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EDITORIAL

The Missing Element of Telemedicine for Diabetes: Decision Support Software

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Introduction

Telemedicine is coming! President Obama has released a proposed fiscal year 2010 budget that indicates a commitment to advancing health care information technology as a way to cut health care costs and save lives.[1] Interest in telemedicine from the business and insurance communities is climbing rapidly. Each week or month, a new telemedicine product for transmitting physiologic data and facilitating communication between patient and health care provider is announced. New trade organizations to promote the use of telemedicine have been formed, such as the CTIA and WWI. Each week brings an announcement of a new telemedicine system or collaboration between a technology company and a patient care organization to deliver telemedicine. New publications, Web sites, and meetings to discuss the implications of wireless communication, mobile health, telemedicine, and other terms for this phenomenon are springing up regularly. A small but rapidly expanding body of research has generally concluded that telemedicine for diabetes offers many benefits compared to in-person visits for selected types of clinical indications, such as for chronic follow-up, review of monitoring data, and assurance of adherence to practice guidelines.[2]

What Is Telemedicine?

What is the telemedicine phenomenon, and when will it become well established? The definition of telemedicine is the use of telecommunications to support health care. Telemedicine includes timely transmission and remote interpretation of patient data for follow-up and preventative interventions. The main purpose of this approach is to facilitate a productive interaction between the patient and the health care provider in order to achieve improved treatment results and lower treatment costs.

Virtually all current telemedicine systems include collection, transmission, and incorporation of data into an electronic medical record (EMR) as well as a process for a health care provider to communicate with a patient in case the transmitted data requires modification of therapy. Thanks to engineering advances in telecommunications, software, and human factors, the core technologies for the practice of telemedicine for diabetes and other diseases are rapidly advancing. Increasingly robust physiological sensors for collecting various types of physiologic data are being developed. Increasingly sophisticated wireless data transmission tools, such as smart phones, are being developed. Increasingly sophisticated EMR software for accommodating a variety of patient history, laboratory, and sensor data is being developed.

In spite of obvious benefits from utilizing real-time transmission of accurate organized and analyzed data, telemedicine has not been widely adopted. The blame is usually assigned to a lack of reimbursement and lack of physician training in using this approach. But these are not the only reasons behind the slow adoption. Even in single-payer managed care systems in which health care providers do not incur any economic penalties for

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Abbreviations: (AHLTA) Armed Forces Health Longitudinal Technology Application, (EMR) electronic medical record, (FDA) Food and Drug Administration, (MHS) military health care system, (MTF) military treatment facility

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using telemedicine systems and in which the computers and software are paid for and training is provided, this practice is gaining traction slowly.

Additionally, telemedicine in and of itself does not solve the resource problem of limited health care professionals and specialists for the vast multitude of patients with diabetes. While telemedicine can enable remote access to patient data, it does not increase the clinician's ability to evaluate more patients within a fixed time period. When an outpatient practice is already overbooked with patients, with many more waiting in line, there is little perceived need to increase workload via telemedicine. Until telemedicine applications can help solve this basic resource problem, their adoption into routine clinical practice will be slow.

What Is Missing from Telemedicine?

Telemedicine is not catching on as quickly as many experts in industry, many experts in business, and some in academic medicine have predicted would be the case. We are not hearing much talk about the benefits of using telemedicine from physicians who are actually using this intervention. What is missing from telemedicine? We contend that the missing element in the telemedicine paradigm is decision support software.

What Is the Definition of Decision Support?

The definition of decision support is a computerized process for improving medical care, which provides clinicians, staff, patients, or other individuals with knowledge and person-specific information, intelligently filtered or presented at appropriate times, to enhance health and health care. Decision support is the process of utilizing medical information and clinical guidelines to convert patient information, such as that provided by telemetry, into decisions and recommendations. The goals of decision support in diabetes are to improve safe and effective use of antihyperglycemic drugs and to enhance adherence to recommended treatments and to improve outcomes of this disease.[3]

Telemetry Systems Compared to Telemedicine Systems That Also Contain Decision Support Software

Most telemedicine programs are actually telemetry systems that transmit physiologic data and history data, but they provide no recommendations or decisions. In order to elevate telemetry to true telemedicine, it will be necessary to incorporate decision support into the telemedicine system. Without decision support, clinicians are no more empowered to provide recommendations for acute care in a remote setting than they are in a face-to-face setting. Furthermore, in a telemetry care setting, clinicians may be hindered by a lack of direct contact with a patient because they cannot glean information from a physical examination or nonverbal communication.

With the addition of decision support to a telemedicine system, transmitted medical information can be instantly distilled into robust treatment recommendations. When such recommendations are automatically generated, this process will save time for the clinician and provide superior care for the patient in an acute care setting or a follow-up visit setting compared to a care delivery system where the clinician has to spend time thinking about the situation, researching best practice guidelines, and constructing an individual treatment plan. A computerized treatment plan should always be considered as a recommendation and not an order. Any decision support recommendation might possibly require modification by the clinician because of factors that are not accounted for in the decision support software. An ideal decision support recommendation will incorporate all the available uploaded data in real time and usually come very close to a recommendation that a clinician will want to order.

Case Management

Case management of diabetes utilizes telemedicine by providing a case manager, who is usually a nurse, with telemetry data information or computerized laboratory or historical information. The nurse has a caseload of patients and identifies the ones who will benefit from individual attention. The nurse then contacts these patients.

The nurse's job can be made faster and more effective if the telemetry system also contains built-in decision support software to ensure that the highest risk patients are contacted first. If telemetry data can be automatically analyzed through a prism of best practices, then the recommendations will be available faster and more accurately than if each case must be individually considered and individually treated. With these applications of decision support software, patients will receive the most appropriate advice that can be delivered in a timely fashion. In some cases, the nurse's recommendation will differ from the computerized decision because of individual factors that were not factored into the software combined with individual judgment of the nurse. Even in these cases, the software is often helpful for supporting the nurse's assessment.[4]

Health information technology is being touted as a tool to save time for clinicians and improve the quality of care for patients, both for remote visits and remote case management care. These goals can be best achieved if decision support software will be incorporated into telemedicine systems. Current telemedicine systems, which mostly lack robust decision support software, simply do not offer enough benefit for a large number of diabetes clinicians in terms of saving time and improving the quality of care to become widely embraced by providers.

What Are the Components of a Decision Support System?

Clinical decision support systems include some or all of ten elements. These include (1) standardized formats for presenting data and interventions; (2) computerized alerts and reminders; (3) a database of validated interventions for improving outcomes; (4) order sets; (5) patient data reports; (6) documentation templates; (7) workflow tools; (8) a method for incorporating new information about interventions for each specified disease; (9) ongoing assessment tools to assess the safety, effectiveness, and economic impact for each intervention; and (10) a method for scaling benefits to include management of additional diseases.[3]

In order to be effectively utilized during a patient encounter, decision support software would need to be designed to (1) access relevant patient data from the EMR system, patient devices (e.g., blood glucose monitors, continuous glucose monitors, insulin pumps, and blood pressure monitors), and telemedicine applications; (2) prompt the clinician to ask appropriate questions of patients to fill in data gaps; (3) analyze the applicable data (e.g., current medications and glucose profile); (4) make real-time treatment recommendations based on professional guidelines; (5) prompt the clinician for treatment decisions; and (6) facilitate documentation of the encounter into the EMR. This type of system would need to be modifiable in order to account for changes in professional guidelines. For example, the American Diabetes Association publishes new guidelines annually, and effective decision support software would need to reflect these changes for newer guidelines to be followed.

What Features Make a Decision Support System Effective?

An analysis of 70 randomized controlled trials of decision support interventions intended to improve clinical practice identified four independent predictors of improved outcomes: (1) decision support provided automatically as part of clinician workflow, (2) decision support delivered at the time and location of decision making, (3) actionable recommendations rather than merely assessments, and (4) computer-based decision support. A common theme of all four features is that they decreased the amount of effort required by clinicians to utilize the intervention.[5]

Without embedded decision support software, a telemedicine system is merely a telemetry system for allowing a health care professional to make recommendations based on information that would also be available in a face-to-face visit, but there is no travel required for the patient. The quality of a decision based on telemetry data alone would not be expected to be any better than a face-to-face intervention. A telemetry visit might even be less effective than a face-to-face intervention because a telemetry visit lacks physical examination data and cannot make use of nonverbal communication. By converting many types of historical, physiologically monitored, and laboratory data into digital information and analyzing this information electronically, it is possible for automatic computerized recommendations to be generated. Such automatic interventions require, first, a digital dataset (which is an essential feature of telemedicine data transmission) and, second, computerized decision support software (which is a necessary but currently absent part of most telemedicine systems). It is important to point out that a computerized decision support system cannot replace a physician's or nurse's knowledge and competence and that it should be considered as complementary.[6]

Even so, we contend that decision support systems would generally raise the level of care provided by the average clinician, especially at the primary care level. A health care professional who sees patients in a traditional face-to-face environment or in a telemetry program without decision support might not remember or even be aware of all the routinely recommended interventions for a given disease such as diabetes. If a decision support system can be established, however, then pertinent routine reminders along with the latest standard of care treatment recommendations can be generated for all patients.

The translation of new knowledge into clinical practice is frequently an inefficient process.[7] The time from when an intervention is shown to be effective and when it is widely applied currently averages 17 years,[8] and a study of implementation of 439 indicators for 30 conditions and preventive care demonstrated that U.S. adults receive only about half of these processes.[9] Decision support

software is an ideal tool for promoting delivery of newly established routine interventions into clinical practice, as well as responding to individual medical situations.

The Need for Automated Decision Support Telemedicine for Diabetes

In order to bring diabetes telemedicine into mainstream use, it will be necessary to develop robust automated decision support software so that health care providers will have access to information and best practice information that will be applied to an individual patient's dataset and contribute to a personalized treatment recommendation. This type of system would likely be adopted by primary care physicians and nurses who see most of the patients with diabetes in the United States. This intervention would also allow creation of case management centers for management of diabetes in between scheduled visits. For health plans with patients living far from diabetes specialty care or even from primary care, a robust case management system and a robust telemedicine care system, incorporating automated decision support software, is needed. Such a system would likely save time for both providers and patients, and it could improve the quality of care. If this system can automatically incorporate and document all decisions into the EMR system, then health care professionals will find this capability to be very attractive.

Current Status of Automated Decision Support Telemedicine for Diabetes

Although Web-based systems for providing information about diabetes or insulin dosing are in various states of construction or have been tested in the past, there is no Food and Drug Administration (FDA)-approved automatic decision support system for diabetes. Several products have been developed for telemedicine in general, and several products are approved for telemetry of blood glucose data. The InTouch system by SymCare is an FDA-approved dedicated system for diabetes telemedicine. This device assimilates a variety of types of diabetes-relevant data transmitted through telemetry and patient-entry and provides analyzed information for patients and physicians, but the current version does not provide automatic decision support for clinicians. Other systems are being developed to offer decision support but are not yet fully verified or FDA-approved.

In the academic community, development of decision support tools for diabetes is currently in its infancy. We performed a PubMed literature review for the four terms "decision support diabetes telemedicine" on August 3, 2009. The database identified 42 articles that matched. Of these articles, only four systems with automatic decision support were presented. All four systems responded automatically to uploaded blood glucose levels and, in some cases, to insulin dosages or food intake as well. No other diabetes information besides blood glucose levels, insulin dosages, and/or dietary composition (such as additional history, other physiologic measures, or acute complications) was considered in any of these four studies. The Diabetes Interactive Diary provides immediate insulin dosing recommendations based on current blood glucose level, carbohydrate intake, and carbohydrate–insulin ratio. All information is transmitted to and from the central server by mobile telephone text message transmission.[10] AIDA is a Web-based freeware educational simulator program of glucose–insulin interactions, insulin dosages, and dietary adjustments in diabetes mellitus.[11] DiasNet is a Web site for patients to experiment with their own insulin dosing regimens and meal data to predict blood glucose levels and to learn how to adjust insulin doses or meals sizes.[12] DIABNET is a Web-based software system that analyzes blood glucose data and proposes quantitative changes in insulin therapy and qualitative diet modifications.[13] Although this search was not a comprehensive review of the literature, the sparse results illustrate that very few articles are currently contained in PubMed on the topic of automatic decision support for diabetes telemedicine systems.

A cluster-randomized controlled trial involving 250 subjects is underway to assess the performance of WellDoc.[14] This cell-phone-based diabetes telemedicine and decision support system provides Web-based data analysis and decision support tools. A pilot trial of WellDoc, which was published in 2008, demonstrated improved hemoglobin A1c levels after 3 months in 13 intervention subjects compared to 13 nonintervention subjects.[15]

Decision Support of Diabetes in the U.S. Military

The military health care system (MHS) is a potential forum in which decision support software could be fielded and tested for diabetes care. The MHS is comprised of several multispecialty medical centers in geographical centers in the United States, but the majority of military treatment facilities (MTFs) are spread throughout the world and are comprised of only a handful of primary care managers in each location. Within the MTF system, the bulk of diabetes care is delivered by these clinicians

with infrequent contact from diabetes specialists. The San Antonio Military Medical Center, Diabetes Center of Excellence is seeking to optimize the delivery of care throughout the MHS.

Telemedicine applications offer several capabilities of interest. Of course, they can provide the ability for a patient normally seen at a remote MTF to gain access to a specialist at a medical center. However, this use of telemedicine does not solve the basic problem, described earlier, which is the limited number of specialists for the total number of patients with diabetes. A more effective use of telemedicine is to provide the primary care manager access to patient information between visits. One of the problems in the traditional model of face-to-face diabetes care is its infrequency relative to the need for patient action. If treatment changes are only made with each actual visit, then valuable time is lost in the control of the disease. Using telemedicine to increase the frequency of treatment/feedback iterations between patient and clinician will naturally improve glycemic control. Of course, the same workload limitations apply at the primary care level. Incorporating automated decision support here brings the knowledge of the specialist to the primary care manager, and it enables quick assessment and treatment decisions such that more patients can be effectively managed.

One feature of the MHS system is the existence of its comprehensive EMR system, the Armed Forces Health Longitudinal Technology Application (AHLTA). This system allows a clinician to access all clinical notes, labs, and radiology studies on any MHS patient worldwide. Plans are in place to deploy registry functionality within AHLTA to include alerts for traditional diabetes metrics. The addition of an automated decision support capability to this EMR system would greatly enhance the level of care that any nonspecialist clinician could provide.

Clinical Informatics as a Medical Specialty

The American Medical Informatics Association approved the Core Content for Fellowship Training in Clinical Informatics in November 2008. The content includes four categories: (1) fundamentals, (2) clinical decision making and care process improvement, (3) health information systems, and (4) leadership and management of change.[16] A formal set of graduate medical education requirements for training in this specialty has been developed and proposed.[17] While these requirements are designed to encompass the entire field of clinical informatics, traditional medical specialties are now in a position to adopt informatics training within their training programs. For example, the management of diabetes mellitus will likely become a major focus of this specialty. It logically follows that endocrinology fellowship programs, and even internal medicine residency programs, can play a significant role in advancing these innovative practices to manage diabetes. An endocrinology fellow, or an internal medicine resident, trained in the appropriate use of informatics for diabetes care will subsequently be an advocate for these technologies upon graduation. Academic centers should therefore seek to build diabetes telemedicine platforms with decision support and train a new cadre of physicians who will usher in this new era of diabetes management.

Conclusions

Telemedicine will become established as a management tool. We advocate that decision support is a necessary component to accelerate the advancement and acceptance of telemedicine. The community of diabetes professionals is in a position to embrace and shape the direction this technology takes us. We should take advantage of large in-place patient populations, like the U.S. MHS, to develop and demonstrate innovative practices. Eventually, clinical informatics will be incorporated into physician training programs and a new generation of physicians will be taught how to work with decision support software for diabetes and other diseases. This development will surely occur within the next decade and will raise the level of diabetes care that can be ahieved.

Disclosure:

The opinions expressed in this document are solely those of the authors and do not represent an endorsement by or the views of the United States Air Force, the Department of Defense, or the United States government.

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