cite the virulence factors of *S. pneumoniae*, the symptoms of lobar pneumonia, and treatment modalities.
  - § Describe the major virulence factors of *Staphylococcus aureus* and their modes of action.
- 8. Spore-forming bacteria
  - § Describe the different mechanisms of disease possessed by pathogenic *Clostridium* spp., including endospores and toxins.
  - § Describe the symptoms, diagnosis, and treatment of major clostridial diseases: tetanus (*C. tetani*), gas gangrene, food poisoning (both *C. perfringens*), antibiotic-associated colitis (*C. difficile*), botulism (*C. botulinum*).
  - § Describe the mechanisms of disease to include major virulence factors of *B. anthracis*.
  - § Describe the symptoms, diagnosis, and treatment of anthrax (*B. anthracis*).
- 9. Mycobacteria.
  - § Provide a description of the morphology, physiology, and staining characteristics of the mycobacteria and the species common to humans.
  - § Cite the key mechanisms and virulence factors of the mycobacteria.
  - § Describe the pathology of pulmonary tuberculosis, as well as its diagnosis and treatment.
  - § Describe the pathology of tuberculoid and lepromatous leprosy, along with diagnosis and treatment.
- 10. Opportunistic nosocomial pathogens (ESKAPE)
  - § Describe the general importance and pathogenic mechanisms of multi-drug resistant Gram-negative and Gram-positive bacteria. List the major genera: *Pseudomonas aeruginosa*, *Acinetobacter baumannii*, *Klebsiella pneumoniae* and Enterococci.

## 2. FUNGAL DISEASES

- § *Candida*
  - Differentiate the general morphological characteristics of fungi—both mycelial (molds) and cellular (yeasts).
  - Describe the virulence factors associated with *Candida albicans* and the conditions necessary for candidiasis.

- Differentiate the diseases in the oral cavity produced by Candida.
- Describe the therapies used in the treatment of oral candida infections

#### § Histoplasmosis

- Describe Histoplasma, its habitat, transmission, and diseases commonly produced.

### 3. PERIODONTOLOGY

#### § Biology of subgingival plaque

- Describe how plaque forms as a biofilm on the tooth surface
- Describe and differentiate between primary and secondary colonizers
- Describe the composition of the normal flora associated with health and the changes that occur that may lead to gingivitis and periodontitis
- Cite the risk factors that contribute to natural gingivitis, disease symptoms, and treatment.
- Cite the risk factors that contribute to natural periodontitis in adults, major diseases symptoms, and consequences of this disease if unchecked.
- Cite the difference between gingivitis and periodontitis

#### § Gingivitis

- Describe the experimental gingivitis model employed to determine bacterial species responsible for symptoms at various stages of progression.
- Describe the progression of the supragingival plaque from health to gingivitis
- Describe the effect that the host's immune response plays in gingivitis
- Cite the clinical features associated with gingivitis
- Cite the different clinical forms of gingivitis

#### § Periodontal disease syndromes

- Describe the symptoms and progression of periodontitis and learn the names of the Gram-negative, anaerobic bacterial species thought to be involved.
- Describe the nature of a "healthy" subgingival flora that results from successful therapy.
- Cite the difference between "recurrent" (limited sites) versus "refractory" (many sites) adult periodontitis.
- Describe the disease characteristics periodontitis in children, associated bacterial species, and treatment modalities.

#### § Periodontal pathogens

- *Aggregatibacter actinomycetemcomitans* (A.a.)
- Describe the bacteriologic characteristics, morphology, cultivation, metabolism and antigenic composition of *Aggregatibacter actinomycetemcomitans* (A.a.).
- Describe the relationship of A.a. with other members of the plaque microflora.
- Describe the virulence factors possessed by A.a. and how they may potentiate disease.

- Cite the diseases associated with Aa
- Cite the risk factors for the manifestation of Aa-associated periodontitis in children and young adults
- Describe and differentiate *Porphyromonas gingivalis* and *Prevotella intermedia*, their bacteriologic characteristics, and their association with periodontal disease.
- Describe the mechanism by which *P. gingivalis* may play a significant role in periodontitis
- Cite the members of the 'red complex' and the roles they may have in periodontal diseases

#### 4. Systemic diseases

- Cite specific systemic diseases that may be associated with periodontitis
- Describe the evidence linking periodontitis to low-birth weight babies
- Describe the evidence implicating periodontitis with cardiovascular diseases
- Cite the relationship between diabetes and periodontitis.

#### 5. Endodontic infections

- Describe the structure of the root canal in single- and multirrootedteeth
- Describe the infection process and potential source of bacteria in root canal infections
- Cite the role of *Enterococcus faecalis* in root canal infections
- Describe other bacteria associated with infected root canals
- Describe the effectiveness of various compounds in eradicating bacteria in infected and necrotic root canals

#### 6. ANTIBIOTICS

##### § Antibiotics

- Learn the definitions of the following: antibiotic, antimicrobial agent, bactericidal, and bacteriostatic.
- Describe the criteria used in selecting an antibiotic/antimicrobial agent for a particular disease state.
- Describe the chemical structure of the  $\beta$ -lactam antibiotics (penicillin, cephalosporin) and their modes of action in inhibiting bacterial cell wall biosynthesis.
- Cite the function of ribosomes in protein synthesis.
- Describe mechanisms by which antibiotics inhibit protein synthesis
- Describe the classes of antibiotics that inhibit bacterial nucleic acid synthesis and their common names.
- Describe the modes of action and side-effects of the nitroimidazoles and quinolones.

##### § Mechanisms of resistance

- Cite the mechanisms for  $\beta$ -lactam resistance in bacteria
- Describe the mechanisms of resistance to ribosomal binding antibiotics
- Describe how the efflux pump works
- Describe ribosomal protection

- Contrast antibiotic resistance in biofilms relative to planktonic cultures
- § Antibiotics in dental medicine
  - State the rationale for the selection and use of particular antibiotics as adjuncts to periodontal therapy
    - State the advantages and disadvantages of local delivery of an antibiotic as an adjunct to periodontal therapy
    - Compare the effectiveness of bactericidal versus bacteriostatic antibiotics
    - Describe when a bactericidal antibiotic is preferred over a bacteriostatic antibiotic
    - Antibiotic prophylaxis for endocarditis and major joint replacement

## 7. CARIOLOGY

- § Role of Bacteria in the Etiology of Caries
  - Caries as an infectious disease
  - Discuss the nonspecific plaque hypothesis.
  - Discuss the specific plaque hypothesis.
  - Explain the concept of the cariogenic potential of dental plaque.
  - List the likely etiologic agents of dental caries.
  - Compare the concepts of acidogenicity and aciduricity.
- § Streptococcus mutans and dental caries
  - Review the roles and types of bacterial virulence factors.
  - Describe non-sucrose dependent adhesion.
  - Describe sucrose dependent adhesion.
  - Describe the nutritional requirements of S. mutans with regard to their ability to colonize the oral cavity.
  - Describe dextran and fructan biosynthesis.
  - Explain the role of dextran in serving as a barrier to the diffusion of acids.
  - Describe the role of intracellular polysaccharide.
  - Describe acid tolerance.

## 8. VIROLOGY

- § Introduction
  - Define the general nature of viruses and learn their basic structures (nucleic acid, capsid, etc).
  - Differentiate between the genomic natures of DNA and RNA viruses.
  - Define the functions of viral capsids.
  - Describe the two geometric shapes of capsids (helical, icosahedral) and how sub-unit proteins contribute to these forms.
  - Describe the structure and function of the membranous envelopes possessed by some viruses.
  - Classify viral groups based on nucleic acid content, capsid geometry, and possession of envelopes.
  - Name each major group of RNA and DNA viruses.

- Describe the life cycle of a virus, including attachment, penetration, replication, and release.
- Describe the maturation and budding of enveloped viruses and compare with non-enveloped forms.

#### Viral infections

- Describe how viruses are cultured in vitro in tissue culture.
- Differentiate between the lytic and latent phases of viral replication and between permissive and non-permissive viral infections.
- Interpret the possible manifestations of viral infection of cells including cytopathic effect, proliferation, fusion, or transformation.
- Explain what is meant by the terms lytic, permissive, and productive.
- Review the host response to viral infections including innate defenses and the induction of specific antibody formation emphasizing the importance of the activation of cytotoxic CD8 T lymphocytes in the killing of virally infected cells and clearance of a viral infection.
- Review the principles of vaccine development and list those viruses for which approved vaccines are available as well as those in development.
- Describe currently available laboratory techniques for the isolation and identification of viruses including cellular assays, quantal assays, visual quantification, hemagglutination, immunoassays, nucleic acid hybridization, and polymerase chain reaction (PCR).

#### § DNA Viruses

- Describe the structure and characteristics of the parvoviridae and learn the two genera.
- Cite the diseases of children and pregnant women caused by parvoviruses.
- Describe the structures and infectious characteristics of the papovaviridae and the names of component genera.
- Describe the human diseases caused by polyomaviruses and papillomaviruses.
- Describe the structure and infectious nature of the adenoviridae.
- Describe the diseases caused by adenoviruses (respiratory and ocular).
- Describe the complex morphology and host specificity of the poxviridae.
- Describe the use of the vaccinia (smallpox) virus as a delivery vector for foreign genes in order to vaccinate against other viruses.
- Differentiate the four major genera of herpesviridae, their morphologies and existence as episomes in infected cells (latency).
- Describe the diseases caused by oral herpes simplex viruses (HSV1) and genital HSV (HSV2).
- Describe how the HSV infections are diagnosed and treated (acyclovir) and where the virus is harbored during latency.
- Describe the infectious effects of varicella zoster infections: chickenpox and shingles; and the relationship of the two diseases.

- Describe the tropism for human B cells of the Epstein-Barr virus and the self-limiting malignancies associated with EBV.

## § RNA Viruses

- Review the classification of the RNA viruses.
- Describe the morphology of the picornaviridae and learn the six major groups of picornaviruses.
- Discuss how the picornaviruses replicate within the human host cell.
- Describe the transmission and infectious nature of poliovirus.
- Cite the differences between the Salk and Sabin polio vaccines.
- Describe the disease symptoms of infections caused by Coxsackie viruses (A and B).
- Identify the major diseases caused by the following picornaviruses: enterovirus (hepatitis A), echoviruses and rhinoviruses.
- Detail why there is no good defense against the common cold caused by the rhinoviruses.
- Characterize the capsid structure and nucleic acid of the calciviridae, their differences with respect to picornaviruses, and the enteric diseases they cause.
- Characterize the capsid structure and nucleic acid of the coronaviridae and the respiratory diseases they cause.
- Describe the unique capsid components of the orthomyxoviridae (influenza) and how they determine serotypes.
- Describe the unique nucleic acid structure of the flu viruses, how it is replicated in the host nucleus, and how “antigenic shifts” may occur.
- Describe the composition of modern flu vaccines and their limitations (“antigenic drifts or shifts”).
- Recognize the component genera of the paramyxoviridae: paramyxoviruses, morbilliviruses, and enteroviruses.
- Describe symptoms of measles, caused by morbilliviruses, and the consequences of persistent infection (subacute sclerosing panencephalitis).
- Describe the disease caused by the respiratory syncytial virus or pneumovirus.
- Describe the capsid morphology and genomic nature of the togaviridae and define “arbovirus.”
- Identify the major diseases caused by togaviruses (three types of encephalitis), flaviviruses (St. Louis encephalitis, yellow fever, hepatitis C) and rubiviruses (rubella).
- Describe the viral morphology of the rhabdoviridae and the most important disease of this group: rabies.
- Describe the important characteristics of SARS-CoV2 and COVID19

## § Retroviruses

- Describe the capsid morphology of the retroviruses, the nature of its genome, and the role of reverse transcriptase.

- Outline the life cycle of this viral group including penetration, transcription of RNA into DNA, translation of mRNA to yield products of the GAG, POL and ENV genes, and assembly.

- List the three known human retroviruses, their diseases and prevalence.

#### HIV

- Describe the symptoms of infection by HIV, both the early and later stages of AIDS, as well as typical concurrent infections.

- Describe the epidemiologic features of HIV dissemination as a pandemic infection.

- Describe the recent observations on the pathogenesis of HIV as related to coreceptor expression on target cells and the role of lymph glands in viral replication.

- Describe the functions of the tat, rev, nef, vif, vpr and vpu viral proteins in regulation of the HIV life cycle.

- Describe current treatment modalities for AIDS and putative modes of drug action.

Learn the major impediments to developing an anti-HIV vaccine, including the diversity of the viral genome due to frequent mutations and a poor understanding of correlates of protection.

#### Hepatitis

- Describe the structure of the hepadnaviridae (hepatitis B virus, HBV), its mode of transmission and prevalence.

- Cite how HBV is diagnosed serologically and the roles of HBsAg, HBeAg and Dane particles.

- Describe the pathogenesis of hepatitis B including duration, symptoms and severity, and the nature of chronic carriers of HBV.

- Cite the composition of the currently used anti-HBV vaccine (recombinant subunit)

- Describe the structure and composition of the hepatitis delta virus and its intimate association with HBV.

#### § Biomedical application of viruses

- Describe the applications of retroviruses in biomedical research.

- List some examples of the application of AAV and adenoviruses.

- Explain what oncolytic viruses are and describe some examples.

- Describe phage therapy.

## VII. Course Competencies

This course teaches the following competencies in the "[Competencies for the New Dental Graduate](#)".

Domain I: Critical Thinking

3: Apply biomedical science knowledge in the delivery of patient care.

## VIII. Evaluation

Assigning Grades: Evaluation of student progress will be obtained by means of four (4) multiple choice examinations. Each exam will cover a particular section of the material. There will generally be 4-6 questions from each lecture from the particular block of instruction. There will be no cumulative final examination.

**Make-up exams for individuals who missed an exam with an excused absence will be totally up to the discretion of the course director.** Alternatively, at the **course director's discretion**, the student may be excused from the missed exam and the grade will be calculated based on the other three exams. Students missing an exam without an excused absence will receive a '0' on the missed exam and will not have the option to make up the exam. An excused absence other than with a medical excuse will be entirely up to the course director's approval. No student will be excused from missing an examination after the fact unless accompanied by a documented medical reason.

### Assigning Grades

Final grades will be based on the multiple choice examinations described above. Each exam may be slightly different in length due to the number of lectures in the block of material being covered by the exam. Each question will be equally weighted, e.g. all questions will count the same regardless of the number of questions on an exam.

Following each exam, the students may review the questions that they missed in the computer testing laboratory. It is the belief of the course director that the exam process is a learning experience as well as a means of evaluating student progress.

Total points=100% of the grade.

Honorlock will proctor your exams this semester. Honorlock is an online proctoring service that allows you to take your exam from the comfort of your home. You DO NOT need to create an account, download software or schedule an appointment in advance. Honorlock is available 24/7 and all that is needed is a computer, a working webcam, and a stable Internet connection. To get started, you will need Google Chrome and to download the Honorlock Chrome Extension. You can download the extension at [www.honorlock.com/extension/install](http://www.honorlock.com/extension/install).

When you are ready to test, log into the LMS, go to your course, and click on your exam. Clicking Launch Proctoring will begin the Honorlock authentication process, where you will take a picture of yourself, show your ID, and complete a scan of your room. Honorlock will be

recording your exam session by webcam as well as recording your screen. Honorlock also has an integrity algorithm that can detect search-engine use, so please do not attempt to search for answers, even if it's on a secondary device. Good luck! Honorlock support is available 24/7/365. If you encounter any issues, you may contact us by live chat, phone (844-243-2500), and/or email (support@honorlock.com. If you encounter issues within the LMS, you may contact Your School's Online Support Services team at their number.

## Remediation:

Course remediation will consist of a comprehensive multiple choice exam that may or may not cover all of the lectures in the course. The decision as to the material to be covered in the remediation process will be entirely up to the discretion of the course director.

## IX. Administrative Practices

Administrative practices for all UFCD courses are universally applied. Exceptions to or deviations from these practices are stated in the individual syllabi by the course director. When not individually stated in the syllabus, course administrative practices default to those identified under "Course Policies" on the DMD Student Website:

<https://dental.ufl.edu/education/dmd-program/course-policies/>

## X. Grade Scale

### DEN5127 Grade Scale

<b>Method</b>	Letter Grade
<b>Scale</b>	100
<b>Tolerance</b>	0.5 (Final letter grades within this range will be rounded up.)
<b>A</b>	93 - 100
<b>A-</b>	90 - 93
<b>B+</b>	87 - 90
<b>B</b>	83 - 87

**B-** 80 - 83

**C+** 78 - 80

**C** 70 - 78

**E** 0 - 70