A. Executive Summary:

Is the Medical Industry Ready for Wireless Devices, PDAs and PC Tablets? We contend the use of Wireless Device, Personal Digital Assistants (PDAs), and PC Tablets by physicians at the point of care will become standard over the next few years, potentially saving the healthcare industry > $50B per year.

The implications of the Wireless Internet for physicians are easy to imagine. Physicians are on the move all the time and they have an intense and constant need for data to make decisions. Add to that, doctors’ proven acceptance of new mobile technology.

On the other hand, physicians are only beginning to take advantage of the Internet to assist them with their clinical practice. According to a recent Harris Interactive study entitled “Computing in the Physician’s Practice,” an overwhelming majority of physicians are online an average of six hours per week, but mostly from home and for personal use. Relatively little time is spent looking for general clinical information or on clinical work related to their patients.

Some 18% of physicians responding to a recent survey said they use a hand-held computing device as an “integral” part of their daily practice. Another 8% of physician respondents said they use hand-holds, but mostly for personal activities, according to the survey of 834 practicing physicians from the polling firm Harris Interactive, Rochester, N.Y. Two years ago, a similar Harris survey showed 10% of physicians used hand-held devices in their practice and an additional 5% primarily used them for personal activities.

The survey does not specifically ask what work-related functions physicians perform on hand-held devices. However, only 3% of responding physicians use hand-holds to track clinical work for billing purposes, according to the survey. Some 49% of respondent’s record billing codes on cards or notes and 27% record codes on a computer. Another 15% of responding physicians said billing codes are automatically generated as part of a computerized clinical record taking process.

Overall use of hand-held devices is more common among physicians under age 45 (33% use rate) than among older physicians (21% use rate), according to the survey. Wholly or partly hospital-based physicians use the devices more than office-based physicians. The size of a physician practice also plays a role in determining how many physicians

Harris Interactive Survey
Key Findings

- 89% of physicians use the Internet at the office or at home, with the average online physician using it six hours per week.
- 86% of physicians use cell phones, and 15% use handheld appliances, e.g. personal data assistants (PDAs), like Palm Pilots.
- 52% of physicians sometimes use computers to receive the results of laboratory tests.
use the device. Only 11% of responding physicians in a solo practice used hand-held devices in the course of their work, while 25% of physicians in a practice of at least 25 members used them, according to the survey.

Some 11% of responding physicians who record notes manually or Dictation on to tapes expect to use a hand-held device for recording within 18 months, according to the survey. Another 22% expect to use hand-holds for recording notes within five years. "Given these expectations and the current rate of growth in the use of hand-helds over the last two years, one can reasonably estimate that about half of all doctors will be using hand-held devices by 2004 or 2005," according to Harris Interactive. "However, this rate could be greatly increased if payers, hospitals or group practices mandated their use." The polling firm notes that pressure on providers to reduce medical errors could accelerate the adoption of hand-held computing devices.

B. PDA Handheld Market Overview:

During the early 2000’s numerous technology vendors entered the healthcare PDA market. Each of these vendors provided one or two of the functions list above. Only Allscripts Healthcare Solutions marketed a “complete” solution. However, the majority of these PDA applications were not integrated with the various practice management systems (PMS) and electronic medical record (EMR) applications. Therefore, a physician was required to re-enter all of the information that was already captured by their office staff. After the initial wave of adoption, the actual % of physician using one of these systems decreased. A number of vendors that were highly rated like ParkStone went out of business within two years of their initial release.

One major factor that drove many of the stand alone vendors out of the market was the transition of the leading PMS and EMR vendors that developed and launched integrated PDA applications. In 2001, only 12% of the leading EMR and/or PMS vendors offered integrated PDA application. By 2003, over 50% had integrated PDA applications. Based on future plans, over 90% of the top EMR/PMS vendors will have integrated PDA applications by 2005. Therefore, PDA applications that are not offered by PMS/EMR vendors or are not tightly integrated will fail, and will be replaced throughout the market.
Today, there are two basic operating systems for PDA devices – Palm OS, and Windows CE for the PC Pocket. During the 1990’s PALM ruled the handheld and PDA market with a 90% share of the healthcare PDA market. However, in 2001 when Compaq released their new PDA device labeled “Pocket PC IPAQ”, the market economics began to change. In 2002, Palm’s new sales market decreased to 50% while IPAQ increased from almost nothing in 2000 to 30%. Based on a survey of 48 healthcare IT vendors, 46 or 95% have elected to build all of their new PDA applications using Windows CE and the IPAQ product line. Based on this and other projections, we expect the IPAQ to dominate the healthcare PDA market by 2004/05. Three of the main reasons are memory and processing speed, color, and IPAC’s ability to record electronic dictations. As shown on the exhibit, the IPAQ increased their healthcare market share from 1% in 1999 to 30% in 2002. Based on all projections from the various healthcare solution vendors, we estimate that IPAQ will exceed PALM by 2003 with a 47.1% share, and the IPAQ could capture as much as 70% of the healthcare marketplace by 2006.

So while is IPAQ capturing the healthcare marketplace? Mostly because the top 40 healthcare IT applications vendors have already switch their development plans to the Microsoft PC Pocket applications and that 90% of this top healthcare application vendors have selected IPAQ as the device of choice.
C. Device Selection

In choosing devices for mission critical applications, consider scalability and robustness. If you purchase an underpowered handheld simply because of the attractive hardware price, you may sacrifice the return on your much larger infrastructure investment. Many organizations will find that different departments and divisions require different devices. As stated earlier, start with the high-level business objectives, move to application requirements, and then consider the most appropriate hardware platform. And still, there is the deployment of handhelds as companions to laptop and notebook PCs. Handheld devices are increasingly augmenting, not replacing, portable PCs. Certain functions such as serious document editing require mobile PCs.

The advent of handheld devices will further differentiate between luggable versus portable technology. Handheld devices are often application specific devices. They may be extending a specific application, almost becoming an appliance or utility. The burgeoning consumer handheld market has flourished largely as an extension of personal information management. Today, organizations are looking to these same devices to extend supply chain management, sales force automation, inventory management, facilities management, and point of care applications, law enforcement, scientific data collection and production data collection.

Despite all being called PDAs, devices in the handheld computer category cover a very broad range of functionality, from simple devices that are basically electronic organizers, to high-power products that rival the functionality of laptops. And to make matters even more interesting, mobile technology is evolving so quickly that newer, more advanced options are being introduced with amazing frequency.

To decide which device is best for you, there are a number of factors to consider, the outcome of which should help you narrow down the field of candidates for your PDA dollar. As you begin to make choices as to which features are important and which are optional, you will find the selection process becoming increasingly simple.

**Color** - Historically, color was one of those features that often dictated choice of device. Pocket PC’s were color, Palm OS devices were not. Time has changed this though and manufactures have moved to more common ground. Palm, Handspring, and Sony make color devices using the Palm OS while Compaq makes a monochrome version of its Pocket PC device. People choosing color screens find the clearer display and enhanced readability in low light environments to be the key benefits. Taking advantage of color displays as well, although aside from games, color doesn’t really change the performance. The noticeable disadvantages of color are decreased battery life, and added size and weight of the device.
**Chapter 6**  
*The ACG 2006 Annual Report*  
*Computer Systems in the Physician’s Office*  
**Level 4 – Mobile and Hand-Held Technology**

**Memory** - On the surface, this seems to be a pretty straightforward comparison. Pocket PC devices generally come with more memory that their Palm OS counterparts (32MB is common for Pocket PC devices compared to 8MB for most Palm OS devices). While this may not sound like much compared to the amount of memory on the average desktop, it is important to note that all memory is not equal. For example, a reference work that may need 10MB on a desktop may function perfectly well using only 1MB on a PDA. What is much more important than the amount of memory that comes with the device is whether or not you can add more. Most Pocket PC devices accommodate Compact Flash cards (the same kind of memory used in digital cameras) as do PDAs made by TRGpro (which uses the Palm OS). Handspring devices can accept more memory through Springboard modules (Handspring’s proprietary expansion port) and the new line of Palm devices incorporate the ability to add memory as well.

**Operating system** - The most important aspect of the operating system is not who makes it, but what kinds of software have been written to run on it (which is discussed next). If you are accustomed to using Windows on a desktop, you may find the Pocket PC interface more familiar. However, it is not as efficient as the Palm OS as it takes more processing power to run. This means faster processors are required which are more expensive.

**Battery life** - As has always been the case with portable computing, a device is only good if it has the power to run. The monochrome Palm OS PDAs has a distinct advantage with a pair of batteries lasting the better part of a month with fairly regular use. A Pocket PC or Palm OS with color screens will exhaust the batteries in a matter of days, if not hours with similar use. Most higher end PDA’s and all color devices have rechargeable batteries that help alleviate this issue. Provided the device is placed in its cradle regularly, it will be a very rare occurrence that the device goes dead. The only downside of this system is that if you don’t have access to a cradle, there is no way to recharge the device (as opposed to those where the batteries are replaced, which can be done anywhere).

**Speed** - One of the benefits the streamlined design of the Palm OS provides is quick response time. Because the operating system is quite simple and does not need to process colors (color models excluded of course), Palm OS devices are very fast. Pocket PC devices on the other hand tend to be more sluggish as the processing required to produce full-color, graphic intensive images is high. The speed on the newer models of Pocket PC devices is dramatically improved over the older models and will likely continue to get even better.
Chapter 6
The ACG 2006 Annual Report
Computer Systems in the Physician’s Office
Level 4 – Mobile and Hand-Held Technology

Data input - Almost without exception, handheld computers use a stylus for data input. If an integrated keyboard is a must, your options are pretty limited. However, both Palm OS and Pocket PC devices have detachable keyboards, which can be used for data entry. These add-ons generally cost between $50-$100 and can dramatically increase the speed of data entry. For the more adventurous there are also a number of more esoteric options such as software that is somewhat better at handwriting recognition and on handed keypads to experiment with.

Screen size - PDAs generally come with two basic screen sizes depending on whether you are interested in a handheld PDA or a palmtop PDA. Handheld PDAs (Pocket PC, Palm, Handspring, etc.) have screens in the range of 2.5 x 3 inches. Palmtop PDAs on the other hand have larger screens; with dimensions starting at 2.5 x 6 inches up to 10-inch screens (a typical laptop screen averages around 12 inches). If the larger screen is a deciding factor, your choices are going to be limited to a small selection of devices. It is also very important to note that most manufacturers have stopped making palmtop sized devices due to the lack of demand so future product support and software choices could be severely limited.

Expandability – The expandability of the newer PDAs is important to insure that your device will not become obsolete too quickly. Expansion slots allow the addition of memory and accessories, thereby increasing the device’s functionality without replacing it. Fortunately, almost every manufacturer makes a device with an expansion slot meaning the choices are no longer limited to just one or two brands. The important factor to consider with respect to expandability is the cost and selection of expansion modules. Make sure the device you select has the choices you require and that the cost of those modules is not going to break your pocket book.

Price - PDAs range anywhere in price from $150 to $1,000 with physical size, memory and color being the most influential factors in pricing. Devices based on the Palm OS tend to be at the low to mid range of this spectrum with Pocket PC devices at the middle to higher end (this is primarily due to the extra memory and added functions that come standard on a Pocket PC). If you are comfortable spending between $250 and $500, you will find a good selection of PDAs using each of the three operating systems

The proliferation of PDAs within the medical profession will become the norm, in our view by 2003/04, especially as other applications such as dictation, charge capture and lab ordering are added to software suites. We estimate that > 45% of the Physicians and > 50% of other medical professionals will be utilizing PDA’s by 2005. This equates to > 3M devices by 2005. For the medical professional, here are just a few of the things that can be done with a PDA:

- Patient tracking
- Dictation
- Receiving Alerts
- Reviewing Lab Data
- Drug Reference
- Simple organizational tasks
- Internet access
- Electronic prescription writing
- Renewing Prescriptions
- Billing, Charge Capture and Correct Coding
- Mobile ECG’s

Chapter 6
The ACG 2006 Annual Report
Computer Systems in the Physician’s Office
Level 4 – Mobile and Hand-Held Technology

The following pages describe each of these applications

Patient Tracking

It is possible to keep simple profiles of patients including personal and demographic information. Or choose one of the more advanced packages that allow for much more sophisticated tracking such as lab data, medical history and prescriptions. Once entered in the PDA, patient information can be exchanged with other handheld users using infrared beaming, ensuring all members of the care team have completed and up-to-date data. And by synchronizing the PDA with a desktop computer, notes from the device can be immediately transferred to a comprehensive medical software package.

- View and manage office schedules from any Internet-enabled PC
- Customize appointment types
- Schedule multiple providers in the same practice
- Use either as a standalone scheduling system or port over data from your existing scheduler

Dictation

Dictation restores mobility and convenience to the physician. Dictation provides the functionality of a handheld digital recorder, incorporating advanced capabilities such as Patient List information and Dictation Templates. By setting new standards for medical dictation software, Dictation has become an industry leader and “must have” tool for doctors in hospitals, clinics and private practice.

Dictation uses the latest in Windows Pocket PC technology to record up to three hours of digital voice files and forward them to the appropriate voice server for transcription. This enables a doctor to complete his dictations without being tied to a telephone for dictation and dictation ID entry. This efficiency also lowers the cost for administrators by streamlining workflow and intelligently processing voice files by flagging incomplete dictations or dictations with invalid medical record numbers.
Reviewing lab results

Healthcare providers can receive lab results at the point of care. Working seamlessly with an integrated Mobile Patient Index, a lab retrieval system represents a significant opportunity to make workflow more efficient. No more logging on to a computer to view labs, or sifting through paper records in a chart to find pertinent information. Oftentimes, labs may be drawn at different times, run on different machines, and reported in different areas, such as coagulation or bleeding lab tests. By customizing the application, healthcare providers can bring together, on one screen, all labs for a particular patient’s clinical condition. Also, users will be alerted to abnormal lab values, and these abnormalities can be fed into a Mobile Patient Index and an Alert so that the user is alerted to this abnormal value when viewing his or her patient list.

Lab will save you time by allowing you to access patient lab data efficiently, improve your quality of care by being able to act immediately on critical lab results, and make clinical decisions quicker, leading to more efficient care and the potential of decreased lengths of stay. Similar to the idea of receiving an alert, physicians can also receive an alert about an urgent lab result. This enables the physician to make an immediate decision about any action required. In addition, having access to this information on the fly can help avoid additional or repetitive tests, saving both time and money.

Decision Support

Amongst the most popular uses of PDAs in maintaining a comprehensive and complete, drug reference. Rather than carrying a cumbersome book, or making a side trip to the nearest nurse’s station, drug guides on handheld computers provide up to date information on dosages, interactions, contraindications and cost.

- The most widely accessed source of drug content used by over 200,000 healthcare professionals
- Unbiased information provided by trusted third party resource
- The number one source of drug reference information for pharmacists across the U.S.
- Offers simplicity with an intuitive, menu-driven interface
- Provides immediate access to critical drug reference information on your mobile handheld device
- Ensures ease of use for busy physicians and healthcare professionals Includes regularly updated information for over 3,000 drugs across 26 therapeutic classes
- Search drug content by generic or brand name, or by therapeutic class
- View dosing, contraindications, adverse reactions, mechanism of action and more
- Reduces risk of drug-drug interactions and other related medical errors
- Provides you with the critical information you need, when you need it
- Integrates seamlessly with the prescribing module for easy access
Chapter 6
The ACG 2006 Annual Report
Computer Systems in the Physician’s Office

Level 4 - Mobile and Hand-Held Technology

Internet access

Virtually all PDAs offer the ability to access the Internet using either wired or wireless connections. This feature provides the ability to access a virtually limitless amount of information from online archives, newsgroups and other websites. There is also an increasing amount of content available on the Internet designed specifically for PDAs (such as AvantGo, which provides updated content such as newspaper and magazine articles specifically formatted for handheld devices). While the small size and screen resolution of PDAs does not make them ideal for general web browsing, for quick trips to find relevant information they can prove extremely convenient.

Electronic Prescription

Prescription errors not only put patients at risk, they result in time consuming callbacks. Using a PDA, prescriptions can be written electronically and then sent to a printer or directly to the pharmacy. More advanced prescription programs even check formulary and drug interactions information.

- Prescription automatically checked for insurance formulary compliance
- Prescription automatically checked for prior adverse reactions and potential drug interactions.
- Claim handled automatically on-line
- Medication is pre-packaged with a tamper proof safety seal
- Automated inventory management process
- Time spent on process is time saved from answering pharmacy calls
- Only most commonly prescribed medications kept in stock (size requirement is the size of typical sample closet)
- Add new patients to your handheld on the fly while doing rounds
- Analyze your prescribing patterns
- Customize your own drug list and create a favorites list of your most commonly prescribed drugs
- Decreases pharmacy waiting time for your patients
- Easily manage medication recalls
- Eliminates medical errors resulting from misinterpreted handwriting
- Lowers incidence of in-pharmacy drug switching
- Maintain electronic and/or printed transaction records automatically
- Maintain patient’s preferred pharmacies
- Order prescription refills from the prescription history reports
Chapter 6
The ACG 2006 Annual Report
Computer Systems in the Physician’s Office
Level 4 – Mobile and Hand-Held Technology

- Physicians using this tool typically save one to two hours each day by reducing pharmacy callbacks and administrative tasks.
- Record and track patient allergies
- Reduces pharmacy-related phone calls to your office
- Send signed prescriptions wirelessly to any pharmacy in the continental U.S.¹
- The formulary lists, programmed into the system, are displayed in a format that encourages physicians to choose the lowest cost medications.
- The practice is notified in advance of pending prescription renewals.
- The printed or electronically transferred prescription is legible.
- The referral module customizes the referral generation process to managed care organization-specific networks.
- The system keeps a record of prescriptions and prints an updated medication sheet for the patient chart.
- The system prompts physicians to prescribe on-formulary for each individual patient.
- View, sort and print medication histories
- Write multiple prescriptions at the same time
- Write prescriptions in as little as 3 seconds

Renewing a Prescription

One of the most time-consuming and frustrating endeavors for physicians is refilling prescriptions. A patient calls a physician’s office with the request, which begins the string of phone calls, time on hold, relaying the same information time and again to each person in the chain. If the physician is away from her office, there is an added concern about making treatment decisions without complete information about patient allergies, other medications, and history.

Imagine this scenario as told by Dr. Anderson, “I was driving in my car, and I received an alert on my cell phone. A patient that I know needed a refill on his antibiotic. By pressing one button, I instantly faxed the renewal to his retail pharmacy, updated his online medical record, and notified him by email that his request had been filled. It was so fast and easy that I felt safe doing it while driving my car.”
Chapter 6  
The ACG 2006 Annual Report  
Computer Systems in the Physician’s Office  
Level 4 – Mobile and Hand-Held Technology

Key Characteristics of an Electronic Prescription Writer  
By Robert Keet, MD FACP

Healthcare practitioners have a professional mandate to prescribe the most appropriate, disease-specific medication in a safe and efficacious manner. Each year, though, this becomes more complex. The number of new medications increases exponentially each year with new entries for each class and new classes for each disease. Each drug has its unique indications, contraindications, cross reactivity, complications, and costs. Increasingly, drug-drug interactions present a major problem, reportedly occurring in 12% to 22% of prescribed medications.1

Providers can no longer rely on memory for necessary details about familiar medications. They must prescribe in the context of all medications a patient takes, including those prescribed by other physicians in the community. In addition to indications, contraindications, and potential side effects, they must be aware of drug-drug, drug-age, drug-allergy interactions, and which medications are covered by the patient's insurance. The cost of managing the plethora of often-modified, insurance-specific formularies is rapidly driving up the cost of care.

Several studies have shown that applying computing technology to prescription writing significantly reduces the cost of medications while increasing the adherence to specific protocols.2 3 Computerized prescription writing can provide tremendous benefit to both the healthcare provider and the patient.4 Despite the obvious benefits, the use of computerized prescription writers is not widespread.

My healthcare community, which includes 135 physician offices, is implementing an electronic prescription writer. The prescription writer is part of a project to automate the flow of clinical data between physicians and their affiliated healthcare partners. The first stage of the project involved managing the flow of incoming clinical data such as laboratory results, radiology results, and transcriptions. The data was digitized and delivered to physicians' "inboxes," and tools were provided to manage those messages. The second stage of the project automates the management of outgoing messages including authorizations, laboratory orders, and prescriptions. Lessons learned during this effort provide insight into specific issues that must be addressed by architects of automated prescription systems for healthcare providers.

A variety of papers and articles have addressed the design issues faced when implementing physician automation in a single economic entity.5 This paper addresses the myriad of issues that must be considered when designing a prescription writing system to meet the needs of physicians in multiple economic entities linked only by a common community of patients.
Cross-Community Implementation

The typical patient sees a primary care physician and several specialists each year. An effective electronic prescription writer must track all drugs prescribed by all physicians in the community and must perform duplicate and interaction checking based on all drugs prescribed for that patient by multiple providers. The prescription writer must provide adequate security, for example, to assure that physicians do not have access to drug information for patients they are not managing. Finally, each prescription must be linked to a unique patient identifier so that data can be appropriately transmitted across the system.

Our healthcare community created a "master patient index" (MPI) that identifies each patient and provides up-to-date patient demographics, eligibility status, health plan, co-pay, and eligibility information. It also has the capability to carry key clinical information including prescribed medications and allergies. The MPI database entries are automatically generated and maintained from data included in incoming clinical messages, such as laboratory results, and from outgoing messages, such as laboratory orders and prescriptions. The database is replicated across the community and allows for rapid demographic look-up and unique identification of clinical data (including prescriptions) and for checking for duplicate and interacting medications.

Although we implemented a wide area network across the entire community to maintain the patient index and to distribute clinical messages, healthcare communities today can take advantage of the Internet and Web browser technology, thereby avoiding the high costs associated with the development of a community-wide network. Using the Internet and Web browser technology, physicians and their staffs can easily access the tools necessary to facilitate writing prescriptions. This includes linkages to expert databases, patient demographic data, and medication history. Using an e-mail metaphor familiar to physicians and their staff, prescriptions can be generated and delivered to the appropriate pharmacy.

Web technology faces two special considerations: security and speed. The U.S. Federal Government via the Health Care Financing Administration (HCFA) is currently setting standards for the Web-based delivery of clinical data. With encryption and appropriate authentication or identification, Web transmittal of clinical prescription data should not be a problem.

Quick Response Time

Each day the average primary care physician writes 10 to 20 prescriptions and processes a similar number of refills. Prescription writing generally occurs at the end of a patient encounter and must be done very rapidly.
Because of this, response time is critical in any point-of-service system. Since the speed of a browser-based prescription writer is dependent on the data transfer bandwidth and the speed of the loading of pages, the prescription writer must be designed with an eye to rapid loading and transfer of data, even if this requires compromising on the quality of graphics.

In addition, physicians are very sensitive to the number of "mouse clicks" and text entry required to complete a task. The physician must be able to quickly choose the appropriate drug and create the "Sig" (directions for use).

Effortless, Intelligent Medication Choice

We found that physicians generally wish to choose a medication by name but appreciate the ability to find medications by diagnosis and cost. Often physicians remember only the brand name, yet wish to prescribe the generic alternative when available. Sometimes they do not know if the drug name is brand or generic, so they must be able to choose drugs from one master list. Spelling is also often a problem; physicians may remember only the first several letters of a drug name. Finally, physicians need guidance regarding the specific strengths available for a medication.

For new medications, physicians often remember that a new drug is available in a specific class or for a specific diagnosis but do not remember the specific name. Presenting the physician with drugs sorted by FDA-approved diagnoses solves this problem. In short, choosing a medication should require minimal data entry and not be dependent on knowledge of the drug's exact name or whether the name is a generic or brand name. Once chosen, the physician should be presented with available strengths and guided to the appropriate direction for use.

Formulary Linkage

Managed care has introduced a new dimension to prescribing a medication—selecting one that is covered by the patient's insurance. Because formulary management directly impacts patient satisfaction and office efficiency, it is of increasing concern to clinicians. Healthcare providers now spend more money on medications than they do for primary medical care. This is an issue of significant economic importance.

Unfortunately, there is no single formulary of medications to use for a specific diagnosis. Instead, the physician usually has several possible choices with costs related to the insurance carrier's contracted rates. The appropriate drug choice thus depends on the patient's insurance and that company's current contracts—a rapidly moving target. Providers should be warned when they prescribe a drug not on the patient's
insurance plan and should be presented with a list of alternative, plan-approved choices in the same drug class. Providing this information at the time the prescription is written saves physicians, patients, and pharmacies significant effort in changing non-formulary drugs to appropriate alternatives.

Physicians tend to prescribe a subset of medications repeatedly. In addition, they usually prescribe the same number of tablets with the same directions and number of refills. The electronic prescription writer should allow rapid completion of the prescription form for each physician's frequently prescribed drugs.

**Expert Database Linkage**

The complexity of prescription writing requires that clinicians have rapid access to expert knowledge. The prescription writer should automatically check for drug duplicates and interactions as prescriptions are written. Duplicate checking includes checking for the same drug as well as for similar drugs in the same class. We have found that physicians wish to be warned but do not want that process to interfere with the completion of the prescription. Often they are aware of the potential problem and do not want more details. When interested, the physician would like the complete detail of the potential interaction including scientific reference.

Prescription writers linked to expert databases such as Medi-Span allow this checking. Expert drug databases can also provide physicians with specific prescribing details including the usual dosage, route of administration, relationship to food, contraindications, and potential reactions. Average wholesale price data is useful for choosing among otherwise equivalent drugs. Providing physicians with details of drug cost leads to cost-effective improvement in prescribing patterns.7

**Directions for Use and Patient Education**

The ideal prescription writer provides defaults for appropriate usage directions. These defaults can come from the physician's personal list for frequently prescribed drugs or from an expert database and can be easily changed. The directions for use should drive other automation within the prescription process. For example, the prescription writer can use the dose, strength, units prescribed, number of refills, and the directions for use to calculate the date that the drug would normally require renewal. This date can drive other processes including the renewal process and the tracking of patient compliance.
Finally, drug databases can provide drug-specific patient education in multiple languages. This includes information about proper usage of the drug, contraindications, warnings, and precautions and can be printed before the patient leaves the office.

Renewal Process

Our workflow analysis showed that the refill process is one of the most cumbersome and expensive processes in a primary care physician's office. A typical primary care physician may receive 20 or more requests for refills each day. These requests come from patients and pharmacies via phone, fax, and mail.

For each request, the office staff must obtain the chart, check and update the medication list, confirm the dose, and present the data to the physician for approval. Once approved, the staff must update the chart and transmit the refill approval to the patient or pharmacy by fax, phone, or mail. In a paper-based system, it is cumbersome to determine if the drug is being refilled too soon and impossible to determine if it isn't being refilled soon enough. Medication lists often become outdated or contain incorrect information regarding dose or directions for use. For critical drugs such as Coumadin, this can lead to significant risk to the patient.

An automated prescription process must allow the staff to enter renewal requests for approval by the physician. By choosing a drug from the prescribed list, a staff member should be able to initiate a renewal with a single mouse click. The original dose, number, refills, and directions for use should be carried forward to a new prescription with the date modified. This preliminary renewal request can then be deposited in the physician's electronic inbox for approval.

If the system can calculate the expected renewal date based on the dose, strength, number, refills, and directions for use, the staff and physician can quickly determine if the refill is occurring too soon or there if evidence of non-compliance. If the dates of the patient's last visit and laboratory tests are also available, refill checking can be even more comprehensive.

Provider Workgroups

Provider groups often centralize the process of prescription management and refills. An automated prescription writer must function in the context of a group of healthcare providers and staff who work together to manage this complex task. Provider workgroups can simply be call groups or may comprise all the clinicians in an economic entity. Thus, the prescription process must take into account the fact that providers often act clinically on behalf of each other. One clinician may write a prescription for another clinician's patient.
or may refill medications on behalf of a colleague who is out of town. While prescriptions must be signed by the generating provider, the regularly treating provider must have information about all drugs prescribed for his patients. It is this provider who takes responsibility for the ongoing management of the patient’s medication.

Because staff members generally work with multiple providers, the refill process must allow staff to generate prescriptions with direction to a specific provider for approval. Legally, an automated prescription writer should allow only physicians or, where legal, mid-level providers to complete (sign) prescriptions; however normal workflow mandates that prescriptions be prepared by the office staff.

Linking All Players

In an ideal world, physicians, pharmacies, and patients would all be electronically linked. While pharmacies often have automated systems to track drugs and refills, clinicians typically deal with multiple pharmacies with dissimilar systems. In recent years, online pharmacies have been proliferating on the Web, yet no simple technology exists to link these services to provider or patient.

An automated prescription writer should have the ability to link to a variety of other computer systems. Refill requests from the pharmacy should be delivered electronically to the responsible provider. Even the patient could be brought into the loop with standard e-mail and Web tools. However, electronic prescriptions must also easily interface with the world of paper, fax and e-mail. Incorporating prescription writing into a standard communication infrastructure allows for maximum functionality now, with a growth path for the future. Electronic prescriptions can easily be converted to fax and paper, thereby meeting the general needs of the current work environment.

Implementation Process

The critical success factor for any new system is that it can be adopted in a gradual, non-disruptive manner. In our healthcare community, we found that, wherever possible, it is best to introduce automation first with the office staff. Once time savings are demonstrated, providers can gradually adapt to the new process. Automating the time-consuming and expensive refill process first provides the most obvious gain for the effort. A few key staff can be trained to enter refill requests from pharmacies and patients into the system. The physicians can approve or reject these requests “online” in a process that requires minimal adjustment from current procedures.
Once the system has been primed with most of the drugs for each of the patients, clinicians can gradually transform their prescription writing practice to one that is online. Providing automated alerts for drug duplicates, interactions, and formulary non-compliance will encourage clinicians to use the system.
Conclusions

Prescription writing is one of the most complex tasks performed by physicians, demanding both detailed knowledge of the patient's care and of drug usage. Treatment protocols are increasingly complex, and providers are responsible for assuring that medications are prescribed appropriately and without adverse interactions.

Several factors are coming together that will move physicians to more automated systems. First, the complexity of medical care is increasing, making it difficult for physicians to maintain the knowledge base necessary to provide quality care to their patients. Second, as computers have become more common and less expensive, clinicians have begun to use them in their day-to-day work. A recent Gartner Group survey found that 78% of physicians use the Internet. Finally, Internet and e-mail technologies are increasingly sophisticated, and complex management tools can be built within this familiar environment to assist in the delivery of healthcare.

Systems that give physicians immediate and direct feedback during the prescription process are most effective in changing behavior and improving quality. Using tools built on communication platforms, professionals can work together across a community to care for patients. Combining systems that generate prescriptions, track medications, provide communication between providers, and link to expert databases allows providers and their staffs to automate this process in the context of their usual workflow.

Dr. Keet has practiced Internal Medicine and Geriatrics in Santa Cruz, California for more than 20 years. During the last four years, he served as chairman of the Steering Committee of physicians overseeing the development of an automated clinical messaging network in his community. He consults with Axolotl Corp. where he assists in the company's ongoing effort to provide clinical automation tools.

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Chapter 6
The ACG 2006 Annual Report
Computer Systems in the Physician’s Office

Level 4 – Mobile and Hand-Held Technology

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Billing and Charge Capture

Outside of solutions that assist decision-making processes directly related to patient care, charge capture is one of the more popular solutions. Particularly in this evolving era of healthcare reform and insurance regulations, efficient and accurate billing is a necessity. The most basic of these types of solutions allow you to reference ICD-9 (International Classification of Diseases, 9th Edition) and CPT (Current Procedural Terminology) codes so you can complete your paper-based superbills more quickly.

The hottest and best received application on the market today in classified as “Intelligent Charge Capture”. Unlike traditional charge capture systems that allow a physician to record daily charges, intelligent charge capture provide the physician with undated “knowledge” on what individual healthplan require for proper coding and charge reimbursement. Companies like MedAptus and Allscripts Healthcare Solutions are the two leaders in developing and deploying intelligent charge capture systems.

• HCFA data indicates practicing physicians are losing $25+billion per year in denied or reduced claims, a direct result in inadequate documentation, while administrative expenses exceed 40% of gross physician revenues.
• Lost billings average $60,000 per year for each of the roughly 450,000 practicing physicians in the US.

When evaluating charge capture systems, there are numerous functions that should be examined. Theses include:

• Does the system have prefigured superbills by specialty?
• Does the system customize the application to match the way you capture charges?
• Does the system use in any care setting, including office or hospital?
• Does the system display user-selected ICD-9, CPT and HCPCS codes?
• Does the system add modifiers, visit notes, and return visit requests?
Chapter 6
The ACG 2006 Annual Report
Computer Systems in the Physician’s Office
Level 4 – Mobile and Hand-Held Technology

- Does the system assign charges to CPT/HCPCS codes?
- Does the system add new patients to the handheld when doing consultations?
- Does the system reconcile today’s patient list to make sure charges have been captured for each one?
- Does the system automatically send charges to your billing/practice management system to be processed the same day?
- Does the system check and confirm patient’s insurance and copay information?
- Does the system track referral information?
- Does the system view or print superbills (including physician’s notes and return visit instructions)?
- Does the system provide a calculator to help ensure your coding is in compliance with the newer E&M (Evaluation and Management) coding recommendations?
- Does the system prompt the physician for missing information required to meet specific level of service?
- Does the system suggest additional data that needs to be captured in order to meet the requirements for the next level of service?

Which Vendors provide the best Charge Capture Application? - Healthcare IT Application vendors provide PDA functionality in many ways. A few companies, like MedAptus, MDeverywhere, PatientKeeper, and MDanywhere provide stand-alone Charge Capture systems that can be interfaced with any Practice Management System (PMS) and Electronic Medical Record (EMR) vendor applications. Other companies like Allscripts Healthcare Solution, NextGen, and WebMD, provide integrated PDA applications with their own PMS and EMR.
applications. However, which vendors have the best Charge Capture System? Based on a recent survey of 56 healthcare IT vendors (self reported data, verified via demonstrations and site visits) that sell applications to physician offices, the vendors with best Charge Capture systems are shown below:

Although the variations are limited in some cases, MedAptus and Nextgen are the clear leaders in Charge Capture systems today. However the up and coming vendors, based on future functionality, will be Allscripts Healthcare Solutions, MDeverywhere, and PatientKeeper. Finally, when selecting a Charge Capture Vendor, organizations must also consider the financial viability of the company and additional functionality that might be considered at a later time.

Management and Financial Viability - When evaluating company management and financial stability, healthcare organizations must consider numerous sources of information. In particular, most PDA application vendors are not publicly traded, and therefore, financial and management strategies are hard to come by. In most cases, company evaluations are based on industry and financial analysts, and are more based on opinion than real concrete data. However, as most will state, the various industry and financial analysts track the industry closely, and although their judgments are not always correct, their influence over the industry creates visibility for those vendors who stand out in regards in functionality, management capability, marketing and sales capability, and vision to survive and thrive in the future.
Using this rating system, companies like NextGen, Allscripts Healthcare Solutions, MedAptus and PMSI are recognized leaders in the Charge Capture Marketplace. Other companies may have strong functionality, but without nationwide name recognition, companies like eClinicalWorks, PatientKeeper, and MDeverywhere become acquisition candidate for larger-national known companies. Already, PatientKeeper has a direct relationship with Cerner Corporation. This direct ownership relationship create great opportunities for Cerner sites (over 1,000 hospitals), but creates conflicts with the other large healthcare IT vendor organizations like McKesson, IDX, Siemens, Meditech, Nextgen, GE Medical, etc.

MedAptus and MDeverywhere are neutral Charge Capture vendors with numerous relationships with IDX, Siemens, McKesson, and GE Medical (Milbrook). This relationship benefits their companies and their clients since they have already tested the required interfaces between the Charge Capture system and the healthcare organization’s practice management system(s).

**Total Combine Charge Capture Rating System** - When you combine ratings for functionality, management, company, and PDA and Wireless Synchronization, the top vendors rating change slightly, but the top functional applications remain at the top. As shown on the next page, the top vendors for charge capture remain NextGen,
Allscripts Healthcare Solutions and MedAptus. However, based on an organization’s willingness to accept minimal risk and depending on their future Practice Management Vendor, companies like MDeverywhere and Patient Keeper would still make good choice for certain organizations.

Overall rating of Charge Capture Functionality, Management,

<table>
<thead>
<tr>
<th>Company</th>
<th>% of Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nextgen</td>
<td>88%</td>
</tr>
<tr>
<td>MD Anywhere</td>
<td>83%</td>
</tr>
<tr>
<td>eClinical Works</td>
<td>78%</td>
</tr>
<tr>
<td>PMSI</td>
<td>75%</td>
</tr>
<tr>
<td>Allscripts</td>
<td>75%</td>
</tr>
<tr>
<td>Medaptus</td>
<td>73%</td>
</tr>
<tr>
<td>Patient Keeper</td>
<td>73%</td>
</tr>
<tr>
<td>MD Everywhere</td>
<td>70%</td>
</tr>
</tbody>
</table>

Charge Capture offers automated alternative to the traditionally cumbersome manual capture of charges for both inpatient and ambulatory services. Physicians can efficiently capture charges for all services at the point of care. Integration with practice management systems is essential. Physicians should be vary of “bolt on” or stand alone PDA software applications that do not integrate with either the physician’s current EMR or PMS applications.

PDAs provide an ideal way to keep track of procedures to ensure proper billing. Not only do they replace 3 X 5 cards and napkins as a medium for recording billing information, the electronic data can be transferred directly to a desktop or hospital mainframe so all changes are accounted for and transcription errors are minimized.
Chapter 6
The ACG 2006 Annual Report
Computer Systems in the Physician’s Office
Level 4 - Mobile and Hand-Held Technology

- Get started faster with pre-configured superbills by specialty
- Customize the application to match the way you capture charges
- Use in any care setting, including office or hospital
- Display user-selected ICD-9, CPT and HCPCS codes on your handheld
- Add modifiers, visit notes, and return visit requests
- Assign charges to CPT/HCPCS codes
  - Reduce lost charge slips and superbills with mobile, electronic data capture
- Add new patients on the fly to your handheld when doing consultations
- Reconcile today's patient list to make sure charges have been captured for each one
- Instantly send charges to your billing team to be processed the same day
- Check and confirm patient's insurance and co pay information
- Track referral information
- View or print superbills (including physician's notes and return visit instructions)
- Generate reports (no-show list, day's charges and cash receipts)
- Helps you reduce lost revenue associated with unrecorded patient visits
- Streamlines billing so that charges can be processed immediately
- Assists your staff with managing office receipts and patient billing

Mobile ECG’s

The latest software product in the IQmark family elevates your ECG capabilities to a new, more efficient level of portability, cost-savings and efficient patient care. When used in conjunction with the IQmark™ Digital ECG, the new IQmark PDA lets you run hundreds of ECGs on a Pocket PC-based device - like the Compaq iPAQ® - without the need and expense of transporting a large ECG cart from room to room.

The IQmark PDA is perfect for use in the office, clinics and medical centers as well as for remote and emergency situations. You can evaluate live ECGs on the LCD screen, then simply click on “Save” to automatically store the ECGs.

Managing the ECG is very easy. Simply connect the PDA device to its docking station and the IQmark Sync will automatically transfer the stored ECGs from the PDA device to the IQmark Diagnostic Workstation for interpretation, measurements, editing and printing. IQmark Sync also works with Infrared (IR) or wireless network connectivity.
Advantages

- Capable of storing hundreds of patient ECGs
- Works on Microsoft® Pocket PC 2002 platform
- Small pocket size PDA (Personal Digital Assistant)
- Download tests via standard docking station, IR or wireless network to the IQmark Diagnostic Workstation for interpretation, editing, storage and management

Summary:

PDA devices are just that – another device to help the physician improve their effectiveness. However, we do believe that the PDA has limited functionality given the screen size. Information reviewing, charge capture, dictation, vital signs, and prescription writing are applications that work well on a PDA. We do not believe that PDAs will be used for clinical charting of physician notes, H & P, and template driven collection of detailed patient information. Numerous studies have shown that the screen is too small for routine collection of detailed clinical information.

Additionally, the majority of the vendors plan on porting their clinical capture applications to a new device labeled the Microsoft PC Tablet. The PC Tablet is expected to have built in wireless capability, integrated voice and handwriting recognition, touch point technology like the PDA, full integrated digital dictation, and the device will be light weight, have a full active matrix color screen, a longer battery life than the PDA and will be able to maintain 5,000 patient records on the expanded hard drive.