is true throughout the book, applications are discussed and illustrated by using similar examples from the 2 principal handheld computer operating systems: Palm and Pocket PC. The generous use of images of handheld computer screens helps to illustrate concepts and the stepwise use of applications. Also included in this chapter is an explanation of the 2 methods of information sharing with these devices: synchronizing and beaming. These processes can be especially challenging for the novice, and the authors provide a succinct, clear explanation. The issue of confidentiality of patient information is also mentioned and emphasized here, because of the ease with which information can be shared between handhelds, from handheld to desktop computer, and from desktop to handheld. The issue of information security/confidentiality is still being debated, weighing the benefit of availability of information with the potential for breaches in confidentiality of patient information.

The authors then review the process of acquiring and installing new software. The chapter is devoted to the technical procedures for downloading and installing software. Finding specific software is discussed in later chapters. Included in the chapter is a discussion of the use of the main memory of the device versus use of expansion memory, which can be tricky. This issue is discussed honestly, including the caveat that some software is limited in the ways it can be installed and used, and that technical difficulties are not uncommon.

The remainder of the book introduces the reader to the many potential uses of handheld computers in medicine, highlighting selected software. This part begins with an effective review of Internet sites related to handheld computing. The chapter includes over 80 Web sites devoted to handheld computing in medicine, many of which the authors rate regarding organization, usefulness and timeliness of information, and various intangible features unique to some sites. The rating system resembles movie rating systems that use a number of stars to indicate the movie's quality. Here stethoscopes are used instead of stars, with 5 stethoscopes being the highest rating. In their enthusiasm for the subject, the authors do not mention the potential for excessive time consumption in searching for information or software. Anyone who searches the Internet on a regular basis knows that the search must be focused and as narrow as possible. If not, one can spend hours hopping around cyberspace.

The first medical application presented is patient tracking. The biggest selling point of these applications is probably the accurate recording of charges. The data entry for the patient tracking programs presented is mostly menu-driven. This technique requires entering certain information before moving on to the next step, which prevents omitting information and guarantees that all appropriate patient information is entered, including charges. Of course, having all the necessary information required for diagnosis and treatment is critical, and this would also be guaranteed with a menu-driven system.

Another invaluable feature of handhelds is that information can be transmitted immediately, as the clinician enters the data, to a central database, where it could be available to other users. The clinician can also receive updated information, such as laboratory results, patient updates, and new consults. This application can be a very useful, time-saving tool.

Clinical calculations can be made easy with appropriate handheld applications, which is reviewed in the next chapter. Calculations such as anion gap, predicted spirometry values, and Glasgow coma scale are preprogrammed. The user has only to enter the relevant data and the calculator produces the results. Several of these programs are free and download information is included in the book.

Another effective exploitation of the size and capacity of handheld computers is handheld-based references. Entire reference texts can be stored and viewed on a handheld computer. The reader programs used to access these texts allow for searching the text, which expedites information retrieval. Referencing peer-reviewed journals is also possible. The authors describe services that provide access to journal citations and, in some cases, abstracts. Although the full text of articles is not widely available for handhelds, many full-text articles will be soon. Articles in some of the popular electronic formats can be read by handhelds, so it is possible to maintain a library of current literature on a handheld.

Another valuable ability of handhelds is developing custom databases. While this is probably not something a novice would be comfortable with, the process is not very difficult with some of the database programs. The authors describe the process in a clear, easily understood, and encouraging way that I think will help avoid some potential frustrations of developing a database. Because of its clarity and medical specificity, the description is actually more useful than the program manual.

The ability of a handheld computer to transmit, store, and display rich media such as photographs, video, and audio can add a new dimension to the clinician's practice. While the size of the screen limits the usefulness of visual media, it adds a valuable tool to the clinician's repertoire. For example, the video recording of a bronchoscopy could be shared with colleagues at a distance, allowing collaboration from virtually anywhere. The authors discuss several examples of the value of this multi-media capability.

Overall, **Handhelds in Medicine** is an excellent introductory text for nonusers and novices. It is also useful for more experienced clinicians, providing introductions and "how-tos" on more advanced topics. The wealth of information on available resources alone may be worth the book's purchase price. In addition, many of the programs described in the book are available on the included CD-ROM. I would recommend this book to all clinicians as an introduction to the coming widespread use of handheld computers in medicine.

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R.A.L.E Lung Sounds 3.1 Professional Edition. Winnipeg, Manitoba, Canada: Pix-Soft and Medi-Wave. 2004. Professional edition download $49; CD-ROM $59; institutional edition CD ROM $195; student edition download $19.95.

> The difference between listening to a radio sermon and going to church . . . is almost like the difference between calling your girl on the telephone and spending an evening with her.
> —Dwight L Moody

R.A.L.E. Lung Sounds 3.1 is a multimedia computerized textbook and educational program. It encompasses over 50 recordings of lung sounds, each with color graphics that relate the sounds to pitch, timing within the breathing cycle, and intensity. The program includes 12 teaching case studies and 24 cases in a quiz/self-assessment format. Version 3.0 of this product

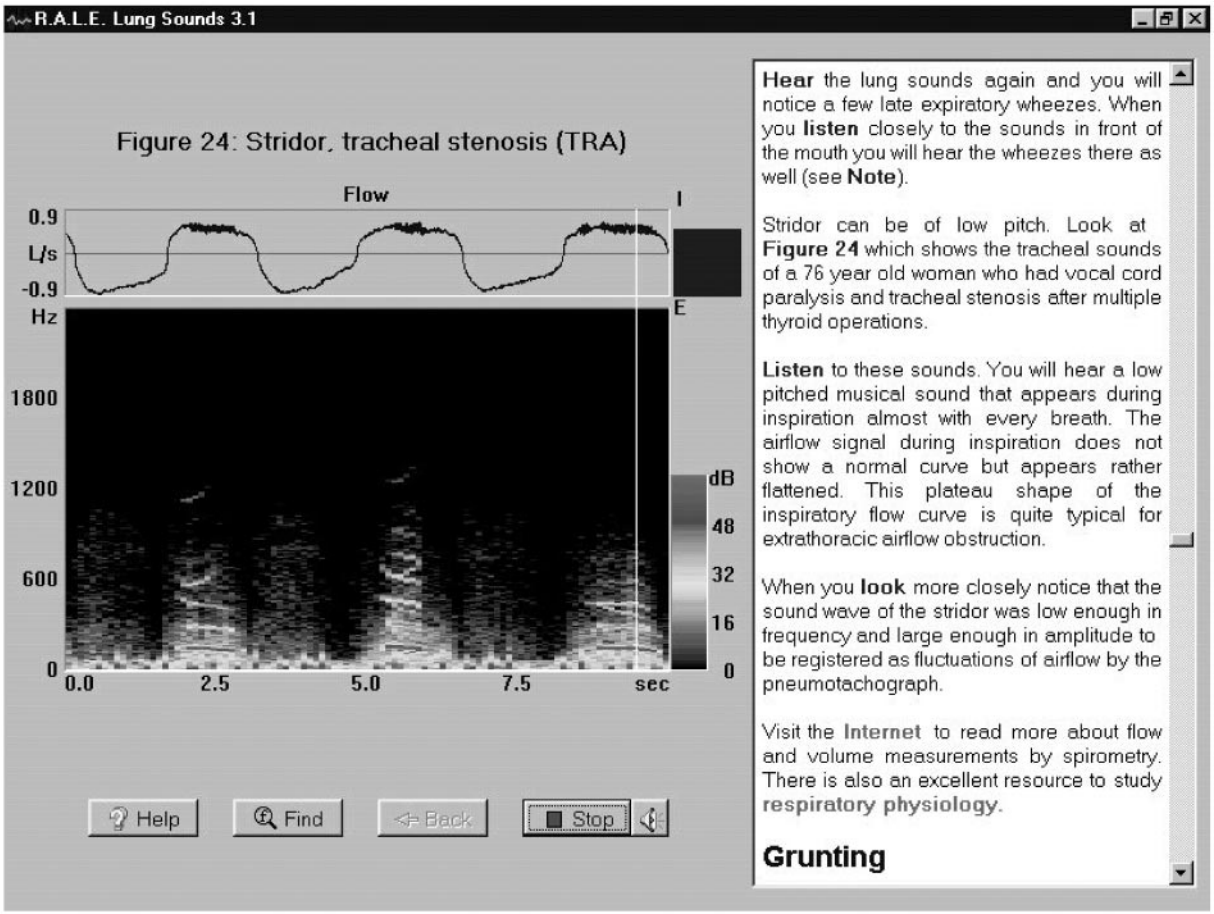

Fig. 1. Sample of the teaching window in the **R.A.L.E. Lung Sounds** tutorial. This frame describes stridor. In the text box (right) the user can read content and click on hypertext-linked words. The white vertical line moves left to right in synchrony with the lung sound as it plays. In this graphic the line is nearing the end of inspiration of the last breath of a flow-versus-time curve. The sonogram (below the flow-versus-time curve) shows both the frequency and the loudness (in decibels [dB], with a color spectrum). Note that the stridor in this recording is predominately during inspiration. The solid bar on the upper right corner of the sonogram elevates and descends with inspiration and expiration. The navigation buttons (at the bottom of the graphics area) are "Help", "Find", "Back", "Stop", and the volume-control button (speaker symbol). (Courtesy of PixSoft.)

was reviewed in RESPIRATORY CARE in 2002.[1] The present analysis will again provide a general description of the software and comment on the changes in version 3.1.

The computer-based tutorial functions much like a "hybrid" Internet-based format that combines written text, digital images, and hypertext links to Web sites. Figure 1 shows the basic screen layout, with the graphics and navigation buttons on the left and a text box on the right. The initial instructions clearly explain the system. The reader proceeds through the text and clicks on the blue hypertext links to bring up the graphics and sounds.

The table of contents includes blue hypertext links that allow immediate navigation to all parts of the tutorial. This is handy for independent learners who want to stop and later pick up where they left off, or classroom instructors who want to go to a specific area of the text as part of their presentation or quiz. The pink hypertext links point to Web sites, and these links have been updated for this version 3.1. The linked Web pages provide both background and greater details on the topics discussed in the text. The interactivity of the tutorial allows breaks in the reading and makes wonderful use of Web resources.

The advantage of **R.A.L.E. Lung Sounds** over other lung-sounds teaching systems is the integration of the text, graphics (sonograms), and sound recordings. The upper part of the screen's graphics area (see Fig. 1) shows flow-versus-time curves, for several breaths, with a blue line, similar to the graphics on contemporary ventilators. Yellow or red lines are used for volume-versus-time curves. A blue vertical "respiration bar" (on the right side of the graphics area) dynamically displays the inspiratory versus expiratory movements of the breath. This helps the learner easily reference the inspiratory versus expiratory timing of the breath sounds. This bar is an updated feature from the previous version of **R.A.L.E. Lung Sounds**. A white vertical line scans left-to-right over the flow or volume curve as the sound is played, correlating the sound to the position on the curve. The lower part of the graphics area shows the sonogram and the breath's "sound characteristics." As it moves across the screen (ie, through time), the white vertical line's dynamic position on the left vertical axis represents frequency (in hertz) or pitch as the sound evolves. The

intensity of the sound (in decibels) is shown with a color spectrum (black = low, yellow = medium, hot pink = high). The combination of the visual sonogram and simultaneous sound playback is a key learning feature of this tutorial. It allows learners to connect the sounds with visual cues and with the timing of the inspiratory-expiratory cycle. A similar physiologic display is a phonocardiogram, which links electrocardiogram graphics with echocardiogram sounds.

In the table of contents there is a hypertext link to PixSoft's Web site, which PixSoft calls the R.A.L.E. Repository.[2] There, anyone can find a sampling of breath sounds, which are in the recording-plus-sonogram format described above. The Web site also provides audio links, citations, and links to full-text access to classic articles on respiratory sounds.[3] The site is also a "clearinghouse" for the links in the **R.A.L.E. Lung Sounds** tutorial.

Following the instruction text section, the initial tutorial covers the scientific aspects of acoustics. The basic physics of sound are reviewed, with short discussions and sonographic examples of frequency (pitch), intensity, harmonics, and audible perception by the human ear. Although adequate for most beginning respiratory care or nursing students, a link is provided to a Web site for those who need details on acoustic physics.[4] Next in this section is a discussion of the stethoscope, complete with a link to the history of its development and a biography of René Laënnec. The final section is a very brief review of positioning a stethoscope on the chest, with graphic examples. A link is provided to the University of Iowa's Virtual Hospital Web site for details on lung anatomy, relating radiographic and computed tomography images to external anatomic locations of lung lobes and pulmonary segments.[5] Of interest was the absence of a link to information on lung auscultation at that same site.[6]

The 2 main sections of the tutorial review normal and adventitious breath sounds. The sonograms help the learner visually to differentiate tracheal, bronchial, and vesicular sounds. The text discussion of bronchial sounds, which are inappropriately located where vesicular sounds should be, is deferred to the case studies (eg, pneumonia). Both adult and infant sounds are provided. That approach is also used with "voice sounds," including bronchophony, whispered pectoriloquy, and egophony. There is no discussion on crepitations or crepitus, which accompany rib fractures or gas-collection in tissue space. And there was no discussion of bilateral or unilateral abnormalities in either the absence of or reduced volume of breath sounds, which accompany pleural effusion, pneumothorax, and endobronchial intubation.

Links to Internet sites are given to support the discussion on chest assessment via percussion, spirometry, spirometry interpretation, and an overview of respiratory physiology. Adventitious sounds include wheezes, rhonchi, crackles, squeaks, squawks, and pleural friction rubs. Upper respiratory or voice sounds include grunting and stridor. I was pleased at the brief but helpful discussion and example of rhonchus/rhonchi. The term "rhonchus" has been part of the general confusion on terminology that appears to have been ongoing since Laënnec's time. "Rhonchus" has even been deleted in some teaching materials and early terminology standards. **R.A.L.E. Lung Sounds** does an excellent job of using current accepted terminology.[7,8] However, it is curious that this software is named after Laënnec's *rāle* which is currently not recommended; "crackles" is the favored term. **R.A.L.E. Lung Sounds** does provide 2 very nice examples (sound/sonographic) of rhonchi combined both with tracheal breath sounds and its higher pitched variant, wheezing.

Text in this section briefly describes current understanding of the acoustic events responsible for adventitious sounds. This allows the learner to connect auscultation findings with various pathologies. I found it unfortunate that the tutorial grouped such a heterogeneous group in a section called "other sounds," which combined sounds from the upper airway (stridor and grunting) and the pleura (pleural friction rubs) with those from within the lungs (squeaks and squawks). Although the text does mention the locations, it might have been easier for the beginner if the sounds were grouped according to anatomic site.

The tutorial does a very nice job of graphically illustrating the issue of paradoxical breathing, by contrasting movement between the chest and abdomen in upper-airway obstruction. At the end of this key section there are links to 12 related books and journal articles, but unfortunately none of these links are to the full-text item. Also unfortunately, the link to the most informative article on lung sounds that is available full-text on-line was not included in this section, though this link is provided later, in the separate "references" section.[3] Many of the journal articles listed at the end of the lung-sound tutorial section are classics from older publications that could not be hypertext linked. Since version 3.1 became available in 2004, a few articles have appeared that are full-text online.[9–15]

I think the case studies will be the most helpful sections to those either initially learning auscultation or refreshing their patient-assessment skills. Version 3.0 had only 6 case studies; Version 3.1 has 12. The cases demonstrate connections between the normal and abnormal lung sounds with pathophysiologic manifestations. The case studies are the most interactive part of the tutorial. The user is asked to identify normal lung sounds, upper-airway sounds, adventitious lung sounds, and when in the breathing cycle the sounds are heard. Feedback from the program is immediate.

The **R.A.L.E. Lung Sounds** tutorial can be purchased as a CD-ROM or as a download from the company's Web site. Those who have purchased either the 3.0 or 3.01 versions can download the updated version at http://www.rale.ca/updates.htm, for free. Version 3.1 is very similar, but provides updated Internet links, adds the dynamic respiration bar, and maximizes to a full-size Windows screen.

The software is quite easy to load into a computer and very easy to navigate while using the tutorial. The hardware requirements are: Windows 95 or later operating system, a Windows-compatible 16-bit sound card, and 11–15 megabytes of available disk space. Sound reproduction is enhanced by using either headphones or high-quality accessory computer speakers.

There are several pricing levels. The student edition (requires proof of student status) download version, for an individual student for one year, costs $19.95. The student upgrade to the professional edition costs $29. The professional edition download costs $49. The professional edition on CD-ROM costs $59. The CD-ROM institutional edition for a single computer costs $195. A site license for use on any number of computers, provided they are permanently located at the offices, grounds, and/or campus of the licensing company or educational institution, costs $995.

R.A.L.E. Lung Sounds is a powerful learning tool. There is some documentation that multimedia of this type do provide an advantage to beginning students, compared

to conventional teaching methods.[15,16] This tutorial is unique among lung-sounds teaching materials. The first lung-sounds teaching systems used audio tapes with books. Audio CDs then replaced tapes. Some systems have offered CD-ROMs with narrated script and the user clicked on (static) spectral images of breath sounds while the sounds were played. **R.A.L.E. Lung Sounds** is the first to combine dynamic graphics with acoustics. I commend PixSoft for their companion R.A.L.E. Repository Web site, at which they make many sounds available.[2]

Chest auscultation requires blending an understanding of the physics of acoustics with the skills of interpretation and human interaction. It is neither exact science nor voodoo. In addition to auscultation, assessment of breathing also requires inspecting chest motion, muscle movement, skin color, and palpation of the body. The challenge of bringing new acoustic and imaging technology along with computers to this cognitive and time-honored standard has provided plenty of grist for editorials.[17–19] Portable ultrasound devices may evolve to parallel the usefulness of the imaginary "tricorder" bioscanner device in Gene Roddenberry's "Star Trek" science fiction series. Most commentaries recount the stethoscope's power as a bonding tool for the clinician and the patient, especially since many patients are unable to speak because they are intubated. I found a recent letter-to-the-editor in RESPIRATORY CARE quite interesting; Murphy recounted that the original impetus for the development of the stethoscope was in fact to *distance* the listener from the patient's body odors and lice.[20]

R.A.L.E. Lung Sounds is a wonderful software tutorial. This 2004 update, Version 3.1, provides some minor enhancements to an already fine learning system. I would recommend this teaching system for both individuals who are beginning their study of chest auscultation and educational programs for nurses, respiratory therapists, and physicians. It is a great starting point. However, since there is considerable variation in lung sounds among patients, the next step is to listen to many lung sounds with an experienced mentor.

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