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SHORT COMMUNICATIONS

Mapping of Medical Microbiology Content in a Clinical Presentation Curriculum

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Abstract
Clinically important microbes, and the pathogenesis, symptoms and diagnosis of their corresponding infectious diseases were integrated into clinical schemes within a clinical presentation curriculum. Decisions on microbe placement considered a variety of factors, including spaced reinforcement of major pathogens. We report here the map of our integrated medical microbiology curriculum.

The pervading trend in medical education is integration of formal knowledge with clinical experience. A strong rationale for this approach is that student retention of non-contextualized basic science information is poor.[1-6] Indeed, students who learn symptoms of a disease in the context of biomedical information are better able to retain their diagnostic performance over time than those who learn disease symptoms in isolation.[7-9]

A. T. Still University's School of Osteopathic Medicine in Arizona (ATSU SOMA) considered this critical issue when designing the curriculum. The SOMA program includes an integrated clinical presentation curriculum (CPC), and early contextual learning experiences.[10-12] Our students learn to diagnose using inductive reasoning through investigation of clinical schemes that represent the most common presenting signs or symptoms (e.g. abdominal pain). Schemes provide a framework that students can use for both learning and problem solving, and reveal the road map that an expert clinician uses in an inductive decision-making process.[10,13] Thus, the schemes serve two purposes, to organize learning and to solve clinical problems.[14]

In SOMA's CPC, 131 schemes are organized into 11 organ system courses that are sequenced through the student's first two years. Instruction in basic, clinical and social sciences occurs within each scheme. Figure 1 shows the sequence of the courses in years 1 and 2, in addition to Medical Skills and Osteopathic Principles and Practice courses run in parallel. Year 1 begins with Principles of Medicine, where students learn basic science fundamentals in the context of clinical scenarios. As an example, bacterial endospores are introduced in a clinical scenario where a patient receives a tetanus booster after falling off a horse and fracturing her radius and ulna. Students are introduced to their first scheme, Sore Throat/Rhinorrhea, toward the end of Principles of Medicine.

For medical microbiology, clinically important microbes, and the pathogenesis, symptoms and diagnosis of their corresponding infectious diseases are integrated into the schemes within each organ system. As summarized in Table 1 (see Appendix), the medical microbiology content, presented in the context of infectious diseases, is integrated into 47 schemes housed within 8 organ systems. Decisions on optimum placement of medical microbiology topics are multifactorial. At the outset, a comprehensive list of objectives/content topics is formulated. The layout takes into account significance to the scheme, and whether the topic has been identified by USMLE, COMLEX and published medical microbiology core knowledge objectives.[15] Integration with other basic science and clinical knowledge disciplines is coordinated.

Because spaced repetition promotes retention of knowledge and improvement of clinical skills, a critical consideration in placing medical

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microbiology topics within the schemes is opportunity for review of major human pathogens.[16-21] Placement of a major pathogen in multiple schemes and courses allows us to reinforce and build on material presented initially. When a pathogen is first introduced within a relevant scheme, its general characteristics and epidemiologic and clinical significance are discussed. Features such as growth characteristics, virulence factors and immune responses associated with that particular clinical presentation are emphasized. When the organism is revisited under other schemes, characteristics relevant to that clinical presentation are covered. Figure 2 provides an example of the distribution of *Staphylococcus* characteristics across the courses. The guiding principle here resembles that of Wilkerson et al., who have developed an ascending spiral pre-clerkship curriculum in which content is purposively repeated at a higher level of complexity.[21] The layout of our map also reflects intentional review of major pathogens prior to board exams. Features of *Pseudomonas aeruginosa* infection, for example, are covered in five courses over the 2-year period (Table 1, see Appendix), with a final review in Dermatology (Figure 1).

Basic concepts and recurring themes in medical microbiology are woven throughout years 1 and 2 of the curriculum. For example, the role of biofilms in the pathogenesis and treatment of joint infections, endocarditis, catheter infections, periodontitis, vaginitis and otitis media is addressed in the Neuromusculoskeletal, Cardiopulmonary, Renal and Endocrine, Gastrointestinal, Genitourinary, and Senses courses, respectively. Lipopolysaccharide (LPS) is another example of a recurring topic. After students grasp LPS structural features and their relationship to disinfectant and antibiotic resistance in Principles of Medicine, the role of LPS in immune evasion and the pathogenesis and symptoms of gram-negative infections is discussed in multiple courses. Another major recurring theme is the predominance of human infection due to normal microbiota, which maps readily to all of the courses. Our strategy is designed to aid in the transfer of basic science knowledge to clinical learning. In transfer, a concept learned in one context is used to solve a problem in a different context, and this phenomenon is enhanced when multiple examples are provided.[22] In addition to facilitating transfer, the reinforcement of medical microbiology principles over time within a clinical context likely facilitates long-term retention of the substantial amount of microbiology knowledge medical students must acquire.[16-21]

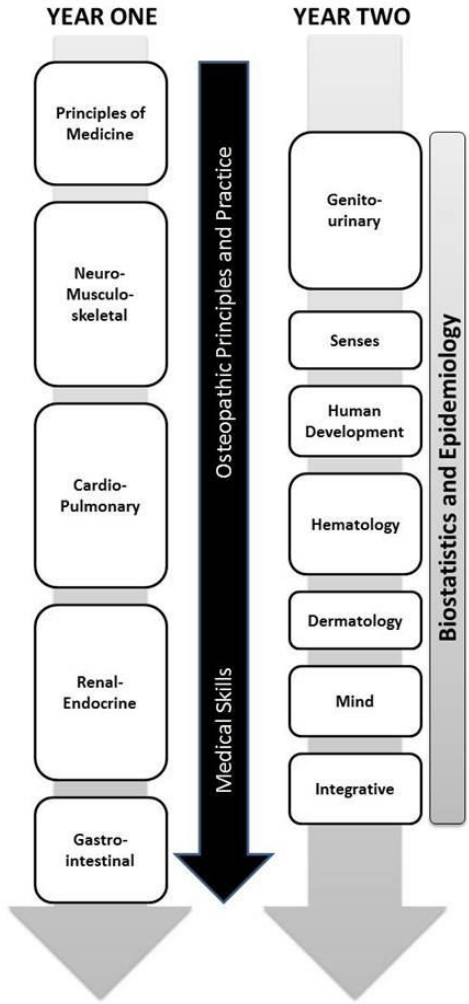

Figure 1. *Sequence of organ system courses in years 1 and 2. Box size is proportionate to the length of each course. Students receive training in Medical Skills and Osteopathic Principles and Practice throughout years 1 and 2. Biostatistics and epidemiology is integrated throughout year 2.*

Delivery of didactic content in our year 1 curriculum reflects the diverse styles of the basic science and clinical faculty involved in each organ system. Multiple approaches, including flipped classrooms, problem based learning, case studies, gallery walks, interactive clicker sessions, games, and traditional lectures are employed. ATSU SOMA MS years 2-4 train in a contextual setting at and around one of eleven community campuses nationwide (each affiliated with the National Association of Community Health Centers), and thus receive didactic content via podcasts.[11,12] As there are no CPC textbooks, content resources are similar to those at institutions with more traditional curricula. Incoming students receive a list of 22 required textbooks which are used throughout their first two

years. For medical microbiology, we require a single non-clinical microbiology text, and recommend an organ-system based microbiology text for clinical correlates. The current lack of CPC-based texts requires faculty to carefully structure their presentations around particular schemes.

One drawback to a CPC, particularly in a relatively new program such as ours, is that scheme details and the sequence of the organ systems are not static. Placement of microbes evolves with new knowledge and with changes in sequencing of the organ systems. However, the availability of a template facilitates this process enormously. Teamwork within the discipline and across disciplines is essential; flexibility and communication are absolute requirements! Another drawback is the need to condense information within an integrated course that contains both basic science and clinical components; however, this is an issue with any integrated curriculum. Faculty need to be mindful that students may have difficulty keeping track of the big picture for a particular discipline. Finally, it's challenging to find the optimum location to cover microbes like *Staphylococcus* and *Streptococcus* that cause important infections in multiple organ systems, and emerging infections like hantavirus that cause divergent symptoms.

In providing a clinical framework for two years of basic science instruction and small group case work, the scheme-based clinical presentation model is likely motivating for students, and may enhance understanding, long-term retention and clinical problem solving skills. The Infectious Diseases Society of America Preclinical Curriculum Committee now advocates a medical education approach that facilitates transfer of classroom knowledge to the bedside.[23] SOMA's integrated medical microbiology content is an excellent example of such an approach. Our medical microbiology map may be of value to other programs interested in developing a scheme-based CPC.

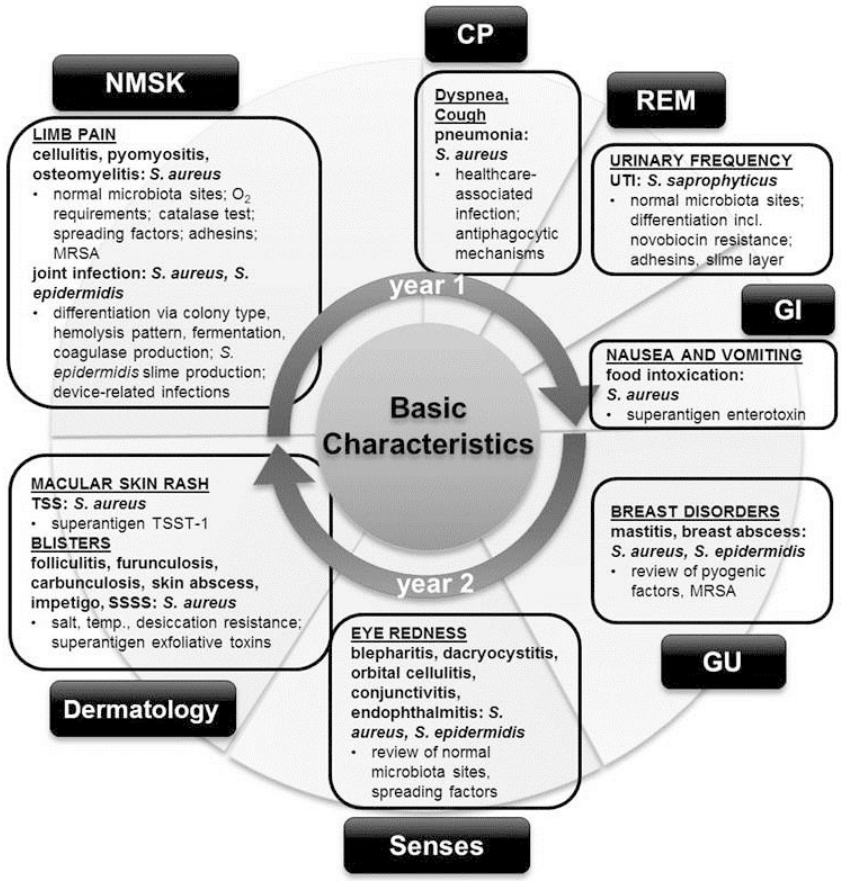

Figure 2. Distribution of Staphylococcus topics across the curriculum. Clinically important members of the genus are introduced/reviewed in eight of the 47 schemes, and in all but one (Hematology) of the organ systems that include medical microbiology content. Basic characteristics, including morphology and gram-stain reaction, are reviewed in each of these schemes. Schemes are underlined. NMSK= neuromusculoskeletal, CP= cardiopulmonary, REM= renal and endocrine, GI= gastrointestinal, GU= genitourinary.

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Keywords

Medical microbiology, scheme, clinical presentation curriculum, integration, basic science

References

1. Swanson DB, Case SM, Luecht RM, Dillon GF. Retention of basic science information by fourth-year medical students. *Acad Med*. 1996; **71:** S80-S82.
2. Fincher, RE, Wallach PM, Richardson WS. Basic science right, not basic science lite: Medical education at a crossroad. *J Gen Intern Med*. 2009; **24:** 1255-1258.
3. Schmidt HG, Rikers RMJP. How expertise develops in medicine: knowledge encapsulation and illness script formation. *Med Educ*. 2007; **41:**1133-1139.
4. Custers JFM. Long-term retention of basic science knowledge: a review study. *Adv Health Sci Educ*. 2010; **15:** 109-128.
5. Watt ME. Retention of preclinical knowledge by clinical students. *Med Educ*. 1987; **21:** 119-124.
6. 6.D'Eon MF. Knowledge loss of medical students on first year basic science courses at the University of Saskatchewan. *BMC Med Educ*. 2006; **6:** 5.
7. 7.Woods NN, Brooks LR, Norman GR. The value of basic science in clinical diagnosis: Creating coherence among signs and symptoms. *Med Educ*. 2005; **39**: 107-112.
8. 8.Woods NN, Neville AJ, Levinson AJ, Howey EHA, Oczkowski WJ, Norman GR. The value of basic science in clinical diagnosis. *Acad Med*. 2006; **81:** S124-S127.
9. Woods NN, Brooks LR, Norman GR. It all makes sense: biomedical knowledge, causal connections and memory in the novice diagnostician. *Adv Health Sci Educ*. 2007; **12:** 405-415.
10. Mandin H, Harasym P, Eagle C, Watanabe M. 1995. Developing a "Clinical Presentation" curriculum at the University of Calgary. *Acad Med*. 1995; **70:** 186-193.
11. Schwartz FN, Hover ML, Kinney M, McCoy L. Student assessment of an innovative approach to medical education. *Med Sci Educ*. 2012; **22:** 102-107.
12. Schwartz FN, Hover ML, Kinney M, McCoy L. Faculty assessment of an innovative approach to medical education. *Med Sci Educ*. 2012; **22:** 108-116.
13. Woloschuk W, Harasym P, Mandin H, Jones A. Use of scheme-based problem solving: an evaluation of the implementation and utilization of schemes in a clinical presentation curriculum. *Med Educ*. 2000; **34:** 437-442.
14. Mandin H, Jones A, Woloschuk W, Harasym P. Helping students learn to think like experts when solving clinical problems. *Acad Med*. 1997; **72:** 173-179.
15. Booth SJ, Burges G, Justemen L, Knoop F. Special Communication: Design and implementation of core knowledge objectives for medical microbiology and immunology. *JIAMSE*. 2009; **19:** 100-138.
16. Kornmeier J, Sosic-Vasic Z. Parallels between spacing effects during behavioral and cellular learning. *Front Hum Neurosci*. 2012; **6:** 1-5.
17. Bahrick HP, Hall LK. The importance of retrieval failures to long-term retention: A metacognitive explanation of the spacing effect. *J Mem Lang*. 2005; **52:** 566-577.
18. Shebilske WL, Goettl BP, Corrington K, Day EA. Interlesson spacing and task-related processing during complex skill acquisition. *J Exp Psych:Applied*. 1999; **5:**413-437.
19. Kerfoot BP, Fu Y, Baker H, Connelly D, Ritchey ML, Genega EM. Online spaced education generates transfer and improves long-term retention of diagnostic skills: A randomized controlled trial. *J Am Coll Surg*. 2010; **211:** 331-337.
20. Kerfoot BP, Shaffer K, McMahon GT, et al. Online "Spaced Education Progress-Testing" of students to confront two upcoming challenges to medical schools. *Acad Med*. 2011; **86:** 300-306.
21. Wilkerson L, Stevens CM, Krasne S. No content without context: Integrating basic, clinical, and social sciences in a pre-clerkship curriculum. *Med Teach*. 2009; **31:** 812-821.
22. Norman G. Teaching basic science to optimize transfer. *Med Teach*. 2009; **31:** 807-811.
23. Southwick F, Katona P, Kauffman C, et al. Commentary: IDSA guidelines for improving the teaching of preclinical medical microbiology and infectious disease. *Acad Med*. 2010; **85:**19-22.

Appendix

Table 1. Medical microbiology content mapped to 47 schemes and eight courses. [a]Introduction to Medical Microbiology includes classification, normal microbiota, fundamentals of bacteriology, mycology, parasitology and virology, and introduction to microbial pathogenesis and diagnosis. [b]Etiologies in bold: introduction/content relevant to clinical presentation; etiologies in non-bold: review/content relevant to clinical presentation; etiologies in parentheses: mentioned but not discussed.

Organ System/ Course	Principles of Medicine			Neuro-Musculoskeletal I (Musculoskeletal System Emphasis)				
Clinical Scheme	**None**	**Sore Throat/ Rhinorrhea**		**Pain Nociceptive Upper Extremity Pain Nociceptive Lower Extremity**			**Lump/Mass Musculo-skeletal**	**Spinal Pain**
Infectious Disease/ Topic	Introduction to Medical Microbiology[b]	pharyngitis diphtheria common cold hand-foot-mouth disease mononucleosis		cellulitis necrotizing fasciitis pyomyositis myonecrosis osteomyelitis	joint infection	Lyme disease	viral oncogenesis: sarcoma, papillomas, etc.	tuberculosis
Microbe[a]	***Clostridium tetani*** (Herpes simplex 1 virus, human papillomavirus)	bacteria: ***Streptococcus pyogenes* (and Group C&G)** ***Corynebacterium diphtheriae*** *(Neisseria gonorrhoeae, Haemophilus influenzae, Treponema pallidum, Mycoplasma pneumoniae, Chlamydophila pneumoniae)*	viruses: **Rhinovirus** **Non-Rhinovirus enteroviruses** **Coronavirus** **Adenovirus** **HSV** **Epstein-Barr virus** (Influenza virus, Parainfluenza virus, Respiratory syncytial virus, Cytomegalovirus)	***Staphylococcus aureus*** ***S. pyogenes*** ***C. perfringens*** ***Actinomyces* spp.** ***Nocardia* spp.** ***Pseudomonas aeruginosa*** ***H. influenzae*** ***Eikenella corrodens*** ***Pasteurella* spp.** ***Brucella* spp.** ***Bartonella* spp.**	*S. aureus* ***S. epidermidis*** ***N. gonorrhoeae***	***Borrelia burgdorferi***	EBV **HPV** **Human herpes virus-8** **Human T-cell lymphotropic virus** **JC virus** **BK virus**	***Mycobacterium tuberculosis***

Organ System/ Course	Neuro-musculoskeletal II (Neurological System Emphasis)					
Clinical Scheme	**Headache Acute Neurological Deficits Seizures**				**Cognitive Impairment**	**Weakness**
Infectious Disease/ Topic	acute and chronic meningitis encephalitis brain abscess			neuro-cysticercosis	prion disease AIDS syphilis	progressive multifocal leukoencephalopathy West Nile disease polio, botulism
Microbe[a]	bacteria: ***S. pneumoniae*** ***S. agalactiae*** ***N. meningitidis*** ***Listeria monocytogenes*** *(H. influenzae, M. tuberculosis, Escherichia coli)*	viruses: Non-Rhinovirus enteroviruses Herpesviruses **Arboviruses** **Rabies virus**	fungus: ***Cryptococcus* spp.** parasite: ***Taenia solium***	***Toxoplasma gondii***	**prion** **Human immunodeficiency virus** ***T. pallidum***	JVC and BKV West Nile Virus Poliovirus ***C. botulinum***

Organ System/ Course	Cardiopulmonary			Renal and Endocrine	
Clinical Scheme	**Abnormal Heart Sounds**	**Dyspnea Cough**		**Urinary Frequency**	**Hyperglycemia**
Infectious Disease/ Topic	Endocarditis	upper respiratory tract infections: rhinitis pharyngitis laryngitis epiglottitis croup	lower respiratory tract infections: bronchitis bronchiolitis typical, atypical, community-acquired, nosocomial pneumonia	urethritis cystitis prostatitis pyelonephritis	rhinocerebral mucormycosis necrotizing otitis externa emphysematous UTIs emphysematous cholecystitis diabetic foot infections necrotizing fasciitis type 1
Microbe[a]	**viridans streptococci** ***Enterococcus* spp.** ***Kingella kingae*** ***Coxiella burnetii*** *(S. aureus, S. epidermidis)*	bacteria: ***Bacillus anthracis*** ***Bordetella pertussis*** ***Acinetobacter* spp.** *S. pneumoniae* *H. influenzae* *P. aeruginosa* *M. tuberculosis* ***M. pneumoniae*** ***Chlamydia* spp.** ***Legionella pneumophila*** *(Nocardia* spp. *S. aureus)*	viruses: **Influenza virus** **Parainfluenza virus** **RSV** **Mumps virus** Coronavirus Rhinovirus Adenovirus systemic mycoses: ***Histoplasma capsulatum*** ***Blastomyces dermatitidis*** ***Coccidioides immitis*** ***Paracoccidioides brasiliensis*** opportunistic mycoses: *C. neoformans* ***Aspergillus fumigatus*** ***Rhizopus* and *Rhizomucor* spp.** ***Pneumocystis jirovecii***	***E. coli*** ***S. saprophyticus*** ***Klebsiella pneumoniae*** ***Proteus mirabilis*** ***Enterobacter* spp.** ***Serratia* spp.** ***Candida albicans*** *(S. epidermidis, E. faecalis P. aeruginosa)*	*Rhizopus oryzae* *P. aeruginosa* *(E. coli, C. perfringens, Klebsiella* spp., streptococci, enterococci, *Peptostreptococcus* spp., *Prevotella* spp., *Porphyromonas* spp., *Bacteroides fragilis* group, *Clostridium* spp., *S. aureus*)

Organ System/ Course	Gastro-Intestinal							
Clinical Scheme	**Oral Complaints**	**Dysphagia**	**Abdominal Pain**	**GI Bleeding**	**Jaundice, Abnormal Liver Enzymes**	**Anal Discomfort**	**Diarrhea**	**Nausea and Vomiting**
Infectious Disease/ Topic	caries periodontal disease cervicofacial actinomycosis oropharyngeal esophageal candidiasis	pharyngitis peritonsillar abscess	intra-abdominal abscess gastroenteritis	gastric and duodenal ulcers	viral hepatitis chlonorchiasis fascioliasis	perianal cellulitis perirectal, perianal abscess intestinal helminth infections	acute diarrhea chronic diarrhea traveler's diarrhea hemolytic uremic syndrome dysentery pseudomembranous colitis	bacterial toxin-related foodborne disease
Microbe[a]	***Lactobacillus*** ***Bacteroides*** viridans streptococci *A. israelii* *C. albicans* (*Fusobacterium*)	*S. pyogenes* *H. influenzae* *C. diphtheriae* EBV Coxsackie A virus (*C. albicans,* CMV, *S. aureus,* anaerobic mouth flora)	***Bacteroides fragilis*** **Norovirus** **Rotavirus** **Astrovirus** Adenovirus	***Helicobacter pylori***	**hepatitis viruses A, B, C, D, E** ***Opisthorchis sinensis*** ***Fasciola hepatica***	(*S. pyogenes, E. coli, Enterococcus, Bacteroides, Staphylococcus* spp.) nematodes: ***Strongyloides stercoralis*** ***Necator americanus*** ***Ancylostoma duodenale*** ***Ascaris lumbricoides*** ***Enterobius vermicularis*** ***Trichuris trichiura*** cestodes: ***Taenia solium*** ***Taenia saginata*** ***Diphyllobothrium latum***	bacteria: ***Salmonella* spp.** ***Shigella* spp.** ***Campylobacter jejuni*** **invasive *E. coli*** **toxigenic *E. coli*** ***Vibrio cholerae*** ***Vibrio parahaemolyticus*** ***Yersinia enterocolitica*** ***C. difficile*** protozoa: ***Entamoaeba histolytica*** ***Giardia lamblia*** ***Cryptosporidium* spp.** (Norovirus, Rotavirus, Adenovirus, Astrovirus)	***B. cereus*** *C. botulinum* *S. aureus*

Organ System/ Course	Genitourinary I			
Clinical Scheme	**Pap Smear**	**Vaginal Discharge/Discomfort**	**Pelvic Pain**	**Scrotal Mass**
Infectious Disease/ Topic	genital warts	vaginitis urethritis cervicitis <u>genital ulcers</u>: genital herpes chancroid syphilis lymphogranuloma venereum granuloma inguinale	pelvic inflammatory disease	epididymitis epididymoorchitis
Microbe[a]	HPV	***Gardnerella vaginalis*** *N. gonorrhoeae* ***Trichomonas vaginalis*** *T. pallidum* ***H. ducreyi*** *Mycoplasma* spp. ***C. trachomatis*** *C. albicans* ***K. granulomatis*** HSV	*A. israelii* *(N. gonorrhoeae, C. trachomatis, Chlamydia trachomatis, Bacteroides*, anaerobic streptococci, *M. hominis)*	mumps virus *(C. trachomatis, N. gonorrhoeae, E. coli, Brucella* spp.*, M. avium* complex, opportunistic yeasts)

Organ System/ Course	Genitourinary II						
Clinical Scheme	**Pregnancy Antepartum**		**Pregnancy Loss**	**Non-Reassuring Fetal Status**	**Labor**	**Breast Disorders**	**Urinary Incontinence**
Infectious Disease/ Topic	TORCH	perinatal infections	spontaneous abortion	chorioamnionitis UTI and RTI during pregnancy	**<u>postpartum infections:</u>** endometritis wound infections perineal cellulitis respiratory complications UTIs, mastitis septic pelvic phlebitis	mastitis breast abscess	STI-related UTI non-STI-related UTI
Microbe[a]	*T. gondii* *T. pallidum* HSV, VZV, CMV HBV **Parvovirus B19** **Rubella virus** (Coxsackievirus)	*S. agalactiae* *L. monocytogenes* HIV	Measles virus Non-Rhino enteroviruses	*Enterobacteriaceae* Influenza virus *(Bacteroides* spp.*, S. agalactiae, E. coli, Candida, Ureaplasma urealyticum)*	***Mycoplasmataceae***	*Staphylococcus* spp.	*(N. gonorrhoeae, C. trachomatis, Trichomonas,* all common UTI etiologies)

Organ System/ Course	Senses			Hematology			
Clinical Scheme	**Ear Pain, Tinnitus Hearing Loss**	**Eye Redness**	**Smell and Taste Dysfunction**	**Anemia**	**White Blood cell Abnorm-alities**	**Lymph-adenopathy**	**Recurrent/ Persistant Infections**
Infectious Disease/ Topic	otitis media otitis externa necrotizing otitis externa	blepharitis dacryocystitis orbital cellulitis bacterial conjunctivitis viral conjunctivitis trachoma loiasis keratitis onchocerciasis endophthalmitis	viral rhinosinusitis bacterial rhinosinusitis fungal rhinosinusitis rhinocerebral mucormycosis	infection-related hemolysis: malaria babesiosis sepsis	adult T-cell leukemia-lymphoma/ lymphocytic leukemia	infection-related general and localized lymphadenopathy: leptospirosis Lyme disease tularemia brucellosis bubonic plague African trypanosomiasis Chagas' Disease leishmaniasis anthrax sporotrichosis	immune-evasion mechanisms microbial drug resistance (review bacterial cell wall, bacterial genetics) AIDS innate immunity-deficit related infections adapted immunity-deficit related infections healthcare-associated infections biofilm infections
Microbe[a]	*S. pneumoniae* nontypeable *H. influenzae*, *P. aeruginosa* ***Moraxella catarrhalis*** *(S. aureus, Candida, Aspergillus* spp.)	***Onchocerca volvulus*** ***Loa loa*** Adenovirus HSV *S. aureus* *(S. epidermidis, S. pneumoniae,* nontypeable *H. influenzae, M. catarrhalis, N. gonorrhoeae, C. trachomatis, P. aeruginosa, Acanthamoeba,* gram-negative bacilli, *B. cereus, Aspergillus* spp., *C. albicans)*	*Rhizopus oryzae* *Aspergillus* spp. (Rhinovirus, Influenza virus, Parainfluenza virus, *S. pneumoniae,* nontypeable *H. influenzae, M. catarrhalis, Fusarium, Mucorales)*	***Plasmodium* spp.** ***Babesia* spp.** *C. perfringens*	**HTLV** (HIV)	***Leptospira* spp.** *Borrelia* spp. ***Francisella tularensis*** *Brucella* spp. *Yersinia* spp. *Bacillus anthracis* ***Trypanosoma* spp.** ***Leishmania* spp.** ***Sporothrix schenckii***	HIV *P. aeruginosa*

Organ System/ Course	Dermatology					
Clinical Scheme	**Burns**	**Macular Skin Rash**	**Papules/ Plaques**	**Blisters**	**Scalp Disorders**	**Pruritis**
Infectious Disease/ Topic	burn infections	scarlet fever STSS TSS rheumatic fever secondary syphilis folliculitis furunculosis skin abscess impetigo erysipelas SSSS Rocky Mountain Spotted Fever endemic typhus childhood viral exanthems tinea versicolor tinea nigra	fish tank granuloma leprosy erythrasma papules/plaques due to hematogeous dissemination dermatophytoses cutaneous candidiasis sporotrichosis cutaneous warts molluscum contagiosum pityriasis rosea acne	zoster oropharyngeal herpes traumatic herpes hand, foot and mouth disease smallpox	folliculitis tinea capitis piedra	pediculosis scabies
Microbe[a]	*P. aeruginosa*	*S. pyogenes* *S. aureus* *T. pallidum* *(P. aeruginosa)* ***Rickettsia rickettsii*** ***R. prowazekii*** ***R. typhi*** ***Malassezia furfur*** ***Hortaea werneckii*** Measles virus Rubella virus Parvovirus B19 VZV HHV-6	***M. marinum*** ***M. leprae*** ***Propionibacterium acnes*** ***C. minutissimum*** ***Microsporum* spp.** ***Trichophyton* spp.** ***Epidermophyton* spp.** *N. gonorrhoeae* *N. meningitidis* *C. albicans* *Sporothrix schenckii* HPV **HHV** **molluscum contagiosum virus**	VZV HSV Coxsackievirus **Variola virus** **Vaccinia virus**	(*Malassezia*, mites, *T. tonsurans, M. canis, Trichosporon* spp., *Piedraia hortae, S. aureus, P. acnes*)	***Pediculus capitis*** ***Phthirus pubis*** ***Pediculus corporis*** ***Sarcoptes scabiei* var. *hominis***