ABSTRACT: The intent of this article is to selectively review certain innovative technologies and how they can assist the pharmacy profession. By no means is this intended to be an exhaustive review of all the applications available. Instead, the objective is to introduce some of the information processing technologies available. This article describes the applications of new technologies and automation with specific examples of innovative products. New technologies are abundantly available to pharmacists. A review of representative technologies should help pharmacists appreciate the breadth and depth of this evolving group of information assets. These assets can be arranged in categories that include the order-entry process, case management, therapeutic outcomes assessment and patient adherence. Technology alone will neither be a panacea for the profession nor destroy it. Realistic expectations from technology need to be formed.

Pharmacists can assuredly expect technology to replace certain manually performed tasks and to extend the capacity of the pharmacist’s role in other instances. The lack of telecommunication, vocabulary, and knowledge representation standards are identified as major implementation barriers, as is the apparent apathy of the profession with regard to forming a concerted, proactive pharmaceutical informatics initiative.

KEY WORDS: Technology, Order entry, Case management, Outcomes assessment, Patient adherence, Informatics

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From a technology standpoint, everything a pharmacist in managed care can possibly need to support a practice exists right now. In most cases the technology is affordable and user-friendly. Some technologies are free of charge, and some are offered at a very low cost.

One purpose of information is to reduce uncertainty. By reducing uncertainty, health care moves toward being more evidence-based, a goal all managed care organizations share. To this extent, technological information management is the major driving force in health care. The degree to which we embrace technology determines the extent to which we as health care personnel will be effective and efficient. Nicholas Negroponte, noted commentator on technology, points out that the single most important factor in an organization’s future is how it will adapt to the digitalization of information.¹

Technology and technological changes can be both a boon and a bane to professions and organizations. History holds plenty of evidence. Buggy whip manufacturers scoffed at the new technology of the automated horseless carriage, rather than adapting to emerging trends. As highways emerged, the railroad industry ignored trends in transportation and stayed with tried-and-true ways of business, prior to declining. The technology of nuclear fusion and cloning have the potential to either advance the world or destroy it. The same potential lies in today’s world of pharmacy. How pharmacists use and implement some of this technology will determine in which direction the profession is heading.

Trends in managed care, business, national infrastructure, and the Internet (Figure 1) are moving rapidly in order to support connectivity of huge amounts of data and information at

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Figure 1. Technology Trends Affecting Health Care

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<th>Technology Trends</th>
<th>Health Care</th>
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<tr>
<td>Financially Focused Systems</td>
<td>Point of Care</td>
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<tr>
<td>Clinically Focused Systems</td>
<td>National Information</td>
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<td>Member-Centered Repository</td>
<td>Connectivity</td>
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<td>Enterprise Clinical Process Automation</td>
<td>Internet</td>
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the point of care. Point of care may be in the physician’s office, in the pharmacy, or over a telephone wire at the patient's home. These innovations are bringing new levels of data and information to patients and health practitioners. Whether these innovations advance knowledge and wisdom is up to each person.

**DATA, INFORMATION, KNOWLEDGE, WISDOM**

Is there a natural progression from having more data to having more wisdom? Does having more data automatically make one a better clinician? Will this technology help us become more knowledgeable and wise practitioners? In evaluating technology for any practice setting it is helpful to step back and address some of these seemingly basic questions.

Conventional thinking suggests that the person with the most data and information has the most power. This may not be the case. Librarians, for example, clearly have more data and information than many other professionals but are not thought of as power brokers, while politicians are notorious for having very little information and yet wield considerable power. Pharmacists clearly have more data and information about medications, yet physicians hold the power to medicate.

Benefit managers have huge amounts of data in the form of claims. Currently, the use of this data focuses on policing therapeutics instead of producing knowledge about better therapies. Raw data needs to be synthesized with information in the right format, presented at the right time, and put into the correct hands to produce knowledge and wisdom. This transfer of knowledge is the principle value pharmacists provide for patients and other health care providers. Therefore, technology in pharmacy is really about five new “rights” for the profession: the right data to produce the right information, in the right format, at the right time, in the right hands.

The following are the categories in which technology is having the greatest impact on knowledge transfer to patients and other professionals. Each includes examples of representative companies and products.

**Case Management**

The Pharmacist's Medical Record by MedOutcomes (804/359-3995) can help pharmacists go through the Subjective-Objective Assessment Plan process with chronic conditions such as asthma, diabetes, hypertension, and hypercholesteremia. It provides consistent structure and content for working up a patient. It will walk the user through a past medical history, subjective observations and objective measurements, medications, the creation of a therapeutic plan, and patient education. For example, in the case of asthma, the product will prompt the user to assess compliance, evaluate the appropriate use of inhalers, determine triggers for attacks, and so on. The product can give a pharmacist confidence in a patient interview to document all relevant issues consistently. The process will build medical record documentation in a structured format familiar to other health professionals. In addition, it automatically will build patient education and data to create letters formatted as templates for the physician. All this is obtained as a byproduct of the patient interview process, providing consistency of care needed for good therapeutic outcomes. At least 12 companies other than MedOutcomes offer similar products. Each product has a particular strength, such as billing, marketing, workflow, or disease coverage, but creating the ideal product would require “cherry picking” the competition and forming the best application from the many.

**Self-Care Management**

The explosion of medical information on the Internet provides much new information to both pharmacists and patients. Anyone with a few thousand dollars can post information and have worldwide access. It has been noted that “the Internet too often resembles a cocktail conversation rather than a tool for effective health care communication and decision making.” The dark side of the Internet is that erroneous and even fraudulent health care information is being disseminated. As a result, efforts to better assess the quality of medical information on the Internet are under way. The American Medical Association and the Geneva-based Health on the Net Foundation have established a code of conduct for sites providing health information (http://www.hon.ch). Web
sites displaying the HON symbol conform to the quality initiatives of the Health on the Net Foundation.

Auburn University's School of Pharmacy is involved in a Pharmacy of the Future, a project with the Eckerd Corporation. Part of this project involves building intranets for patient access so that a health system will control what patients are reading by suggesting valid information sites.

One example of a resource for patients active in their own care is the Sapient Health Network (http://www.shn.net), an interactive health information service developed for people with chronic and serious illnesses. It provides timely information and support, giving patients the tools to be their own experts and helping them make informed decisions about how to fight these diseases. Diseases that are covered extensively are asthma, breast cancer, depression, diabetes, fibromyalgia and CFDIS, heart disease, hepatitis C, weight control, and prostate cancer. The service also offers a women's health place.

As patients are exposed to more data and information, the knowledge and wisdom of the pharmacist will be critical to helping them manage their disease and treatment.

**Patient Information and Education Resources**

Eighty-two percent of Americans learn better visually than by any other means, yet pharmacy counseling areas are designed for talking. Patients typically receive very little visual information. There are, however, a number of visually appealing products on the market.

The Mayo Family Health Disk and the Mayo Family Pharmacist (sold in a set called the Mayo Clinic Ultimate Medical Guide), and dozens of other CD-ROMs are offered in many software stores for very affordable prices (both disks in a set for under $40).

The ADAM Software Company, producers of ADAM The Inside Story and a dozen other relevant products, discounts its products to pharmacists to a cost of only $20 each (800/408-ADAM, discount code 2124). They have products for both consumers and health practitioners. More than nine gigabytes of digitized visual information is available for licensing, for teaching patients, or for in-service education.

Pediatric House Call and Medical House Call focus on the diseases, surgeries and medical tests associated with pediatric and adult medicine. These CDs, found in most computer software stores, are directed toward the consumer audience and are quite good at showing pictures that support patient-focused counseling and case management activities.

Nine-Month Miracle for neonatal, gestational birth-oriented information is a rich visual experience where parents can get answers to every conceivable question about the birth process.

Life's Greatest Mysteries is a good example of "edutainment" (a CD-ROM program that is both educational and entertaining). It shows how migraine headaches occur physiologically, what medical leeches have to offer, and answers such questions as whether the brain is still working after a visit to the guillotine.

**Drug Information Tools**

Every single drug information tool that a pharmacist already knows and respects also is available electronically. Many include advanced features that make taking a heavy book off of the shelf seem obsolete.

While the USP DI Volume 1 is known and respected in the pharmacy community, it is not as well known in the medical community. One useful tool of the electronic CD-ROM version, called USP DI Plus (800/822-8772), is a feature that cites the reference for each section of the monographed information, giving the ability to cite primary reference sources recognized by physicians while using a tertiary source.

The Lexicomp Clinical Reference Library (800/837-5394), a series of CDs, has some very advanced search features across many different reference books. Lexicomp provides a tool that allows a pharmacist to quickly isolate the drugs, chemicals, or even natural products that could be causing a problem. It searches through multiple tertiary references, such as the Drug Information Handbook, pediatric and geriatric dosing references, to document the information.

While Micromedex remains the familiar electronic standard in drug information, a recent article points out that two relatively inexpensive electronic drug references, Clinical Pharmacology and Physician’s GenRx, were able to answer as many drug information questions as Micromedex. One of the strengths of Clinical Pharmacology is its ability to include a patient screening or brown bag review feature. It will print a detailed analysis of a patient’s drug therapy, including drug interactions, adverse drug reactions to monitor, conditions and indications matching, and contraindications.

The Stat Ref (800/STAT-REF) is a complete medical library shelf full of references with 28 key medical references on a single CD ROM. It includes Stein’s medical dictionary, Harrison’s Internal Medicine, pediatric books and diagnostic books, Martindale’s, the Merck Manuals, USP DI, American Medical Association Drug Evaluation, American Hospital Formulary Service, and others. The Stat Ref will assign a code to allow the user access to any or all of the reference sources.

**Continuing Education**

The use of streaming audio signals over the Internet with products like Realaudio and Realvideo (www.real.com) has tremendous ramifications for continuing education. Instead of downloading a presentation that takes massive amounts of disk space, one click on the play button of these products and it starts sending audio information directly to the user.

On January 21, 1997, renowned experts in HIV/AIDS were invited to a symposium in Washington, D.C. While they presented to that live audience, a Helix team sponsored by Glaxo Wellcome captured over 10,000 slides, with accompanying narration from each speaker. That same day, the speeches, slides, and narrations went up on the World Wide Web where they could be viewed and heard (www.retroconference.org). Since that time, 1.8 million people in 100 different countries have accessed the symposium from their desk-
Diabetes

LifeScan offers the In Touch software and interface cable used in conjunction with the One Touch meter. A glucose meter with a memory chip records each finger stick, with the time of day, date, and the value of that stick. The interface cable can download results into a computer for control assessment (contact local representatives for each of these products).

Boehringer-Mannheim has two software products, PDMP Pro and Camit, used with their AccuCheck meters.

The third product is Precision Link from the Medisense Company, which downloads the memory from its Precision glucose meters. Bayer offers the Dex glucose meter, which interfaces with Dyason download software.

The DCA 2000, also by Bayer, is a CLIA-waived hemoglobin A1C test. CLIA stands for the Clinical Laboratory Improvement Act, a federally managed program that monitors the licensing of medical laboratories in the United States. If a test is CLIA-waived, a pharmacist must apply for this waiver and pay an annual fee of $100 to the federal government. State laws also must be adhered to, but CLIA waiver is a low-impact license to do many tests that will enhance the practitioner's ability to have a significant impact on therapeutic outcomes. The device costs approximately $1,700. If a practitioner is working with many diabetic patients, it can be a valuable alternative to a reference lab.

Asthma

Air Watch by the Enact Company (800/267-9452) measures peak flow. Currently, more than 20,000 patients are on this product. It not only does peak flow and forced expiratory volumes (FEV), but also measures percentiles of green, yellow, and red zones from previous readings. From a standard telephone jack it can download up to 500 readings and give the user a 30-day and a six-month trend analysis on both peak flow and FEV1.

Cholesterol Management

Cholestech is a $1,700, CLIA-waived, full lipid profile analyzer. It operates from a finger stick and is in increasingly heavy use in pharmacies across the United States.

The Hemocue is a $600 CLIA-waived device that measures blood hemoglobin, by way of a finger stick, to help diagnose anemias and hematocrit problems.

THE VIRTUAL PHARMACY

One of the more innovative applications of automation and technology to extend pharmacy services has been implemented at the University of Utah and Veterans Administration with a Massachusetts company, ADDS, Inc (978-670-0746). The service places an automated dispensing device at the physician's office. The prescription is faxed or electronically sent to a servicing pharmacy. The pharmacy does the normal...
adjudication of the claim and conducts drug utilization review (DUR). An electronic message is sent over normal phone lines back to the dispensing machine which releases a prepackaged bottle of the prescribed medication. A bar code reader ensures the proper label is attached to the prepackaged medication. Over the same phone line, the pharmacist can interact with the patient through a real-time video connection, utilizing videophone capabilities now available from a number of manufacturers. While the quality of the image and transmission delay would not be suited for a long presentation, it seems to work for limited face-to-face interactions.

There are possible advantages in this scenario for managed care, because a single pharmacy is able to reach areas not serviced previously, and the patients do not have to make additional trips to the pharmacy. Finally, the formulary can be controlled at the point of care via the dispensing technology.

PHYSICIAN ORDER ENTRY, ELECTRONIC MEDICAL RECORDS AND DECISION SUPPORT

The most expensive piece of technology today is the physician's pen, which accounts for most of the healthcare dollars spent. The value of an order-entry system with the needed data elements to drive decision support for rational prescribing is unequivocal. In 1995, the American Society of Health System Pharmacists adopted the position to support direct electronic entry of medication orders by the prescriber as the preferred method of prescribing. Yet only the early adapters of technology are using these tools today. It is estimated that less than 5% of physicians use electronic order-entry tools.

For managed care pharmacy, the integration of an intuitive formulary analyzer based on patient history and current condition, with an order-entry system tied into a complete electronic medical record, will drive the more effective use of pharmaceuticals. One of the reasons current products are not used more often is that simple on-formulary/off-formulary messages and DUR programs not suited for prescribers produce too much clinical noise for physicians to find them useful. Separate products that do not integrate prescriptions into the physician's workflow have little hope of success. Integration of a computerized physician order-entry tool, with an electronic medical record offering evidenced-based, decision-support capabilities, are the elements that will move this technology to many more users. Very few product offerings have all these attributes.

Many companies are attempting to automate prescription-writing and are operating on the assumption that physicians will enter prescriptions electronically, disconnected from other functions. A simple search on the Internet of "prescription writer" yields at least 50 products on the market today. There are at least 80 companies offering an electronic medical record. A survey of these vendors yielded only 31% (25 out of 80) that offered multiple-plan formulary support and dynamic real-time use of formulary at point of care, based on the patient's plan.

A few exceptional products come from Physician's Empowerment Technologies (www.hdipet.co) and Cerner Corporation (www.cerner.com). Physician's Empowerment Technologies has incorporated more than 100 clinical guidelines, with prescribing as a component, into an electronic medical record. They are in the process of negotiating malpractice reductions for physicians who use the automated tools to comply with established treatment guidelines. Cerner has teamed up with ADIS International, a medical publisher, to develop automated alerts in pharmacotherapeutics for their product line.

STANDARDS UPDATE

The importance of standards cannot be over-emphasized. It was the adoption of standards that led to the use of many technologies such as fax, Internet, and claims processing.

While the National Council on Prescription Drug Programs (NCPDP) has been the standard of choice in the pharmacy claims world, many questions remain that standard-setting organizations are starting to address. For example, how is a prescription item uniformly represented? National Drug Codes, with all of their variability and package size specificity, are not well suited for use in order-entry systems. The Health Level Seven (HL7) vocabulary special interest group (SIG) is attempting to solve this important issue (http://HL7.com and www.mcis.duke.edu/standard/hl7). They also are tackling larger issues of different vocabularies for representing clinical concepts.

How can decision-support guidelines be interchanged among organizations? The HL7 Decision Support SIG will be adopting the medical knowledge representation standard first developed by the American Society for Testing and Materials. HL7 and NCPDP have formed a joint task force to begin work on merging message structures to facilitate communication among pharmacy claims systems and other medical data. A joint meeting was held and progress is being made to combine the two message structures for better communication between disparate systems.

What security will be needed to transmit patient data? This will be part of the Department of Health and Human Services' standard adoption due in 1998 for payor/provider transactions. This is an important initiative that most software vendors and organizations are expected to adopt.

The medical and nursing professions have taken very active positions and roles in the development and advancement of clinical informatics standards, while pharmacy organizations have been noticeably absent in this important movement. Medicine's work has primarily been through the American Medical Informatics Association (www.amia.org). The American Nurse Association (ANA) has several clinical informatics initiatives. The ANA Steering Committee on Databases to Support Clinical Practice is developing the Nursing Minimum Data Set (www.va.gov/pub/standard/health/ana.htm), described as "the minimum data elements necessary for defining the cost and quality of nursing care." The NIC (Nursing
CLAIMS PROCESSING SOFTWARE

Real-time pharmacy claims processing software has been the domain of monolithic mainframe-oriented information systems organizations. Software now is available that can process millions of claims per month. These systems can screen for eligibility, handle multiple financial and drug coverage benefit designs, assist with DUR, manage physician and pharmacy networks, promote custom messaging, manage formularies, track rebates and reimbursement, perform accounting functions, and provide complex reporting. The software vendors offering this type of functionality are:

ProCare Rx
1475 Peachtree Street NE, Suite 120
Atlanta, GA 30309
800/377-1037 or 404/888-5345
http://www.procarerx.com

Prospective Health, Inc.
7808 College Drive
Palos Heights, IL 60463
800/305-5577
http://www.prospective-health.com/

Systems Xcellence Inc.
555 Industrial Drive
Milton, Ontario, CANADA L9T 5C2
800/622-3111
http://www.systemsxcellence.com

CONCLUSION

Every systematic change that occurs usually follows a precribed path that begins with early adapters or innovators taking risks and learning how to implement change. The problem for pharmacists is that the window of opportunity for establishing the newer, more viable roles for the profession is not infinitely long. The case has been made, and hundreds of innovators have successfully proven, that pharmacists can have a positive impact on patient care. The question remains: Will pharmacists use their knowledge base to identify, solve and prevent drug-related problems, or will apathy dominate? Our crystal ball sees pharmacists possessing the knowledge but do they possess the will? The flux that health care finds itself in puts the future of the profession in our hands. Will we respond?

Will we embrace technology that facilitates the expansion of the profession or stand idly by and watch other disciplines adapt and triumph? The authors of this article are optimistic but only guardedly so. We have a sense of urgency. Let's write our future together by embracing technology and automation.

References