Staff Training and Computers in Respiratory Care

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The respiratory therapists' (RTs') knowledge base is among a hospital's greatest assets. RTs routinely use advanced medical technologies and must understand the patient's physiology, anatomy, and condition to deliver safe and effective treatment with those technologies, especially within critical care environments. Also RTs often must educate patients and patients' families, which requires thorough understanding of the operation of medical equipment. RT education must include both tacit and explicit knowledge, so RT education can be complex, which may present challenges to clinical educators. RTs must have continuing education, and computer-based education can help meet education challenges, promote safe and effective patient care, improve patient outcomes, and improve employee satisfaction, which may improve RT recruitment and retention, while decreasing the cost of staff training. However, since computer-based education is relatively new to health care, RT educators should learn from other industries that have extensive experience with computer-based staff education. *Key words: computer-assisted instruction, education, medical errors, computers, training techniques, information management.* [Respir Care 2004;49(5):489–496. © 2004 Daedalus Enterprises]

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Introduction

Respiratory therapists (RTs) are integral members of the health care team for patients with cardiopulmonary disorders. RTs need extensive training and continuing education so that they can safely and effectively use advanced medical technologies and deliver the best possible care. RTs must also be knowledgeable in the anatomy and physiology of the disorders that they treat, and RTs often must educate patients and their families about therapies and related technology. That RTs must possess, apply, and continuously update extensive clinical knowledge presents serious challenges for the directors of RT staff education

programs. Clinical educators of RTs must categorize, critique, and evaluate voluminous amounts of published information specific to the targeted patient populations so that the RT staff can practice evidenced-based medicine. Information is typically disseminated to the RT staff at a weekly or monthly classroom-style in-service, which requires that staff attend the classes on their own time off from work or that they leave the bedside, which may increase associated costs and decrease the likelihood that they will retain the information, because they are pressed for time. Therefore RT educators should review the methods of other industries for delivering high-quality employee education that focuses on "knowledge management" and the application of Internet transactions.

Knowledge Management Experience From Other Industries

Recently leading companies from industries that rely on well-trained workers have incorporated "knowledge management" strategies and routine use of the Internet for employee education. The most prominent of those companies include those that work with computer software related to research and development and those that sell their products worldwide.[1] Companies in the software industry have long recognized that competing in the global software market requires a well-informed workforce.[2] One of the greatest values of a well-defined knowledge management strategy for software companies is that it responds to the fact that the software product is constantly undergoing revision and improvement. Many software corporations have employees based in countries throughout the world, and the Internet provides rapid communication among distant individuals, decreasing the costs to keep the workforce informed of past, current, and upcoming versions of the products. Keeping the engineering, marketing, distribution, and sales force knowledgeable of the products increases sales revenues and fosters positive relationships with the customers. Companies such as Adobe Systems (San Jose, California) have made knowledge management part of their strategic plan as well as a success factor for the company in meeting its financial commitments and the expectations of its governing board and shareholders.

Knowledge Management for Recruiting and Retaining the Best Respiratory Care Talent

Today's labor force entering the work place is very different from individuals of years past, who began their careers in various industries. Today's young workers want new benefits from their employers, and one of their most important criteria for accepting and remaining in a job is continuing education to learn new skills and stay abreast of new and emerging technology.[3] Obtaining new skills related to job enrichment allows employees to advance their professional careers and improve their marketability to current and future employers. Younger workers also understand that technology in the work place is constantly changing and that one must learn the new technologies to remain competent within the current and future job market. Therefore, the labor force of the near future must develop knowledge-intensive skills to enter and transition into the new global knowledge work domains.

To recruit and retain employees health care organizations must also provide advanced training for clinical application of new technologies. In today's competitive job market, health care competes with other industries for new talent to meet the rising demands of its customers, especially as the population is growing older. As the average age of the population increases, patients will consume more health care services than previous generations, because life spans will be longer than at any other time in history. Unfortunately, older and experienced clinicians are leaving health care to pursue careers in other professions or retiring from the workforce entirely, which leaves hospitals with a large staffing gap (between experienced clinicians and new graduates), especially in the critical care environments. That staffing gap will continue for the next decade and poses serious problems for the entire health care industry. In addition, new technology and treatments will present patients with more therapy options. To meet current and future patient demands, hospitals must rely on newly graduated clinicians to fill the projected vacancies. The field of respiratory care is no exception to these new challenges. A well-constructed orientation program and career-development strategy that has knowledge management at its nucleus will assist the hospital in attracting and retaining staff.

Knowledge Management and the RT Orientation Process

Respiratory therapy schools cover the basics of clinical care, but because of the rapid advancement of respiratory care technologies and therapies, a newly hired RT must have a comprehensive orientation to obtain the advanced skills needed to care for critically ill or injured patients. Recently, a publication from the nursing profession documented that the cost of orienting a new nurse to the intensive care unit can exceed $200,000.[4] That report also indicated that the turnover rate for new nurse graduates has been approximately 92% in many hospitals since 1997, and the main reason was the poor preparation the employees received during orientation, which led to feelings of inadequacy about their assigned responsibilities. Not only did the new nurses report a negative experience, the high turnover also negatively impacted the current clinical staff

(eg, because they had to fill the extra shifts left by vacancies). To correct those problems the researchers developed an intensive training program for the preceptors, to improve the preceptors' teaching abilities with newly hired nurses, and they put special emphasis on recent graduates. They also improved their didactic clinical training program to provide the graduates with sufficient training and information that made them ready to gradually assume patient-care responsibilities. These changes to the orientation process improved the turnover rates to < 10% among recently-graduated nurses. The lesson learned from the nursing profession—that good training improves recruitment and retention—also applies to RT staffs.

The Role of the Preceptor

One of the major components of a successful orientation program is the training of the preceptors, so that they can function as clinical experts and resource-people for the newly hired graduate RT. An RT preceptor must assume the roles of clinical expert and mentor and must foster a collaborative relationship with the new employee to create an environment of mutual respect and appreciation related to each practitioner's level and experience. Maintaining that positive relationship will lay the foundation for a positive experience for the new graduate and help minimize feelings of inadequacy during and following orientation. To obtain a positive outcome from the new graduate's orientation, the preceptor must assume a majority of the responsibility for training the new RT, so that the institution realizes real value from the orientation process. Preceptors must have the proper tools to meet the orientation goals. Proper tools will assist the preceptor in providing information, both in hands-on training at the bedside, where much tacit clinical knowledge is learned, and in other didactic settings, in which primarily explicit knowledge is learned.[5] Incorporating computer-based education technologies will improve the efficiency and decrease the cost of clinical orientation and training.

Implementing computer-based education requires transferring into an electronic format the content that has traditionally resided on paper, so the preceptor and clinical educator need to determine the best technology to optimize the learning experience and maintain a user-friendly approach to clinical training. The institution's internal computer network may provide user-friendly access to critical information and link to the Internet.[6]

Transferring clinical training materials from printed to Web-page format (hypertext markup language [HTML]) has become easy and inexpensive because many word processing and slide presentation programs can automatically convert their files to HTML. Documents that are not stored in an electronic format can be electronically scanned (document imaging) and converted into Web pages, which is a low-cost option available in medical records departments of many hospitals. A great advantage of converting paper documents into Web pages is that once they are converted, they are immediately available for distribution without certain costs (printing, copying, and binding) associated with paper documents. HTML allows linking to related Web pages and portable display format (PDF) documents so that the end-user can easily access desired materials. An example of linking related documents for the orientation process is linking a ventilator's user manual to the organization's policies and procedures for the clinical application of the equipment specific to an individual intensive care unit in the hospital. Many questions a new RT graduate might have can thus easily be addressed by linking to documents that can answer the questions. If the preceptor is not always readily available for questions, inserting an e-mail link into the Web page makes it easy for the trainee to send a question that the preceptor can address when his or her schedule permits. E-mail facilitates the sharing of vital information and strengthens the working relationship between the preceptor and new RT, which enhances the learning experience, provides valuable feedback, and decreases the likelihood that the new graduate might resign during the orientation period due to fear of inadequate clinical skills and knowledge.

Computer-Based Continuing Education for Experienced RTs

Experienced RTs demand a well-designed continuing education program so that they have access to the latest information on their subjects of expertise. Advances in medical technology, especially mechanical ventilators, makes it essential for RTs to stay abreast of current practice with those technologies. In addition, as published research is constantly changing therapeutic practices for respiratory technology, immediate access to critical and up-to-date information is necessary so that RTs can deliver safe and effective treatments.[7] To keep the experienced staff informed of current practice requires a well-designed strategy from the clinical educator. Experienced staff need critical and detailed information, not the basic hands-on training used with the new graduate orientation. Therefore, the content for advanced practitioners must be "scalable" and easily accessible at all times at or near the point of care. Scalability (various levels of detail available) is important because sometimes the RT will need to review only the abstract and other times will need all the research details. The clinical information must be immediately available, easily accessible, and in a flexible format, which presents several challenges to providing educational offerings to the experienced RT staff. However, by incorporating classroom presentations, the Web and Internet, and other technologies and media, the educator can organize

appropriate information that will meet the needs of the entire staff on an as-needed basis, including at the point of care.[8] But before implementing technology into the clinical education process, the educator must develop a strategy that will improve the education program and decrease the cost of maintaining the staff's respiratory care knowledge base.

Developing a Computer-Based Education Strategy and the Appropriate Technology

Continuing education for experienced RTs is usually in the form of weekly or monthly classroom presentations. This type of instruction consumes large amounts of resources, including on-duty RTs leaving the patient's bedside and off-duty RTs attending the meetings, which in effect causes them to lose time off from the work place. Requiring staff to be present for classroom education during their off-duty hours causes employee dissatisfaction unless they are paid overtime compensation, but paying overtime compensation increases education expenses and could lead the hospital administration to decrease clinical training hours because of budgetary constraints. So to provide effective education while containing costs, the RT educator must incorporate appropriate technology. The institution's internal computer network can provide a portal for accessing education material as needed, at all times.[9] Similar to the use of the institution's internal computer network and associated links to the Internet for new graduate orientation, this same process is useful for experienced RTs, but with more detailed content.

In addition to placing the staff education materials on the institution's internal computer network, linking the materials to specific journals to which the hospital's library subscribes can help keep the staff education materials current and evidenced-based *if* the clinical educator stays abreast of the literature and edits the staff education materials regularly. The staff education materials must also agree with the current clinical practice guidelines. Maintaining content consistency may decrease medical errors associated with the application of complex technology, especially with newer mechanical ventilators. In January 2002 the Joint Commission on Accreditation of Hospitals published a sentinel alert regarding serious medical errors associated with inappropriate mechanical ventilation. In response to the sentinel alert, the American Association for Respiratory Care made 2 recommendations related to clinical education for decreasing mechanical ventilation errors:

1. "Professionals responsible for application, adjustment, and monitoring of ventilators, alarm systems, and airways, possess relevant education and have undergone validated competency testing."[10]

2. "Organized, periodic, ventilator-related continuing education is accessible to those professionals responsible for

the many components of care directed to ventilator patients."[10]

To meet the American Association for Respiratory Care recommendations, the RT educator must provide the staff with information that will assist in minimizing medical errors associated with mechanical ventilation. Strategically merging computer-based education and other pertinent technology will enhance the delivery of care from even the most experienced RT staff working in intensive care. This approach may also improve the institution's employee-retention, because providing "just-in-time education" will meet the staff's requirements for obtaining continuing and up-to-date education. To supplement the routine application of an internal computer network and the Internet, providing the staff with training materials on CD-ROM gives them a method of accessing the information when they are not physically present within the institution. CD-ROM is a relatively inexpensive way to reproduce and keep an up-to-date digital library of staff education materials. The availability of education materials on CD-ROM may encourage experienced RTs to review clinical materials while away from the hospital, which may enhance their skills, improve patient care, and complement the hospital-based training. In addition, incorporating CD-ROMs as a source of current clinical information may stimulate discussion among the staff, which can foster the development of personal networks that will enhance learning and increase employee satisfaction.

Many vendors of respiratory care technology provide the training materials about their products on CD-ROM, which supplement the hands-on training presented by company representatives. However, although that material is excellent for introducing the technology, it may lack specific information the staff require, so the clinical educator may need to adjust and fine-tune the content of the vendor-supplied material to meet the culture and workflow needs of his or her hospital. To effectively integrate the vendor-supplied training materials with the hospital's education materials requires collaboration between the clinical educator and appropriate members of the company's staff. The materials may provide continuing education units at no charge to the staff and may meet the department's continuing education requirements. This type of cooperation between the vendors and clinical educators may lead to new training materials (eg, computer simulations) that will further improve staff education while reducing the cost of obtaining new respiratory care technologies.

The Role of the Chief Knowledge Officer: Lessons From Other Industries

RT educators should review the role of "chief knowledge officers" in other industries, such as software companies. The chief knowledge officer ensures that the ap-
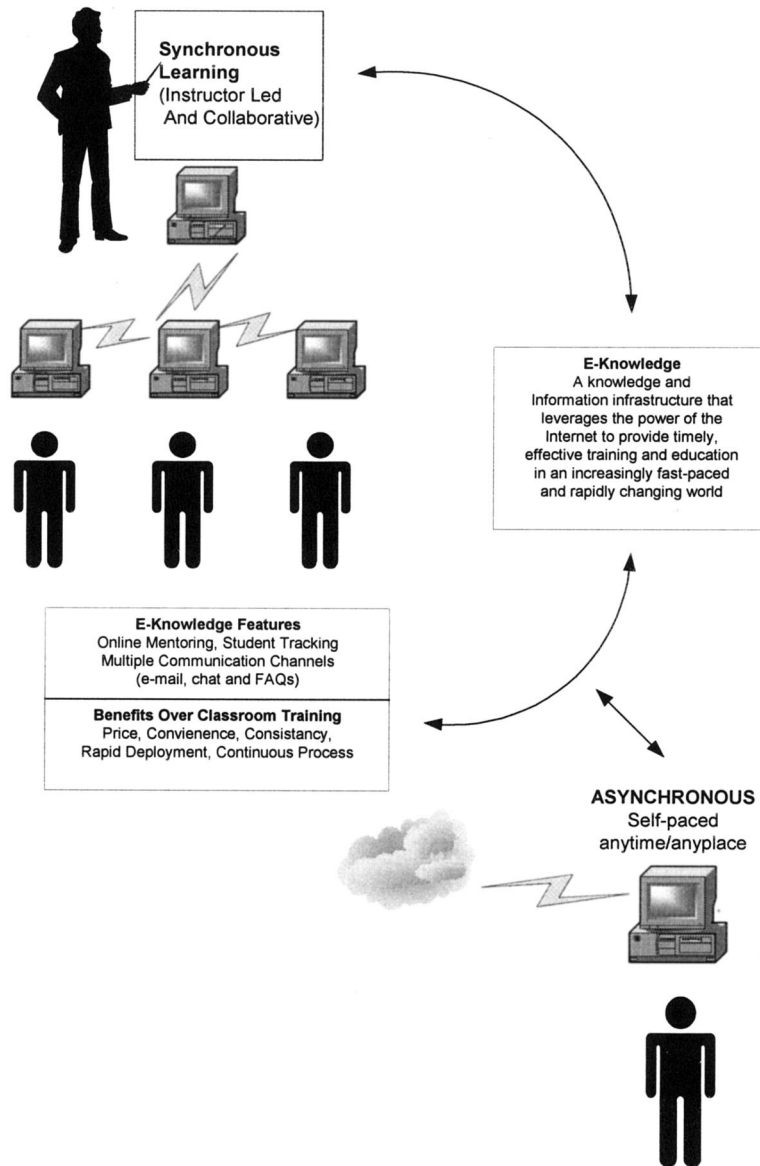
Fig. 1. Outline of the synchronous and asynchronous training system, which used existing technology, at Children's Hospital Central California, Madera, California. FAQ = frequently-asked question.

propriate knowledge is available to all employees when it is needed,[11] that the staff-education strategy supports the corporation's overall strategic plan and goals, and that the various departments share information to enhance productivity. Since many aspects of respiratory care include interventions from other departments of the hospital, the RT educator can orchestrate knowledge with those departments to improve patient care. For example, expediting weaning of an infant from mechanical ventilation following cardiac surgery requires input from the various clinicians responsible for the infant's immediate-postoperative care. The RT educator can also organize and coordinate educational materials from the various departments so that all relevant information is immediately available. This type of collaborative information-sharing is necessary if multidisciplinary interventions are to be effective, especially with patients who have complex conditions.

To ensure that critical information is communicated in a timely manner between all the care-team members, the information system should allow for both synchronous training (ie, the trainees attend a live presentation by an instructor or view the presentation via live video transmission) and asynchronous training (ie, the instructional presentation is audiovisually recorded for the trainees to observe later). Figure 1 describes the system used at Children's
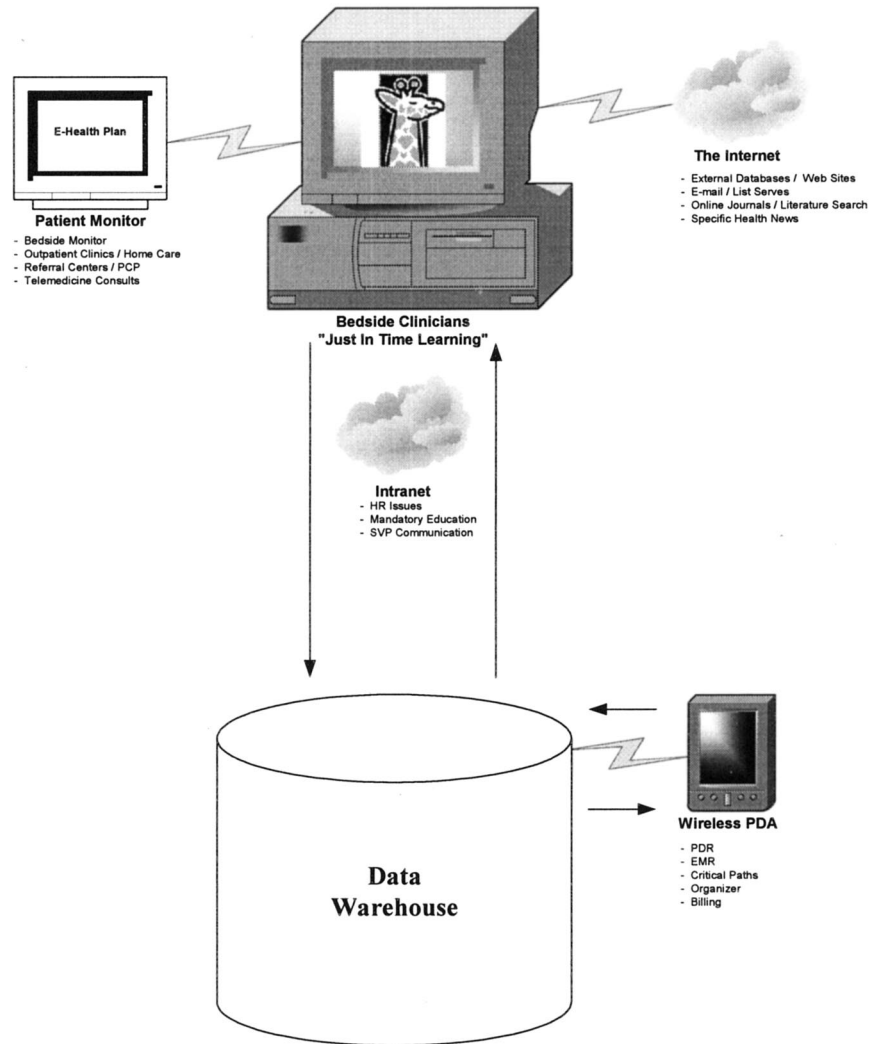
Fig. 2. One possible technology strategy for delivering on-demand education, incorporated into a bar-code system for drug delivery. PCP = primary care provider. HR = human resources. Intranet = institution's internal computer network. SVP = senior vice president. PDA = personal digital assistant. PDR = *Physicians' Desk Reference*. EMR = electronic medical record.

Hospital Central California, Madera, California, which includes synchronous and asynchronous training.

To fully realize the potential of these training and knowledge-distribution approaches, the hospital must have the necessary information-technology infrastructure. Primarily, the technology must provide for "Webcasting" (live video transmission via computer network) the training presentations throughout the facility. Webcasting allows clinicians to remain in their areas of responsibility while seeing and hearing the presentations. This form of instruction has greatly improved knowledge distribution in software companies such as Cisco Systems (San Jose, California), which must keep a worldwide force up to date on new changes to their products. By simply logging into the company's internal computer network, Cisco's employees can view the training presentations from any location.

Synchronous presentation requires the student to be present at the presentation or watching a computer monitor at the time the training session is presented, whereas asynchronous presentation (storing an audiovisual recording of the training session on a computer server) permits staff to view it any time after the session. The video player software used to view such presentations is free to download from various Internet locations. The audiovisual format can enhance the value of the presentations to the end user, and asynchronous presentation decreases costs (eg, decreases overtime pay and lost productivity during work time), since the classes are available for viewing whenever

the trainee's schedule permits. In addition, asynchronous presentation can electronically document attendance and evaluate attendees, using online tracking software.

Computer-Based Education and Business Plan Development

In various industries computer-based employee training has been demonstrated to be effective and cost-saving, regardless of the employee's location. Corporations insist on business plans that demonstrate a positive return on investment from computer-based employee training,[12] so corporate educators have designed systems that enhance the quality of the companies' core products and thus positively influence the "bottom line." Given the current economic conditions of the health care industry, an RT educator will need to convince his or her hospital's management of the value of investing in computer-based employee training. To persuade the hospital administration to fund computer-based education, the RT educator must focus on the hospital's business plan and on improving patient care while decreasing costs.

To demonstrate a positive return on investment, the RT educator can compare the cost of computer-based education to that of traditional training methods such as the classroom setting and attending conferences, which can include tuition, salary, travel and living expenses, overtime pay, and the cost of covering for staff who are at training instead of at work. Although attending conferences and other off-site seminars can be important for obtaining new, clinically-useful information, hospital administrators may disallow conference/seminar expenses during periods of fiscal tightening. Therefore, it is important for the RT educator to demonstrate that computer-based education can meet the organization's education objectives while decreasing costs. Working with the hospital's information technology department will assist the educator financially to justify a computer-based education system, especially if the information technology department has recently or is about to introduce new (or upgrade existing) technology that can support computer-based education.

Bar-Code Drug-Delivery System Integrated With Computer-Based Education

Recently, many state governments and the federal government mandated that hospitals develop strategies to decrease medical errors, especially drug-delivery errors. One approach to minimizing medical errors is bar-code technology to control drug delivery. Bar-code drug-delivery systems can use handheld computers wirelessly linked to a network, so that the entire drug-delivery process is thoroughly documented and immediately provides clinicians with patient and drug information at the point of care. Such a handheld, networked

system could also simultaneously support computer-based staff education, allowing clinicians to access various types of information in addition to drug-delivery information. Figure 2 illustrates a technology strategy for integrating computer-based, on-demand staff education and a bar-code drug-delivery system, which merges 2 projects and thus cuts costs and enhances the usefulness of the handheld device for the clinician; such a strategy might help convince the hospital's administrators to implement computer-based staff training. To implement such an integrated system, the RT educator will need to collaborate closely with the information technology department to coordinate the functionalities of the handheld devices so that they (1) adhere to all of the hospital's policies, standards, and guidelines; (2) are protected from software viruses; (3) protect patient-data security; and (4) fully integrate with the hospital's existing information technologies.

Summary

Hospital employees and their knowledge base are as important an aspect of the health care industry as are the portfolios of corporations in other industries, but health care has lagged behind other industries in implementing advanced information technologies to improve employee education and decrease costs. RT educators can lead the way in the health care industry by working to implement and improve computer-based staff education. RT educators should follow the lead of educators and chief knowledge officers in industries unrelated to health care, who have long demonstrated success with computer-based employee training. Moreover, the RT educator can set an example of clinician involvement with the hospital's information technology department, which may improve the value of computing and communications technology for the hospital by improving patient care and decreasing staff training costs for all health care providers.

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Discussion

Giordano:* Thank you for that thought-provoking presentation. I'd like to carry it one step further, though. If you've got information that you could access through your Pad [brand personal digital assistant or PDA] or your Blackberry [brand PDA], what's to prevent—and maybe this is already done, so it's my question—the real patient data from being sent to a respiratory therapy education program so the instructor could use real-time, real patient data, as a teaching tool?

Walker: You hit the nail right on the head. You brought up 2 subjects. This is part of our bar-code system for drug administration. The hospital already bought these things, and since I work in the information technology department, I said, "Why don't we open up the portal to do something more than drug administration? Get me access to everything that's on the network." So this costs the RT department nothing because it was already part of the hospital's strategic plan.

At our RT program in Fresno we're doing what you suggested. And we're meeting the HIPAA [Health Insurance Portability and Accountability Act] requirements. With all of our remote monitoring we can take out all the patient identifiers so it's possible to see how a patient responded to, say, a PEEP [positive end-expiratory pressure] change, without being able to see which patient it was. I want to

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stress that coordinating with the respiratory-therapist-training programs is essential, because we rely on those programs for future RTs.

Gardner: I have a question about monitors. We've had the capability of gathering data from bedside monitors for a decade or so, and they gather the data beat by beat and store it for 24 hours. I've seen no benefit from that. Twenty-four hours later the data is just deleted. You don't have the other supporting data, and so I'm worried that we're now going from a big screen to a little PDA that has poor screen resolution, and we're saying that does wonderful things. Have you done studies to show that it made a difference? I haven't seen it yet.

Walker: No, I've not seen anything with biological information yet, but there is data from other industries. A friend of mine works for the irrigation department in San Mateo, California, and his handheld device has access to all the flow of water in San Mateo. He can control those with his handheld device. Also, Pacific Gas and Electric Company is working on a similar project, in which they'll be able to look at energy use throughout California. Soon there will be no meter-readers because they're going to have people out there with handheld devices that will automatically read the meters and shut off energy, as needed. I don't know of any published data yet, but my own personal opinion, after using this for a couple years, is that it works extremely well for me.

Gardner: I'm still a doubter.

Walker: That's good.

Gardner: Give me the study to show me the "so what" of it. The technology is wonderful, but does the technology really *do* anything or is it just fun? We need to do the studies. And I challenge you to do them. It sounds like you're in a great position to do it. Get your folks busy and do it.

Walker: That's true, but if I wanted to get this information through a paper system, it would be a nightmare to capture the data, copy the forms, etc.

Gardner: That's not the challenge. I agree with you that the paper system won't work. But now that you've *got* this technology, what difference does it make and why, and how can you optimize it?

Walker: I can tell you this much. Our cardiac surgeons don't come in in the middle of the night anymore. They use the technology so they can assess a patient's situation and give medical orders from home or wherever they are. The surgeon might say, "OK, give the patient a little more epinephrine. Hmm, That's not enough? Give him a little bit more." The doctors would not let anyone take away their ability to deliver orders at a distance. To me that's worth a lot of money.

MacIntyre: You're telling me that cardiac surgeons are giving orders for epinephrine from home? I don't want that surgeon.

Walker: That was just an off-the-cuff example.