Computers in Hemodialysis Facilities

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Computers came somewhat late to dialysis, but as in most of life, they are now commonly in use. In reviewing the topic, I found no orderly literature, but examples of studies showing the benefits of data systems, and reviews of aspects of computerized operations in dialysis. Some of these are listed, but not specifically referenced. The author is also indebted to individuals for information and important insight into current operations.

This commentary does not specifically involve Medicare's ESRD database or its use by the contractors as the United States Renal Data System (USRDS) which provides useful analysis of registry data and of some special studies. It should be noted that clinicians clamored for Medicare to produce such a system for years, and then found that as the only dedicated database, it put the ESRD program in a spotlight enabling easy criticism not possible for other Medicare programs. More information and more analysis leads to more opinions.

Background

Dialysis used to be many small medical practice businesses which did not use automated business systems or computerized clinical data systems. Now dialysis is a few very large corporations operating hundreds of facilities; a number of remaining hospital facilities; and a few independent outpatient dialysis facilities. Medicare, which covers most patients, requires electronic billing; purchasing, inventory control, payroll and equipment maintenance are facilitated by effective electronic data systems. The necessary compilation and analysis of clinical data to manage quality of care and to meet guidelines requires a computer. Today, almost every facility, even small or solitary independent ones, has computerized systems for both business functions and operational clinical data.

In 1988, ESRD Network 5 surveyed its member facilities and found that fewer than 15% used computers to handle clinical data. The larger groups had some automated data for billing. The rest were all manual. A repeat survey in 2003 found computers to be universally used. The long term character and repetitive pattern of dialysis treatment produce recurring data which is readily aggregated for useful analysis for operations or for quality management.

Computerized systems allow data to be entered once, then used for multiple purposes. Initial entry of demographic and diagnostic information into business data systems at the onset of dialysis treatment is subsequently a resource for repetitive episodes of billing. Clinical systems collect treatment monitoring, laboratory results, medications, and orders to use for clinical care, referrals, travel, laboratory orders, and service tabulation for charges. Now that there are guidelines for performance, these clinical data provide the basis to analyze performance of care for both individuals and populations. The profile of the patient can be transmitted with the patient to and from referrals and updated as events occur. While both clinicians and government worry about privacy and security of individual information, it is likely more secure in databases than in the file cabinets they replace.

Most providers first incorporated computerized data into their operations as patient registration, documentation for billing, and for the actual billing process. At first, these systems produced a printout which was delivered to payors; now, almost all payors want electronic transmission of charges. This process has improved accurate capture of services for billing at the point of service, reduced errors, and improved documentation practices. The demographic data necessary for this function allow some analysis of populations, but lack details to enable clinical quality assessment.

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Once business systems became established, the obvious advantages of clinical data systems were appealing. Many providers sought such a service. Although several vendors developed software for physician offices, and even more for hospitals, clinical software for dialysis was slow to develop, often so individualized to a single provider's approach that it could not be generalized, and sufficiently unique that comparisons between facilities was not possible. Numerous efforts by many organizations fell short of expectations for usefulness and ease of operation. In the limited community of dialysis professionals those problems were common knowledge; still, some who seek systems today expect service that exceeds current developments, and become disappointed.

A number of companies now provide dialysis-specific software and training, and there is considerable compatibility among their systems. Most are still small businesses, and do not have the troubleshooting resources or structure we have become accustomed to from the major vendors of computer hardware and software. Their smaller size may make dialysis software companies quicker to respond, despite their limitations. Some dialysis software companies try to select the most important data elements and limit collection to those; others, attempting to cope with varying expectations, try to include every piece of clinical information, leading to a larger, more complex and expensive means of serving the need. Incomplete systems require adjustments on the part of providers; the comprehensive system will offer more analytical options, but be more expensive, and by having more data to sort, may be slow with even a large server. Even a limited system will rapidly accumulate millions of inputs from treatment records, lab reports, and orders. Each is a compromise, and the buyer must know his requirements and do his homework to select a system.

The Health Level 7 (HL-7) standards helped. Laboratories, now using automated analyzers, produce standardized outputs according to that standard. Those results, after internal review, are transmitted directly into the provider's database, and are often also available online. Internet access in dialysis centers is variable, but growing. Security and control issues retard widespread access to the Internet at work. Most dialysis organizations have informative web sites, and CMS' "Dialysis Center Compare" site is a complete listing of facilities, their hours, and services available.

Although a paperless dialysis operation is possible, convenience to monitoring clinicians and rounding physicians usually leaves a "run sheet" at the patient station. This is often accompanied by a notebook of reports from recent treatments, labs, medication orders, and notable events. The data reports and orders noted on the run sheet are then entered into the database, which becomes the official medical record of that treatment episode. Despite that, most providers and legal advisors are not comfortable discarding the run sheet at that point, and masses of old paper records are maintained in warehouses. These redundant records, imaging and procedure reports, consultations, and other papers can be scanned into the database for access and preservation.

Nurses and patient care technicians have become comfortable with the computerized record. Physicians are often less willing (or able) to type orders, search menus, and review data on-line. The advantages of computer entry of consistent, legible physician orders make it unlikely that feature will be resisted for long. Until methods are established to make the dialysis machine display serve as the port into the data system, further change is likely to be slow. No other access to data at the patient station is economical or stable.

Dialysis Machine Computers

Dialysis systems for proportioning dialysate and monitoring the patient and the dialysis process began to use microprocessors in the late 1970s, and now all current machines use internal computers to control functions. These computers have unused capacity. Many have touch screens for entering operating values and displaying the status of treatment. Many systems can connect the machines into the clinical data system as an input of dialysis time, blood and dialysate flow, pressures, and ultrafiltration. No one yet uses the touch screen as the portal into the data system for access to records and ordering at the point of care. This is both a security concern and an issue of interoperability of a broad data system with one designed for process control. FDA standards for computers as clinical devices are still in evolution, which may inhibit innovation by manufacturers. This central collection of machine data is not routine, and has yet to demonstrate important utility. Because this function often requires additional software and/or hardware for the interface between systems, another vendor may be involved, and the difficulties involved in connections can lead to revolving blame which obscures solutions.

Advantages of Computerized Clinical Systems in Dialysis

Computers are sufficiently ubiquitous in daily life, business, and patient care that the benefits may seem obvious, but it is worth tabulating.

1. Data entered once may be used repeatedly for multiple functions.
2. Data may be brought up to date without having to replicate the existing facts.
3. Policies, procedures, practice guidelines, forms, reports, etc. may be posted on a server and made available to all authorized staff without multiple copies in various sites; a less wasteful and more secure way to manage such processes.
4. Laboratory data can be captured promptly and reviewed from any authorized site, enabling screening, tabulation, and analysis. Omissions become obvious.
5. Orders may be entered from menus or typed in, avoiding confusion and omissions. Routine orders can be flagged with reminders for reauthorization or changes. Laboratory orders are transmitted to the lab confirming the specimen label (which is usually produced by that computer).
6. Capture of services to be charged is easy and accurate, decreasing error opportunities. Checking and correction is simple.
7. Clinical data from the episode of care, entered in a standard format, can be tabulated and analyzed, either serially for an individual or for aggregate populations. Incidents are easily noted and followed up.
8. Notes can be produced using template guidance for both efficiency and completeness.
9. Protocols for managing routine practices can be readily accessed and followed. When protocols need change, that, too, is simple and immediate.
10. Necessary records for referrals can be assembled and transmitted where needed.
11. Communication among sites is facilitated and written communication avoids many misunderstandings.
12. Prior clinical values (weight, vital signs) are immediately available to clinicians, as well as current medications, standing orders, and special precautions.

In addition to clinical data use, data systems can track inventory and purchasing, equipment maintenance (including reminders for preventive maintenance), delivery schedules, and services. A current roster of essential phone numbers, email addresses, etc. can be at hand. Most systems can use data or forms from standard office software to do some of these functions.

Financial and Human Costs of Clinical Computerization

Establishing a computerized system for the first time in a facility creates stress as does any major change, and there is often resistance. Once it is operating and familiar, there is a learning curve for new staff, but the problem of everyone learning at once is over, and there is a base of experience to give confidence to the novice. The facility often finds that patient care technicians and many nurses do not have basic computer skills or a comfort level with the concept of electronic data handling. Education must be done on-site, usually by personnel more comfortable teaching patient care. Nonetheless, learning from other clinicians gives context to the facts and practices learned, making the practical applications clear. Because of this, most suppliers train a relative few expert user clinicians, who then train their staff.

A system may be seen as Hardware—the computing machinery; Software—the internal instructions telling the computer what to do; and Humanware—the person-machine interface, where critical data entry occurs, and errors and emotion may combine. The humans bring "baggage"—memories, opinions, relationships—to the task. Machines remember only what they are told, and presumably the current version of software is free of any former developmental baggage. These human, most complex, and equally critical components of the system must be planned for, along with the hardware and software, to create a successful operation.

The financial costs are highly variable. Every system will not run on the same kind of processor and operating system, though most are now adapted to a Windows environment and use PCs readily. Software from two vendors may not collaborate, and each may blame the other, while both blame the computing environment. Once these issues are resolved, the selection of a system may proceed. Computing equipment is still following "Moore's Law," which is reported to claim computing power doubles and price halves every 18 months. Despite that advantage, the operation still requires a substantial investment. Estimates for a small operation amount to $50,000 to $100,000 to set up a system. The continuing cost of annual software maintenance is sig-

nificant and necessary. Other functions such as equipment maintenance and replacement, system coordination and troubleshooting, and communication across the organization usually require a Manager of Information Technology (IT) for all but the smallest operations. The cost goes up with the size of the operation. Large providers spend millions of dollars annually for this essential utility. A computer system does not necessarily save money, but the increased access to data eases reporting, improves quality monitoring and management, and avoids omissions in charging and documentation. Data improves operations.

Current Status of Dialysis Computing

As consolidation of so-called Large Dialysis Organizations (LDOs) occurs, there will be conversion and ultimate uniformity of data systems within each organization as well. These organizations, like smaller dialysis companies, have developed their systems by various means. A few examples:

Dialysis Clinic Inc. (DCI), after working with an internally produced system for several years, hired a software company to produce a dedicated clinical and business system for them. They used extensive consultation with clinicians and administrators to inform programmers about the operations the system had to address. This consultation continues, and is typical of the interaction used to make software responsive to specialized patient care. The system is complete, but never final.

DaVita has utilized existing, commercially available software for dialysis, with multiple adaptations specific to their operations, and with unique access portals for different functions (registration, billing and receivables, clinical data entry and analysis, physician remote access) to organize access to the system. Large scale use of modified commercial software has proved effective and economical.

Fresenius Medical Care (FMC) used the existing system acquired with National Medical Care's facilities to

store and analyze their data (PROTON). This system has demonstrated, through the multiple publications of Lowrie and others, the vital importance of aggregate clinical and laboratory data in assessing risk factors, quality of performance, and clinical outcomes. The operating system is now technically obsolete. FMC is now in the process of adapting and implementing a new, more modern, comprehensive and flexible system to serve these functions and more, and plans to develop a paperless operation.

There are at least five companies that produce data systems specifically for dialysis operations. With experience, all products have become more complex, flexible, and effective. Each company has programs for maintenance, problem solving, and improvement to support their customers. It is a small and specific industry, but one now functioning in the pattern of other successful software vendors for broader applications, and satisfaction has improved with experience.

External Demands and Opportunities

The efforts to define quality of care and to shift review from processes of care to outcomes could not have progressed without the ability to record and compile large amounts of clinical data. The ESRD Networks receive and validate registration and other data; periodic surveys for Medicare have adjusted some of their sources and their focus; the KDOQI voluntary guidelines and RPA practice guidelines have arisen out of the evidence from analysis of aggregate data on patient complexity, methods of treatment, and outcomes of care. These guidelines provide rational benchmarks by which facilities and physicians may evaluate the effectiveness of the therapy provided to ESRD patients, and also now on a smaller scale, to chronic kidney disease (CKD) patients.

Home Dialysis Applications

While most patients dialyzing at home are not connected to dialysis facility networks, those programs that wish to monitor hemodialysis patients dialyzing overnight have found the Internet more effective than keeping a telephone line open. A minority of patients use e-mail to report and ask questions of home dialysis staff. No systematic computer use in home dialysis is yet typical.

Conclusion

Computer systems for dialysis facilities are no longer optional. Computers and the data they contain are essential to fulfill the broad reporting, analysis, and communication duties of facilities and clinicians. Computers amplify and simplify documentation, ordering, and by assembling information, facilitate clinical decisions about care. Savings may not equal costs, but the capability of handling data electronically makes facilities better and more efficient. ■

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