CHAPTER-4

Information Technology assistance to Diabetes Mellitus

4.0 Introduction

Diabetes continues to be one of the oldest diseases widespread across geographical and genetic boundaries. Diabetes is defined as a condition that occurs because of lack of insulin or presence of factors opposing the action of insulin, resulting in an increase (hyperglycaemia) in blood glucose levels. Poor control of diabetes leads to complications, which could damage small blood vessels throughout the body, thereby causing impaired delivery of nutrients and hormone to the tissues and eventually causing tissue-damage. Macrovascular complications have been associated with hypertension and dyslipidaemia, both of which are directly or indirectly linked to cardiovascular, cerebral, renal and peripheral atherosclerotic vascular diseases.

Types of diabetes

There are two major kinds of diabetes: type 1 diabetes, known as insulin-dependent diabetes mellitus (IDDM), and type 2 diabetes known as non-insulin-dependent diabetes mellitus (NIDDM). In addition to these two common forms, which account for about 95% of the total diabetes cases reported worldwide, the WHO has recognized four additional types of diabetes. These include malnutrition-related diabetes mellitus (MRDM), gestational diabetes (GD), impaired glucose tolerance (IGT) and diabetes associated with other conditions and symptoms such as pancreatic disease, disease of hormonal aetiology, drug or chemical induced or those as a result of abnormalities of insulin or its receptor or certain genetic syndromes.
IDDM, which results from the destruction of pancreatic cells through an autoimmune process, eventually leads to absolute insulin deficiency. There is a genetic predisposition, which is triggered by environmental and/or nutritional factors. Type 2 diabetes or NIDDM accounts for 75% of all diabetes cases and is characterized by peripheral insulin resistance and relative insulin deficiency.

**Diabetic complications**

When insulin was introduced into clinical practice, it was assumed that it would provide a complete therapy for diabetes mellitus. However, 50 years after the discovery of insulin, diabetic patients still have a considerably reduced life expectancy despite a significant reduction in the incidence of ketoacidosis. This excess mortality is mainly due to long term complications that affect the blood vessels, eyes, kidneys, heart and nerves. An understanding of the pathogenesis of diabetic complications will help in identifying potential sites of therapeutic intervention. (Seshaih et al. 1997).

People with diabetes are 25 times more likely to develop kidney disease, 30-40 times more likely to undergo a major amputation, 2-4 times more likely to develop a myocardial infarction and twice as likely to suffer a stroke than individuals without diabetes.

The pathogenesis of late diabetic complications should not be considered as a single condition, but as a process that occurs in stages over a period of years. Early in the course of disease, functional alterations are detected in the target tissues. These alterations remain reversible if good control of hyperglycaemia is achieved. However with the persistence of hyperglycaemia and in the presence of secondary factors such as hypertension, hyperlipidemia, smoking, alcohol abuse, dietary excess or deficiency or
other environmental toxins. The functional alterations progress to early structural changes. Once these set-in, further progression to irreversible damage and end stage disease which is caused by unknown factors independent of hyperglycaemia. (Seshiah et al. 1997).

4.1 Information Technology assistance to Diabetes Mellitus

Diabetes is common and once diagnosed for life, effective co-ordination of this prevalent condition by doctors, nurses, and dietitians requires reliable documentation and exchange of information. The management of patients with Insulin dependent diabetes mellitus requires regular insulin injections and the monitoring of the patients metabolic status. The diabetes control and complications trial (DCCT) – long term, randomized, prospective trail has demonstrated conclusively that intensive Insulin therapy can delay the onset and slow the progression of retinopathy nephropathy, and neuropathy. In highly motivated patients with diabetes mellitus (DCCT group 1993) - finding that confirm previous reports of a link between glycemic control and diabetic complications (P.H Wang et al, 1993). One way to achieve the goals demonstrated by DCCT as well as implementing the requirements of the St. Vincent declaration (WHO report) in relative clinical practice is likely to be through the use of information technology.

Patients with diabetes have a two to forwarded increased risk in coronary artery disease and the risk of stroke and peripheral vascular disease is also substantially increased (Kasiska BL et al 1993) Advanced in scientific knowledge have provided the medical community with information and disease management strategies designed to prevent the costly debilitating complications of diabetes.
These strategies include behavioral and pharmaceutical methods for maintaining tight glycemic control, reducing hypertension, and reducing plasma lipids, which can prevent or complications of the disease (Carolyn Schwartz et al., 2006). Because patient behavioral regimens can have a salient impact on disease course in diabetes, a patient-centered approach is particularly important. Patient reported outcome measures can be important tools and facilitate collaborations between clinicians and patients, and can provide clinicians with tools to elucidate how diabetes and its treatment are affecting their patient lives and ability to take control of their disease. Accordingly, there is emerging evidence in diabetes (Carolyn Schwartz et al., 2006) to suggest that heart related quality of life assessment can be used in a clinical setting to improve clinician, diabetologist and patient communication and to ensure that the clinical encounter focuses on topics that can enhance well-being, that is effective symptom management referral to relevant clinical care particular good diet control and effective medication.

4.1.1 The Internet and Diabetes Care

Few innovations in history have had the potential to so profoundly change our lives as the Internet. What began in 1969 as a Department of Defense initiative and then evolved to a communications network for educational institutions and computer junkies has now metamorphosed into a vast network of networks and the subject of endless treatises in the poplar media. In the midst of the Cold War, Defense Department scientists developed a technology known as packet switching that could ensure data movement from one point to another even in the face of war-related interruptions to some parts of the network. The technology is called TCP/IP. Linked information on World Wide Web pages allows users to click a link and navigate to other information on the
same page, on other pages of the same document, on other files on the same computer or on other computers linked to the Internet anywhere in the world. Moreover, the navigation requires no knowledge of arcane, difficult-to-remember commands. Hypertext links have the great utility of allowing users to navigate though information needs as opposed to those predetermined by an author. The web also allows authors to link to other sources of information rather than having to recreate it themselves.

Increasingly prevalent and easy access to the World Wide Web has dramatically reduced the barriers to publication of information, because it is much easier and much less expensive to place information on the Web than it is to publish and distribute in hard copy from. This ease of publication has led to an incredible proliferation of information on the Web, including extensive diabetes information for the public, people with diabetes, and their health care professionals. Recently Kim et al, (2007) evaluated an intervention using the SMS by personal cellular phone and internet would improve the levels of plasma glucose of obese type 2 diabetes at 3, 6, 9, and 12 months.

Information on the Web is largely not peer reviewed, and there are no standardized criteria for assessing quality or validity; thus, information seekers need to be cautious. One can use the credibility of the provider as a surrogate for validity. Thus, information from not-for-profit disease-specific organizations, government sources, and specialty-specific organizations can be considered reliable. Examples of such organizations are listed in Box 44-2. One should always check the data of Web-based information.

This section reviews a variety of valuable Internet sites for diabetes health care professionals in their clinical, research, and education roles and provides a number of
examples of each. Some Web sites with particulars information of value to patients and the public are also noted. Many of these sites have been described in a section of Web Alerts published in the journal, Current Diabetes Reports (http://www.current-reports.com/).

Advances in promoting and evaluating conventual’s mutual aid self-help groups (Hum Pharys 1997) has come a surging interest in using computer technology to link people who share similar life circumstances, personal challenges or illness (E.J Madara 1997, G.A Bogat et al). The creation of virtual communities through online groups is one important element of a larger effort to use computer technology to address problems and improve life. (K.F Burrent et al., 1992, Gackenbach J. Psychology). There are many attractive features to information technology based groups. As report by madara, people search for a sense of community when they recognize that community is something that is chosen rather than something in to which they are born.

Information technology based support groups fit into a broader effort to develop interventions that make use of social support concepts (King Sa and Moregg D, 1998) support groups are a prominent form of social support interventions (Barrer M book, Hellar K. et al) as are mentoring interventions that some times include the use of professionals such as visiting nurses (Humpharys K), what is common to both support groups and mentoring interventions is that they involve the introduction of new people, people who were strategies prior to the intervention but who were expected nevertheless to provide support that would be helpful and relevant. Thus for much of the literature on information technology support groups has elaborated on the reasons for their growth, their structure, and their advantages and disadvantages (D.Z Olds and Kitzman H. 1993,
N. Weinberg et al., 1995). Some studies have provided content analysis of the actual exchanges that took place between members of online support groups (D.A Salem et al., 1997, Winfebery A, 1997) those descriptive studies showed that the supportive statements made in computer mediated interactions are similar to those between support group members in face-to-face interactions. Cohen et al proposed that social support affects health and morality through a number of mechanisms that include (a) improved health behaviors (b) decreased negative effect and (c) improved immune system functioning. (Health Psychology, 1988)

4.1.2 The Need for Clinical Information Systems

As other chapters in this book have detailed, there is a genuine and growing epidemic of diabetes mellitus in this country and around the world. Today there are an approximately 1 billion people are suffering from this chronic disease and complications. Most of the financial agencies spending huge amount of money, much of this cost is related to the chronic micro vascular, neuropathic, and macro vascular complications of diabetes.

Landmark randomized, controlled clinical trials have demonstrated that treatment of hyperglycemia, as well as the hypertension and dyslipidemia that often accompany diabetes, can markedly reduce the development and progression of these complications. Moreover, in the last decade many new therapeutic agents have become available with which to better treat diabetes patients. Yet, most patients do not achieve treatment targets advocated by the American Diabetes Association (ADA), the American College of Endocrinology, and other guideline-setting organizations. One study 4 has noted that fewer than 40% of the adults with diabetes achieve treatment goals for cardiovascular
(CV) risk factors and only 7% achieved recommended targets for hemoglobin A1C, blood pressure, and cholesterol. Better information systems are needed if clinical research is to become integrated in everyday clinical practice, for the benefit of both patients and clinicians (Iain Chalmers, 2007)

These and other findings reflect a need for better education of both health care professionals and patients. However, there is also a growing awareness that education alone will not solve this problem. The lack of optimal diabetes care is aloes related to flaws in our systems of care for complex, chronic diseases. Indeed the American health care delivery system too often is fragmented, lacks clinical information capabilities, often duplicates services, and is poorly designed for delivering chronic care. In addition, much information is locked in order “legacy” systems that do not provide information exchange with other systems, which isolates information from both the health care professional and the patient.

Access to medical knowledge and literature databases that provide diagnostic and therapeutic decision support.

Computerized instruction and education for patients, their families, the public, and health care professionals.

Clinical management support from computerized patient registries and electronic medical record systems that can provide population based performance measures, quality indicators, and systems to enhance safety.

Software that allows analysis of clinical data, such as self-monitored blood glucose readings.
Electronic prescribing applications.

- Nutrition support
- Practice management support for appointment and call scheduling
- Billing systems.

Most physicians of systems of care cannot easily look across their patient populations and identify the patients who are not attaining treatment goals. Without this ability to examine a population, health care professionals cannot implement prospective measures to improve quality of care and outcomes. Instead, they have to wait for each patient to visit and then make reactive evaluations and therapy adjustments'. Should the patient present with a problem that takes precedence over his or her chronic illness, the opportunity may be missed and necessary evaluations and changes might not be made at all. This lack of an organized system of care contributes to suboptimal diabetes control and outcomes as well as increased costs.

In contrast, a more systems-based approach provides population-based care guided by an understanding of the history of the disease and accompanied by well-timed interventions to prevent exacerbations and complications. Wagner and coworkers have proposed a chronic care model as a guide to higher-quality management of chronic illness.(Wagner EH et al., 2001) This model highlights clinical information systems, delivery systems redesign, and decision support among the interrelated components of improved care. The ability to deliver information to the members of the care delivery team is fundamental to a successful implementation of the model.

The IOM has called for action to provide care that is evidence based, patient centered, and systems oriented and that takes advantage of information technologies that
could contribute to better and continuous quality improvement (Committee on QHC, 2001)

One of the key components of a systems approach is a clinical information system. This can range from a patient registry containing patient demographic, diagnosis, laboratory, and medication information to a full-featured electronic medical records system (EMR). The system does not have to be electronic, and a simple rotary file (such as Rolodex) or paper-based system can be effective. However, a registry—ideally electronic—organizes patient information so that the health care professional can rapidly see across her or his entire practice population or can look longitudinally into an individual patient’s history. It can also serve as the basis for scheduling follow-up appointments, tests, quality improvements. Also vital are the use of clinical practice guidelines, which ideally are supported through electronically generated reminders. Recently Samson W. Tu et al (2007) describes the development and innovative features of the Standards-Based Active Guideline Environment Guideline Model and reports their experience encoding four guidelines. Innovations include methods for integrating guideline-based decision support with clinical workflow and employment of enterprise order sets. Using Standards-Based Active Guideline Environment, a clinician informatician can encode computable guideline content as recommendation sets using only standard terminologies and standards-based patient information models.

4.1.3 Computer Application for Clinical Questions

Although prospective learning will always be important for health care professionals, it is not possible to prospectively obtain all of the knowledge required to appropriately treat all patients. Therefore, clinicians must be able to access knowledge at
the point of care that answers clinical questions and provides diagnostic and therapeutic
decision support. A number of available computer applications address this need. There
of these are highlighted here. Many Internet sites can provide valuable information to
clinicians, and the applications discussed in this section can be accessed on the Internet.
However, Internet information resources are discussed separately in the section that
follows this one.
UpToDate
www.UpToDate.com
UpToDate is a subscription-based clinical information resource available to
physicians on an individual, group, or institutional basis. UpToDate gets physicians
concise, practical answers at the point of care. Content covers internal medicine and its
sub-specialties, obstetrics and gynecology, family medicine, and pediatrics. Content is
comprehensive yet concisely written and is extensively reference.
UpToDate has extensive information about diagnosis, evaluation, and management
of diabetes mellitus and its complications and comorbidities. More than 355 topic
documents are devoted specifically to diabetes mellitus, and many more address related
issues. Despite the large amount of information UpToDate uses a sophisticated
controlled vocabulary to search for information, which allows users to quickly navigate
to information that answers specific, focused questions. Some examples are “The most
appropriate treatment of hypertension and/or dyslipidemia in patients with T2DM,” “the
effects of exercise in people with diabetes,” and “ACE inhibition or angiotensin receptor
antagonism in patients at high risk for a cardiovascular event.”
UpToDate offers personal, workstation, and enterprise subscription options. Content can be accessed on the Web, through a CD-ROM, or on Windows pocket PC PDAs. A palm version is in development.

Info POEMs and InfoRetriever

www.infopoems.com

This subscription service is not a diabetes-specific application but rather a more general medical application resource. It does include diabetes-specific information, and because people with diabetes are likely to have other medical problems, it can be helpful in their care. The system identifies and summarizes new medical evidence that is deemed valid and clinically significant. (POEMs is an acronym for “Patient-Oriented Evidence that Matters.”)

Daily InfoPOEMs point out relevant research to subscribers via daily e-mail synopses every Monday through Friday. Monthly, the complete set is compiled and sent for additional summary review. Each InfoPOEM is also added to the InfoRetriever database for easy future reference. Editors review more than 1200 studies monthly from more than 100 medical journals, although a number of diabetes journals are not included. The POEMs process applies specific criteria for validity and relevance to clinical practice. About 1 in 40 studies qualify.

InfoRetriever allows simultaneous searching of the complete InfoPOEMs database along with six additional evidence-based databases. Search results come from all InfoPOEMs, all Cochrane Systematic Review abstracts, more than 200 decision rules, 2200 predictive calculators, more than 700 summaries of evidence-based practice guidelines, and the full 5-Minute Clinical Consult.
Other features include an International Classification of Diseases, 9th Revision (ICD-9), look-up, an evaluation and management (E/M) coding assistant for payments, guided searches of Medline and other Internet references, and hundreds of indexed links to patient-education materials on the Web.

Patients with diabetes, especially those with type 2 diabetes (T2DM), often are prescribed many medications so that information about indications, contraindications, dosing, and drug interactions and needed by their health care professionals. A number of electronic sources of information about medications can be viewed on the Internet or installed on a personal computer or personal digital assistant (PDA). Handheld resources were recently reviewed (Liu D 2004). EPocratesRx and mobile PDR are two good examples that offer very good functionality and have free versions.

EPocratesRx provides medication information by class or by drug, provides drug interaction for 2 to 20 medications, and has an insulin dosing calculator adapted from an algorithm developed at the Diabetes Research Institute at the University Of Miami School Of Medicine by Dr.Luigi Meneghini. It also has MedMath, developed by Dr.Phillip Cheng, which includes formula calculations including BMI, anion gap, basal energy expenditure, ideal body weight, LDL cholesterol, osmolality, number needed to treat, water deficit, and many others.

4.2 Computerized Prompts for Diabetes Management

As early as 1976, report demonstrated that computer-generated suggestions regarding tests and medication changes could have a significant impact on physician behavior. Use of well-designed and implemented technology in diabetes management can potentially improve outcomes, increase efficiency and access to care, and reduce
system errors. Empowering increasingly sophisticated patients with technology-based diabetes self-management tools can enhance their involvement in disease management.

As noted earlier, there is discordance between targets recommended by guidelines and those achieved in clinical practice. Using computer-based algorithms and clinician prompting at the point of patient care could help bridge the difference between what is known and what is done. Hyuk-Sang Kwon et al (2004) developed a blood glucose management system using the Internet and short message service (SMS), which can lessen the social economic burden and materialize an individualized diabetes mellitus management. Recently Lee et al (2007) developed patient-orientated diabetic education management system, which help patients control their glucose, HbA1c and total cholesterol levels to manage their diabetes, providing an easy and inexpensive way to extend hospital-based patient education services for community-based continuous patient education.

Prompts can be separated into passive, active, and patient-specific prompts. Reminders can also be active and passive. For example, a passive prompt, such as a wall poster listing clinical targets, can be effective as long as the doctor looks at it periodically. Active reminders mean that the doctor has responded to the prompt; for example, after performing the foot exam, the doctor puts a check by the foot exam. Finally, the patient-specific prompt is a recommendation for a given patient; for example, “Today you need to perform this patient’s annual microalbuminuria screen.” Recently Kamel Boulos MN et al (2006) have undertaken the initial work of describing the necessary requirements (framework) of an advanced educational component for multi-access services for telematic management of diabetes mellitus,
The use of diabetes guideline recommendations printed on the patient encounter forms was compared to usual clinical practice in a randomized manner in a family practice setting in the United States over a 6-month period (Lobach DF 1997). Although adherence to physical examination guidelines increased significantly, no significant difference was noted in HbA1c assessment, foot examination, or ophthalmologic examination guidelines. In a clinic-based trial of 2 years’ duration, patient-specific reminders regarding tests and physical examinations were compared with usual care over 2 year’s periods in the United Kingdom. Routine diabetic clinic visits and physician reviews increased assessments of HbA1c, but there were no significant differences in HbA1c levels in either group during the studies.

Meigs and colleagues43 assessed the effects of a Web-based decision support tool by conducting a randomized, controlled trial of 12 intervention and 14 control staff providers and 307 intervention and 291 control patients with T2DM in a hospital-based internal medicine clinic. The decision support tool displayed interactive patient-specific clinical data, treatment advice, and links to other Web-based care resources. The number of HbA1c tests obtained per year increased significantly in the intervention group, as did the number of LDL cholesterol tests and the fractions of patients undergoing at least one foot examination per year. Levels of HbA1c decreased by 0.2 percentage points in the intervention group and increased by 0.1 points in the control group (p=0.09). Fractions of patients with LDL cholesterol levels lower than 130 mg/dl increased by 20.3% in the
intervention group and 10.5% in the control group (p=0.5). Thus the improvements in glycemic and lipid control seen with this intervention were not statistically significant.

The authors concluded that Web-based patient-specific decision support has the potential to improve evidence-based parameters of diabetes care. However, an accompanying editorial by O’Connor expressed disappointment that key care outcomes such as HbA1c and LDL levels did not improve by a statistically significant amount. Another study also showed increased rates of test ordering but no improvement in metabolic parameters such as HbA1c, lipids, or blood pressures levels. O’Connor suggests that reminders to physicians that tests are due or patients are not yet at their clinical goals are important but not sufficient. Rather, clinicians need information system that suggests specific clinical interventions for a particular patient at a particular time.

In contrast, Balas and colleagues found evidence that what they termed computerized knowledge management could be associated with improvements in follow-up procedures, insulin dose adjustment, and diabetes-related outcomes. They identified reports of randomized clinical trials of computer-assisted interventions in diabetes care and grouped them into three categories: computerized prompting of diabetes care, use of home glucose records in computer-assisted insulin dose adjustment, and computer-assisted diabetes patient education.

Among 40 eligible studies, HbA1c and blood glucose levels were significantly improved in 7 and 6 trials, respectively. In 6 of 8 studies of computer prompting, guideline compliance was improved. Overall compliance with recommended diabetes care procedures was 71% to 22.7% higher when physicians were prompted compared to usual care. There of four studies of small insulin-dosage computers were associated with
reduced hypoglycemic events and insulin doses. Meta-analysis of studies using home glucose records in insulin dose adjustment demonstrated a significant mean decrease in blood glucose and HbA1c. Several computerized educational programs were associated with improvement in diet and metabolic indicators.

Diabetes disease management has emerged as a cost-effective solution in achieving good diabetes related outcomes. Fundamental to this model is the assessment of repeated clinical and educational measures. This assessment process results in an increased amount of and redundant capture data. The organizations and hospitals fail to integrate these systems into day-to-day workflow. In order to overcome this problem, it is essential to systematically evaluate the environment where diabetic care is delivered. Additionally available web-based reference modules are available and efficiently can update and destruction over Internet will be useful. All of these features will be useful to reduce data redundancies while improving clinical workflow and patient outcomes.

4.2.1 Registries

Computer-based disease registries are software data-base applications that contain disease-specific information about a patient population. Information in a registry is structured to allow sorting, analysis, and retrieval of subsets that meet certain criteria. A review of chronic disease registries can be downloaded from the California HealthCare foundation (Simon L and Powers M 2004). The Virginia Health Quality Center has assembled a comparison spreadsheet (http://www.vhqc.org/inc/pdf/regprodgrid.doc) for registry software for preventive health and chronic disease management used in different regions.
Registries can be used to identify patients with diabetes who have not achieved target HbA1c, blood pressure, or lipid levels, or to report population-based information such as the mean HbA1c for all patients, for patients of specific health care professionals, or for patients receiving certain treatments. Registries can also aggregate information about individual patients, which can be used during and between patient visits to optimize care by facilitating targeting of high-risk groups or by initiating reminders. Population-level registry information can demonstrate the quality of care delivered to diabetic patients by an individual physician or other health care professional, by groups of health care professionals, or by an entire system of care. Registries often have a variety of components, including storage, reporting functions, data entry, data access and management, and import and export functions.

4.2.2 Electronic Medical Records

In the early 1990s, the IOM called for a nationwide electronic medical records system by the end of the decade (IOM 1997, Bake K 1996). Almost halfway through the succeeding decade this goal is not much closer to being achieved. Nevertheless, the potential of EMRs even within a solo medical practice is enormous, and health care professionals, who care for people with diabetes mellitus, as well as their patients, are among those likely to derive the greatest benefit from their use. This is because people with diabetes have many co morbidities and are often treated by many different health care professionals and prescribed a large number of medications.

EMRs allow the capture, organization, and analysis of health care services including examination and laboratory results. They can facilitate direct patient care services by providing continually up to-date problem lists, medication lists, and easily
retrievable, readable, and problem-specific progress notes. More ever, EMRs have many advantages over paper medical records, including less expensive, more secure chart storage and retrieval, remote access to patient information, and the ability to rapidly find specific information items.

EMRs can allow multiple authorized health care professionals to access records simultaneously, even from disparate locations, and to share information and incorporate diagnostic and therapeutic decision support tools. Computerized records can automatically calculate a body mass index (BMI) value when a patient’s height and weight are entered. One can generate reports of all patients whose HbA1c, blood pressure, or lipid values are not at goal or demonstrate the quality of care that is being delivered for regulatory purposes or contract negotiations. When a medication has a labeling change requiring an alteration in monitoring or when an indication is changed or withdrawn an EMR can allow rapid identification of patients taking that medication. Moreover, using patient demographic information stored in an EMR or registry one can quickly generate personalized mail-merge letters communicating to patients what has occurred and how they need to proceed to address the issue (Emr update).

Both registries and EMRs can support population management quality improvement initiatives that have been demonstrated to enhance diabetes care. One can use these resources to identify patients within a practice or system who have diabetes, to risk stratify those patients, and to implement risk-specific strategies to improve care and then regularly reassess the effects of the interventions (Clark. Cm et al). Ideally such programs include information technology approaches to identify patients who have not
achieved recommended therapy targets as well as decision-support tools suggesting appropriate therapeutic perturbations (Grant Rw et al).

Figure: 4.1 flow chart of Electronic Medical Records

4.2.3 Implementing Registries and Electronic Medical Records

Computerized registries and EMRs can improve the organization and efficiency or diabetes health care delivery. Studies have demonstrated that such systems can improve the processes of care. Improvement in outcomes has been inconsistent. However, the marked improvements in care outcomes among people with diabetes treated through the Veterans Health Administration System can be attributed at least in
part to their adoption of a system-wide electronic health record (Graham G et al). Other large systems are also investing in such technology (Kaisar Permanente).

Barriers to implementing EMRs or registries in practice settings include security and confidentiality concerns; the cost of hardware and software; the cost of acquiring, implementing, updating, and maintaining the technology; and perceived cost of date entry. Yet implementation of an EMR system can’t result in a positive financial return on investment to the health care organization (Wang Sj et al, Antoine W). Purchasing a registry application or an EMR is a complex process, and appropriate choices must take into account individual characteristics of the practice or system in which it will be used.

The National Diabetes Education Program has a relatively new Web site (www.betterdiabetescare.nih.gov) that can help health care professionals who want to enhance the organization and systems of diabetes health care delivery in their practices (NDE program). Included on this Web site is information from the Health Disparities Collaborative Tools for Diabetes, 19 which addresses such issues as clinical information systems, including diabetes care chart audit, flow sheet, protocol checklist, and patient encounter form; and delivery system design, including group visit starter kit, sample registry report, and standing orders.

Some EMRs have incorporated specific diabetes-related features. For example, CliniPro’s Diabetes Management System features direct data transfer from (Kaisar Permanente) different glucose meters; health analysis charts and graphs to track vital factors, such as blood glucose and medication, and compare results to recommended levels identified in the patient’s care plan; and assessment screens to help identify, record and monitor behavior goals, such as nutrition.
The Diabetes Education Management Module21 has tools to help manage an organization’s diabetes education program and collect data required for submission to the ADA’s Education Recognition Program. Features include patient evaluations, class and individual consultation scheduling, customizable course descriptions, and patient attendance and progress reports.

The Delphi Diabetes Manager (www.delphihealth.com/sol_ddm_pvervoew/shtm) software provides the ability to monitor and analyze clinical results on an ongoing basis. Delphi developed the software in collaboration with the American Diabetes Association (ADA). This and other registry software products can assist with tracking, abstraction, and analysis of data needed for application for the National Committee for Quality Assurance (NCQA) and ADA Provide Recognition and ADA Education Recognition programs. A number of other products are also focused on diabetes or have diabetes-specific modules (Virginia Health Quality Center).

DiaTrends (Overlook Software, Greensboro, NC), is another registry program for health care professionals to track and improve diabetes management outcomes (DiaTrends Diabetes Management Software), Practicing clinical endocrinologists were involved in the development of the system.

4.2.4 Electronic Prescribing

Electronic prescribing offers a number of advantages over conventional prescribing, including generation of active medication lists for all authorized personnel and make it easy to identify potential drug interactions. A number of systems offer wireless access via PDA, tablet, or laptop computer, electronic prescribing can dramatically
reduce the time it takes to authorize refills and can reduce Potential medication errors (Miller Sr 2003). It can also be cost effective (Caremark, Zix Corporation).

EHealth Initiative has an extensive discussion of this topic. Its report on electronic prescribing (Ehealth Initiative) effects the collective wisdom of a diverse group of experts who began work in early 2003 with the objective of determining what action is needed to celebrate the adoption of electronic prescribing in regulatory care.

4.2.5 Diabetic Retinopathy Screening

Diabetic retinopathy screening cameras can be stalled in clinical settings frequented by diabetes patients, such as primary care offices and endocrinologist's offices. Retinal photographs can be sent via an organizational intranet or the Internet to retina specialists for reading. A report (Choremis J and Chow Dr 2003) of one institution's use of this approach demonstrated that in images of 830 eyes of 415 patients, most of whom had T2DM, macular hard exudates were observed in 50 years (6.0%), non-proliferate diabetic retinopathy in 1.8%. Overall, 10% of the patients were referred to a retina specialist based on the screening photographs.

The main difficulty encountered with the screening program was image inconsistency. Overall, 35% of the images graded were of poor quality, usually (84.4%) because of poor exposure. The quality of the images improved significantly over the study period. A systematic review comparing the effectiveness of screening and monitoring tests for diabetic retinopathy concluded the most effective strategy for testing is the use of mydriatic retinal photography with the additional use of ophthalmoscopes for cases where photographs are upgradeable.
4.3 Bioinformatics

Bioinformatics is the science of using and developing computational tools and algorithms to help solve different biological problems. These problems include similarity searches of unknown DNA/protein sequences, 3D protein structure prediction and protein function prediction. The extra information obtained from bioinformatic analysis of unknown data can help researchers to design better, or more precise experiments in solving their problems. In bioinformatics, using existing biological databanks to help analyze any raw data from various experiments. Therefore, biological databases place a vital role in bioinformatics. Recently William Loging et al (2007) described in silico approaches that are driven towards the identification of testable laboratory hypotheses; they also address common challenges in the field. They focus on flexible, high-throughput techniques, which may be initiated independently of 'wet-lab' experimentation, and which may be applied to multiple disease areas. The utility of these approaches in drug discovery highlights the contribution that in silico techniques can make and emphasizes the need for collaboration between the areas of disease research and computational science.

4.3.1 Biological databases

The increasing volume of biological data collected in recent years has prompted increasing demand for bioinformatics tools for genomic and proteomic data analysis [Kitano H 2002]. Web based bioinformatic application platforms have become one of the popular tools for biological data analysis among the bioscience community. However, these application platforms utilize different stand-alone bioinformatic applications and they use different data sources in different formats. Integrating different programs into a
functional application platform would require new software components to be written for data exchange between different applications, since they use different formats for input and output. The lack of standards for data conversion between these programs further complicates the construction of application platforms. This adds extra time and cost to the software development process of these application platforms.

4.3.2 Bioinformatics- Type 2 Diabetes

Diabetes mellitus is defined as a syndrome characterized by chronic hyperglycemia associated with disturbances of carbohydrate, fat and protein metabolism due to absolute or relative deficiency in insulin secretion and/or action. The most common symptoms of diabetes mellitus are polydipsia, polyuria, polyphagia, weight loss etc. Complications of diabetes mellitus are acute complications and chronic complications. Acute complications mainly include Ketoacidosis and Ketoacidotic coma. Chronic complications are further divided into microvascular and macrovascular complications. Microvascular complications are retinopathy, neuropathy, and nephropathy. Macrovascular complications are coronary artery disease, diabetic cardiomyopathy & peripheral vascular disease (Seshiah.V and Ganeshan V.S. Handbook, 1977). Microarray technology is well established as a research tool, and now it is increasingly being used in clinical and diagnostic settings. Gregory Vlacich et al (2007) describes the principles behind microarrays, and details the current and potential applications in the search for biomarkers for diabetes, endocrine tumors and hormonal modulators of tumors

Diabetes mellitus has been on the rise across the world affecting over 150 million people. Over 20% of diabetics in the world are Indians. At present, it is higher in
developed than in developing countries. The number of adults with diabetes in the world will rise from 135 million in 1995 to 300 million in the year 2025. The major part of this numerical increase will occur in developing countries. By the year 2025, greater than 75% of people with diabetes will reside in developing countries. The countries with the largest number of people with diabetes are, and will be in the year 2025, India, China and U.S. [King H. et al].

Bioinformatics is the emerging field that deals with the application of computers to the collection, organization, analysis, manipulation, presentation and sharing of biological data. Bioinformatics, therefore, provides the necessary data as to the gene expression and formulates further biological questions proteomics and metabolimics try to address. All of the above fields are heavily dependent on the experimental methods and instrumentation for the high-throughput data collection and analysis necessary to accomplish the ambitious goals of the analysis on a cell wide basis. Experimental methods such as microarray technology, liquid chromatography tandem mass spectrometry, and nuclear magnetic resonance profiling of metabolites make it feasible to address the biological questions of the “bioinformatics” era.

Bioinformatics research is in the midst of a transformation that is being driven by the massive increase for information and the development of bioinformatic analysis technologies exploits its use diabetes research for development of biomarker and new drug therapies. Recently we have reported the analysis of genes causing hypertension, cardiovascular and diabetic diseases using composition alignment method in which a new approach has been developed for analyzing DNA sequences in order to detect regions with similar nucleotide composition (Allam Appa Rao et al 2006). Bhramaramba et al
reported analysis of species affected by diabetes, which will be useful for protein folding studies (R. Bharamaramba et al., 2007). Bases on the serum butyrylcholinesterase levels (Allam Appa Rao et al., 2005) or brain derived neurotrophic factor (Allam Appa Rao et al., 2007(a)), based on the cholinesterase levels we may identify the diabetes associated alzheimer's disease (Allam Appa Rao et al., 2007(b)), these enzymes are excepted to be useful as biomarkers for type 2 diabetes.

The bioinformatic technologies will not replace the other approaches of quantitative genetic evaluations of populations but will complement and add to already existing approaches. Our review briefly describes existing joint transcriptome-proteome analyses using bioinformatic tools and proposes an integrated -bioinformatic approach or so-called systems biology or systems genetics approach (Chassman M 2005) for biomarkers identification in type 2 diabetes associated complications. consider ways to incorporate data on genetics, genomics, proteomics, and metabolomics into the already existing approaches of selection of proteins, which are accepted to be useful as biomarkers. Finally, possible uses of bioinformatics or systems genomics approaches in quantitative genetic/genomic analysis are discussed. Information technology playing the crucial role for diabetes disease management, data collection online electronic medical records and disease progression. The relational view of the active, constitutive role of information technologies developing now interferes with some core tenets of diabetes research and disease management.

Diabetes is a chronic disease that causes a great deal of morbidity and poor quality of life for millions. Equally the incidence of the disease on the increase in on many areas of developing world, particularly as life style patterns, including those of diet,
change, at the same time, diabetes has over the last two developments according the spectrum of information technology. As this centenary dreams to a close this trend continues as evidenced by the publications in reputed journals, which exemplify the use of information science and technology in relation to diabetes, decision support and clinical management.
References


5. Antoine, W; Electronic Miracle. Memorial Hermann Put Its Patient Files Online And Watch Its Revenue Grow. Health Forum


7. Bake, K; The Clinically Related Information System (Cris); A Cpr Pilot Using Pjprimary Care Advice Rules And Reminders. Second Annual Nicholas E.
Davies Cpr Recognition Symposium. Bethesda, Md, Computer-Based Patient Record Institute, 1996.


12. Clark Cm Jr, Snyder Jw.Meek RI, Et Al; A Systematic Approach To Risk Stratification And Intervention Within A Managed Care Environment Improves Diabetes Outcomes And Patient Satisfaction. Diabetes Care 24:1079-1086, 01


14. Committee On Quality Of Health Care In America; Crossing The Quality Chasm; A New Health System For The 21st Century. Washington, Dc, Institute Of Medicine, 2001


20. Finn J Computerbased self help groups online recovery for addictions: Computers in human services 3 (1996) 21-41
25. Graham G, Nugent, L, Stroucse K, Information Everywhere; How The Her Transformed Care At Vha, J Ahima


31. Hyuk-Sang Kwon, Jae-Hyoung Cho, Hee-Soo Kim, Jin-Hee Lee, Bok-Re Song, Jung-Ah Oh, Je-Ho Han, Hee-Seung Kim, Bong-Yun Cha, Kwang-Woo Lee, Development of web-based diabetic patient management system using short message service (SMS) Diabetes Research and Clinical Practice, Volume 66, Supplement 1, December 2004, Pages S133-S137

32. Iain Chalmers; Otolaryngology - Head and Neck Surgery Better information systems are needed to help patients and clinicians integrate clinical research within everyday clinical practice, Volume 137, Issue 4, Supplement 1, October 2007, Pages S69-S71


42. Lee T, Yu-Ting Yeh, Chien-Tsai Liu and Ping-Ling Chen
Development and evaluation of a patient-oriented education system for
diabetes management; Int. J. Med. Informatics, Volume 76, Issue
9, September 2007, Pages 655-663

Medical Software Reviews March-April

44. Lobach Df: Hammond We: Computerized Decision Support Based On A
Clinical Practice Guideline Improves Compliance With Care Standards. Am J

45. Miller Sr: Scrip For Success. Kentucky Family Practice Uses Electronic
Prescriptions To Improve Efficiency, Revenue And Customer Service. Health

46. N.Weinberg; Schmale.J UkenJ, K.Wessel; computer aided support groups.
Social work with groups 17 (1995) 43-54.

47. Overlook Software; Diatrends Diabetes Management Software

48. P.H wang, J Lav and T.C Chalmers, metaanalysis of effects of intensive blood

49. R.Bhramaramba, Allam Appa Rao and GR Sridhar, 2007, 'Principal
Component Analysis of protein variates among species affected by Diabetes:
An Exploratory Study', International Journal of Diabetes in Developing
Countries, ISSN 0973-3930–accepted for publication

50. RL street, Gold jr, nannings T Health promotion and interactive technology :
Theoretical applications and future directions London, Erbuam


55. Virginia Health Quality Center; Diabetes Resources For Improving Care.


