Antimicrobe.org: An Online Reference for the Practicing Infectious Diseases Specialist

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Antimicrobe.org (http://www.antimicrobe.org) is a World Wide Web–based version of the textbook Antimicrobial Therapy and Vaccines, volumes I and II. The Web site currently consists of 3 texts (Microbes, Antimicrobial Agents, and HIV Clinical Manual) and will soon include a fourth, Empiric. The Web site focuses on therapy for infectious diseases, and it covers, in comprehensive detail, a great majority of infections encountered today. The dynamic nature of a Web-based reference allows for information to be frequently updated and enhances a physician’s searching capabilities to find answers to very specific clinical questions and the latest available evidence. A Smart Search engine allows users to ask specific questions and to find focused answers, either within the textbook or through PubMed via a guided PubMed references option. The Web site also provides clinical vignettes and minireviews on hot topics in infectious diseases and hyperlinks to other important articles or Web sites. Chapters are written by experts in their field who provide evidence-based information, as well as anecdotal reports about rare infections. Antimicrobe.org would be of great benefit to physicians who treat infections on a routine basis.

Numerous software programs provide expert recommendations regarding antibiotic choices and infectious diseases. We previously reviewed software available for Personal Digital Assistants and emphasized the breadth of recommendations with regard to infectious diseases [1]. Antimicrobial Therapy and Vaccines (Antimicrobe.org; available at: http://www.antimicrobe.org) is a World Wide Web–based textbook with updated information on a wide variety of microbes and antimicrobials. The textbook was designed to provide decision-making information for the practicing clinician. This Web site intends to be an alternative to information acquired from searches of the PubMed database or of general internet searches, because the results of the latter searches are often erratic in relevance. [2, 3]

SITE FORMAT

Access to Antimicrobe.org is provided in 2 ways: through an institutional subscription or with the purchase of the second editions of the textbooks Antimicrobial Therapy and Vaccines Volume I: Microbes [4] or Antimicrobial Therapy and Vaccines Volume II: Antimicrobial Agents [5]. After signing in, the user is taken to a Web page with individual links to the Microbes Manual, Antimicrobial Agents Manual, and HIV Clinical Manual (which are briefly reviewed in this article). The still-in-development Empiric manual will be released in the future.

Antimicrobial Therapy and Vaccines Volume I: Microbes is organized alphabetically by pathogen, with subdivisions for bacteria, mycobacteria, rickettsia, miscellaneous bacteria, fungi, viruses, and parasites. The list of pathogens is quite complete and encompasses established pathogens as well as pathogens that are rarely encountered in clinical practice. Antimicrobial Therapy and Vaccines Volume II: Antimicrobial Agents is organized on the basis of antibacterial agents, antmycobacterial agents, antifungal agents, antiviral agents, and antiparasitic agents.

Chapters of the textbooks are updated at least annually, whereas entries for more common pathogens are updated as often as every 3–4 months. New chapters that are available on the Web site (but not in the textbook) include “West Nile Virus,” “SARS,” “Hendra Virus,” “Herpes Simplex,” “Human Metapneumovirus,” “Menangle virus,” “Dengue Virus,” “Papillomaviruses,” “Molluscum Contagiosum,” “Salmonella (non-typhoidal) species,” and “Mycobacterium terrae.”

SEARCHING THE WEB SITE

Three methods of searching for clinical information are provided. The most obvious method of finding information is...
through direct access to the textbook chapter. Each chapter has a "sliding" table of contents in the left corner of the screen that "floats" while the reader scrolls through the text, allowing one to access different portions of the chapter quickly and efficiently. A second option is the standard keyword search, which is performed by entering words using the Boolean connectors "AND," "OR," or "NOT."

The third and unique option is the "Smart Search," an innovative and unique approach based on artificial intelligence methods. A pathogen is matched with 1 of 10 subjects: microbiology, epidemiology, clinical manifestations, laboratory diagnosis, pathogenesis, susceptibility, antimicrobial therapy, adjunctive therapy, vaccines, or prevention. As an example, the chapter on *Staphylococcus aureus* allows the user to select either *S. aureus*, methicillin-resistant *S. aureus* (MRSA), or glycopeptide-intermediate *S. aureus* (GISA). After selecting an organism, one selects from a variety of topics that correspond to the different sections of the chapter. Selection of "MRSA" and "epidemiology" yields 8 "hits" in the database, and a brief description of each hit is provided, allowing the user to review and select the most appropriate section. In comparison, selection of "GISA" and "epidemiology" yields 4 hits.

For specific treatment questions, a much more detailed search page is provided (figure 1). When *S. aureus* is chosen as the pathogen, the Smart Search will return multiple different options to help narrow the search. A user can select from 23 types of infections (including CNS infections, bacteremia, and prosthetic device infections) and can select the route of administration, the duration of therapy, or many other options. The Smart Search engine allows clinical questions to be directly addressed, eliminating the need to scan entire paragraphs to find an answer. For example, if a physician is treating *S. aureus* endocarditis, and if intravenous antibiotics cannot be administered, the physician could use the Smart Search function, which provides 4 hits on the use of oral antibiotics for *Staphylococcus* endocarditis.

The hits from the Smart Search query also link to a guided PubMed search. These route the user to the PubMed database and provide the reader with abstracts that are focused on the same topic. PubMed references are drawn from the previous 3 years, and searches are constructed using Medical Subject Heading (MeSH) terms, as would be done by an experienced medical librarian, thereby limiting irrelevant hits. Unfortunately, al-
though abstracts are provided, separate fees may be required to access many full-text, PubMed-linked articles.

VOLUME 1: MICROBES

The goal of Antimicrobial Therapy and Vaccines Volume I: Microbes is to provide clinically relevant material on the subject, not necessarily to provide a comprehensive review of the each organism or to provide a disease- or syndrome-based review. The Smart Search allows the practicing physician with specific real-world questions regarding a pathogen to quickly find the answers within a huge database.

**S. aureus** will be used as an example. After the reader selects an organism, the next screen allows him or her to navigate the database (figure 2). There are links to tables and figures. For some organisms, there are links directly to pertinent chapters in volume II of the textbook. For **S. aureus**, there are links to the chapters “Daptomycin,” “Fusidic Acid,” “Glycopeptides Including Dalbavancin and Telavancin,” “Linezolid,” “Mupirocin,” “Quinupristin/Dalfopristin,” and “Tigecycline.”

A unique feature of the Web site that is not offered in the textbook is the inclusion of clinical vignettes. This offering ranges from historical information (such as information on the
naming of *S. aureus* and *Candida* species or the history of malaria chemotherapy) to hot topics (such as the World Health Organization’s monograph on avian flu). These clinical vignettes may provide access to major review articles in PDF form (including those published in the *Journal of Infectious Diseases*, *ASM Microbe*, *PLoS Biology*, *Bulletin of the History of Medicine*, and many others), guideline information, figures from the Centers for Disease Control and Prevention, and images.

At the entrance to the Web chapter, there is a list of authors and their contact and biographical information. A floating table of contents hyperlink at the left margin is visible when the cursor is placed over the area. This permits quick access to any section of the manual. Chapters begin with basic clinical microbiologic information, followed by epidemiologic information. The *S. aureus* chapter includes data on MRSA, GISA, and glycopeptide-resistant *S. aureus*, in addition to data on methicillin-susceptible *S. aureus*, whereas the epidemiology section is augmented with multiple review articles from *Sports Illustrated*, *New England Journal of Medicine*, *Emerging Infectious Diseases*, *Pharmacotherapy*, and *Lancet Infectious Diseases*.

The third section covers clinical manifestations, followed by information on laboratory diagnosis and pathogenesis. For *S. aureus*, the discussion about clinical manifestations also includes data on toxin-related manifestations. Laboratory diagnosis covers routine culturing but is not meant to be a reference for microbiology laboratory personnel. The *S. aureus* section on pathogenesis includes a clinical vignette on the Panton-Valentine leukocidin toxin.

The most impressive part of each chapter addresses infection management, beginning with in vitro and in vivo susceptibility patterns, drugs of choice, and recommendations regarding special situations. For the *S. aureus* chapter, recommendations on the drugs of choice are divided by penicillin-susceptible *S. aureus*, methicillin-susceptible *S. aureus*, MRSA, and GISA. The special situation sections include sections on catheter-related bacteremia, endocarditis, pneumonia, toxic shock syndrome, and 19 other infections. The *S. aureus* chapter also includes a discussion of the eradication of carriage. The management section includes information on adjunctive therapy, including surgical interventions. The chapters conclude by reviewing the duration of therapy, vaccines, and prevention of infection. At the end of each chapter, there is a link to tables, which are available in both HTML and PDF format; these are followed by the references, each of which has a hyperlink to that article’s citation in the PubMed database. Each chapter is well referenced; for example, the *S. aureus* chapter includes 460 references.

**VOLUME II: ANTIMICROBIAL AGENTS**

Each chapter in this volume focuses on a single antimicrobial agent. The chapters are organized on the basis of antibacterial agents, antmycobacterial agents, antifungals, antivirals, and antiparasitic agents. Each chapter begins with a section on the antibiotic class, including a history of class, other drugs in that class, chemical structure, and structure-activity relationship. For each antimicrobial agent, there is a figure depicting its chemical structure. The antimicrobial activity section includes detailed discussion of drug-susceptible and drug-resistant organisms. Each chapter includes at least 1 table with MICs for important organisms. The section on pharmacodynamics includes data related to concentration-dependent killing, time-dependent killing, postantibiotic effect, and synergy. The mechanisms of action section includes detailed descriptions of target sites and mechanisms of resistance. Pharmacokinetic information includes data on absorption with oral administration, protein binding, distribution, and routes of elimination. CNS penetration is discussed for those antimicrobials for which data is available. Dosage information includes dosing in adults and children, in patients with renal failure, with in those with hepatic insufficiency, in morbidly obese individuals, and for women during pregnancy. Pregnancy information included in the chapters usually goes beyond the statement of the US Food and Drug Administration (FDA) pregnancy category, and information regarding drug levels in breast milk is provided for nursing mothers. For the section on adverse events, studies are often quoted with rates. The section on monitoring requirements includes recommendations for routine laboratory studies, as well as monitoring therapeutic drug levels. The section on drug-drug interactions includes combinations that should be avoided, as well as information on drug combinations that can be used with caution. FDA indications are listed, and for newer antimicrobials, data from clinical efficacy trials are presented. Data are presented when they exist for non-FDA-approved indications. The extensive lists of all brand names used internationally for each antimicrobial agent are helpful for physicians when patients identify their drugs by brand name. A condensed summary for each antimicrobial agent can be downloaded as a PDF file.

**HIV MANUAL AND EMPIRIC**

The HIV manual (which will be reviewed in a future edition of the Surfing the Web section) is a comprehensive reference on HIV infection and its therapies. It has a similar format and style to the other volumes that have been previously mentioned within this text. *Empiric*, a guide to empiric therapy for infectious diseases, is a reference that will be released in late 2006.
STRENGTHS

Each chapter is written with a clinical focus on a depth of knowledge that will cover most real-world scenarios. The hyperlinks and floating table of contents allow quick access to answers to a clinical query.

The strength of Antimicrobe.org is the comprehensiveness of the sections on clinical therapeutics (drugs of choice, alternative therapies when the drugs of choice cannot be given, combination antimicrobial agent therapies, duration of therapy, use of oral therapies, end points for monitoring, and adjunctive therapies, including surgery). For example, the section on antimicrobial therapies and in vitro susceptibilities for *S. aureus* totals >17 pages and includes 3 tables. The section on prevention of malaria is >9 pages in length and includes 6 tables.

Articles have been solicited from international authorities. Few chapters are written by the same author, thereby providing a wide range of expertise and opinions on clinical issues. Each author’s biographical and contact information is available in each chapter, to allow the possibility for the reader to discuss his or her clinical issues with the chapter authors. Chapters are free of commercial bias.

One advantage of Web-based manuals over static textbooks is the dynamic update potential. Keeping data up to date is dependent on the editor and author of the chapter, but it is more feasible with an electronic format. For example, tigecycline and anidulafungin were added to the Web site shortly after FDA approval. As chapters of the Web site are updated, the date of most recent version is recorded in the top right hand corner of the page. This feature also provides more information than exists in the paper version of the textbook. Along with clinical vignettes, these dynamic updates are prime examples of information that is available online but not in the paper textbook. Another online feature is hyperlinking between the volumes. For example, while reading about MRSA in the Volume I: *Microbes* textbook, the reader can select the tigecycline link, which will take him or her to the tigecycline chapter in the Volume II: *Antimicrobial Agents* textbook.

WEAKNESSES

Dosing information for patients with reduced renal function is discussed for each antimicrobial agent. However, detail is occasionally lacking for dosing in patients receiving continuous renal replacement therapy. These recommendations are reviewed in a recent article [6] and would be an excellent addition to the Web site.

Although there are helpful pictures throughout the second volume, there are relatively few in the first volume. Photographs (e.g., photographs of rashes, Gram stains, and radiographs) would add to the already considerable practical value of these chapters.

SUMMARY

Antimicrobe.org is a Web-based textbook that provides updated clinical information on a wide variety of microbes and antimicrobial agents. The dynamic nature of Antimicrobe.org allows for up-to-date clinical information (for example, the chapter on *Candida* species on Antimicrobe.org has 649 references, whereas the corresponding chapter in the textbook has 466 references) that would be of benefit to practicing physicians anywhere. The hyperlinking of multiple cross-referenced resources increases the available database. The Smart Search engine allows users to ask specific questions and find focused answers, either within the textbook or through PubMed. The extensive treatment focus of the Web site and the format make it a unique reference, compared with other print- and Web-based references. Comprehensive material not found in other textbooks or other online references sets this reference apart from others already on the market. Antimicrobe.org is a resource that should be a part of every practicing infectious diseases clinician’s armamentarium.

For a limited time, Infectious Diseases Society of America members and readers of *Clinical Infectious Diseases* will be able to access the Antimicrobe.org Web site by entering the username “IDSA” and the password “IDSA.”

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References