Chapter-2

Era of Information Technologies in Medical Science

2.1 Information Technology Role in Medical Practice

Information and communication technology (ICT) is being increasingly used by healthcare professionals to assist them in patient care and management. It is postulated that use of ICT may be beneficial in reducing the incidence of medical errors (Dumay, A., Freriks, G., et al. 2004). The use of information technology is changing the nature of rural medical practice, and bringing more support and information to rural general practices. However, some of the technologies now available are of little perceived use to the general practices, and general practices with good support staff are better able to take advantage of the technology than general practices with little or inadequate support. The findings of this study have implications for policies being implemented to increase the availability of information technology to support rural health care. (Robinson, A., et al. 2003) Medical information groups are searching for innovative ways to support their business. For some companies, globalization may provide just the right opportunity to streamline business process, ensure consistency, and reduce duplication of effort. (Riggins, J.L., et al. 2000)

Technology is assuming an increasingly important role in medical practice and health care delivery, fueled by forces such as uncertainty, variability, error, and quality problems. While the benefits of technology are obvious, there are insidious costs that are harder to discern. Technology has a significant, but less appreciated, role in imposing standards and constraints upon medicine. These ancillary effects account for some of the physician reluctance to embrace technological innovations perceived as
Clinical data management is a vital vehicle in medical research to ensure the integrity and quality of data used to take medical decisions. When applied to clinical trials or observational studies it must comply with several regulations and guidelines developed in recent years; these include general purpose national and international legislation for data privacy and data protection, good clinical practice (GCPs) for medical interventions, and specific guidelines for electronic data submission to regulatory agencies (Clivio, L., et al., 2006).

The transformation of the medical practice is possible today because of the advancement of system design knowledge coupled with innovations in information technology (IT). Examples of such transformed care are present today, and they are creating a roadmap for others. Those efforts are also elucidating critical issues in the use of IT to advance health care quality. Connectivity, electronic integration, and knowledge management are the key functionalities emerging as levers to promote this transformation (Kilo, C.M., et al., 2005).

In fairness to doctors, however, there have also been problems with the “product.” Historically, computer systems for physicians (as well as hospitals) have been difficult and expensive to install and use. All too often, business software for medicine has been riddled with bugs and is difficult to connect to other programs or systems on which the software depends (Kleinke, J. D., et al., 1998). Vendors of medical software have often misrepresented the capabilities of their products and have had difficulty in delivering the improvements in care and cash flow they promised. The future role of information technology in the medical industry is never clear, but we can identify some trends, such as electronic medical records and database management systems. Many of these trends can boost productivity for practices, but all managers need to
carefully analyze their needs and understand the products to see how they may or may not help their individual practice (Sterling, R.B, et al, 1999)

2.2 The Internet: A Revaluation in Connectivity

The information revolution is bringing people of different backgrounds from around the world into a global information superhighway. The Internet provides a global platform connecting thousands of networks around the world. There is a variety of information available on the Internet for the users. It has been considered as a forum for users to share worldwide information resources. The resources are so vast that many of us really cannot grasp or understand the Internet fully. It has become a 'global information library' which allows the users to participate in the group discussion, search for any information, start any discussion with others and so on (Hura, G.S, at al, 1998) An Internet survey of the Pick's Disease Network showed the potential for use of the Internet for research into diseases that are too rare to find sufficient subjects to gather data on patient and family experiences, helpful interventions, and other care-related information. This descriptive survey used an author-constructed instrument posted on a university server to collect information on both the affected persons and the family (Yeaworth, R.C, et al, 2001) One of the most frequently discussed topics in the current international business literature is the impact of the Internet on the internationalization of smaller manufacturing enterprises (SMEs). The study was carried out through a mail survey of the top executives of 125 Wisconsin firms. It examined 10 research hypotheses on internal and external factors which had been identified by previous research to influence the internationalization of SMEs through the Internet (Moini, H., Tesar, G, et al, 2005). Measuring the Internet-the size of its infrastructure, how many people use it, and their
prevalent uses is of obvious interest. However, the wealth of available quantitative information regarding the Internet so far has fallen short of satisfying the many needs that it would fulfil. We set the problem of measuring the Internet into a framework that allows us to derive insights on the peculiar nature of the Internet as a piece of infrastructure (Giacomello, G., Picci, L., et al., 2003).

2.2.1 The Internet and Health Information

The internet is one of a range of health information sources available to adolescents. It is recognised that young people have difficulties accessing traditional health services; in theory, the internet offers them confidential and convenient access to an unprecedented level of information about a diverse range of subjects. This could redress adolescents' state of relative health 'information poverty', compared to adults. (Gray, N.J., et al., 2005).

Health-related information was among the most immediately popular points of convergence. Six million people use the Internet to seek health information every day, just in the United States (T. Ferguson, et al., 2002), and according to the Pew Trust Internet American Life Project, 62 percent of adults connected to the Internet sought health information through it. (Fox, S., and L. Rainie, et al., 2000)

2.2.2 The Internet in Healthcare

The use of the Internet in daily healthcare business processes is still minimal compared to other industries. Healthcare information is inherently "mobile", i.e. it travels with the patient - and therefore, the need for information to be ubiquitously, available is key to efficient and improved diagnostic accuracy, reliable care and reduced medical
errors (Seshadri, K, et al, 2001). Internet applications have less direct saliency to hospitals and other healthcare delivery institutions, where improving clinical and financial operations is the most immediate management challenge. However, Internet technologies will be used to make hospitals and the information they contain more accessible to patients and families. (Goldsmith, J. C. 2000) For progress on Multimedia Computers, we can have the communication environment for images, sounds, and so on. Internet is taken notice of an communication tool for regional healthcare information. But it is difficult to assure the security for healthcare information data. (Hisanaga, Y, et al, 1998). In addition it is suggested that the experiences and the knowledge developed by the patients during this process can be a valuable resource both in the design and in the maintenance of information technology support used in the healthcare - patient relationship (Josefsson, U, et al 2004).

2.3 Bioinformatics and Medical sciences

Bioinformatics has a profound impact in medical sciences. The biological databases are helping physicians to diagnose the disease and develop strategies for its therapy. Information science has been applied to biology to produce the field called bioinformatics - the study of information content and information flow in biological systems and processes. Its simplest tasks are the creation and maintenance of databases of biological information, but the most pressing tasks involve the analysis of sequence information. Computational biology is the name given to this process. The collecting, organizing and indexing of sequence information into a database, a challenging task in itself, provides the scientist with a wealth of information. The power of a database comes not from the collection of information, but from its analysis (Sarafian, V, et al, 2006). To
Contribute a new respective on recent investigations into the scientific foundations of medical informatics (MI) and bioinformatics (BI). To support efforts that could generate synergies and new research directions. Methods: MI and BI are compared and contrasted from a philosophy of science perspective. Historical examples from MI and BI are analyzed based on contrasting viewpoints about the evolution of scientific disciplines. (Maojo, V., Kulikowski, C, et al, 2006). Compare MI and BI along several dimensions, including: (1) historical development of the disciplines, (2) their scientific foundations, (3) data quality and analysis, (4) integration of knowledge and databases, (5) informatics tools to support practice, (6) informatics methods to support research (signal processing, imaging and vision, and computational modeling, (7) professional and patient continuing education, and (8) education and training. It is pointed out that, while the two disciplines differ in their histories, scientific foundations, and methodologic approaches to research in various areas, they nevertheless share methods and tools, which provides a basis for exchange of experience in their different applications. MI expertise in developing health care applications and the strength of BI in biological "discovery science" complement each other well (Maojo, V., Kulikowski, C.A, et al, 2003) Modern molecular biology allows genomic approaches and technologies to identify drug targets, to search for potential receptors by bioinformatics means, or to investigate patterns of gene expression in both pathogens and hosts. The pursuit of potential cancer therapy targets needs the examination of the characteristic expression patterns found in tumor or patient samples. Genomic/bioinformatic methods are used to identify genomic polymorphisms characteristic of particular patient response profiles. They could be applied for individual administration in optimizing the doses and development of new therapies. (Sarafian, V, et
al, 2006) Medical Informatics and Bioinformatics meet. Traditionally, Medical Informatics has been focused on the intersection between computer science and clinical medicine, whereas Bioinformatics have been predominantly centered on the intersection between computer science and biological research. Although researchers from both areas have occasionally collaborated, their training, objectives and interests have been quite different (Martin-Sanchez, F, et al., 2004). The possibility of using information technology makes the drug discovery and development no longer a labour-intensive, trial-and-error process. Bioinformatics builds the foundations of future medical progress based on the intelligent use of structural databases to understand and predict functional relations, as well as to create modern tools for diagnosis and treatment (Sarafian, V, et al., 2006).

2.4 Drug Design

A drug molecule that interacts with a target in the body biological molecule, usually a protein) thus triggering a physiological effect. Drugs can be beneficial or harmful depending on that effect. Drugs for the treatment of diseases interact with targets that contribute to the disease and produce positive effects. The traditional approach of drug discovery, as described in (Dixit Ks.Mitra et al, 2002) involves “target identification, validation, lead search and optimization followed by clinical development phases”. The cost of drug discovery process is an important factor Bioinformatics methods can reduce the costs by using computer analyses of drugs chemical components interactions and stability. The new technology of genome sequencing simplified the process of target identification. Bioinformatics is now focused more on target validation, which is “finding a target that is mostly likely to succeed” (Dixit Ks.Mitra et al., 2002). Traditionally, structure-based drug design has been predicated on the idea of
the lock-and-key hypothesis, i.e., the ideal drug should have a structure that complements the target site structurally and energetically. The implementation of this idea has lead to the development of drug molecules that are conformationally constrained and pre-shaped to the geometry of the selected target. (Velazquez-Campoy, A, Freire, E, et al, 2002). A clearer understanding of the specific goal of a drug delivery/drug targeting approach will make the expectations more realistic and the chances for success greater. Primary to improving drug targeting is a better understanding of the biology of tumors. (Welch, D.R, et al, 1987).

2.4.1 Drug Design using Bioinformatics Tools

Bioinformatics is a new field of current interest that came into existence when biology and information technology (IT) converged to explore the chemical basis of life at large. Present millennium is likely to see a revolution in clinical practices as research in the field unfolds genetic informations and supercomputers assist in organizing, understanding and analyzing this information for a meaningful purpose. Advances in hardware and software tools have helped to identify the genetic sequences pertaining to organisms and this unravels gene expressions for specific diseases. Future of medicine is likely to be based on molecular simulations and 3D structural and surface analysis of gene expressions to provide for individualized post natal treatment for aberrations in hereditary instructions. (Anand, S, Santhosh, J, et al, 2001). Genomics and proteomics technologies have created a paradigm shift in the drug discovery process, with bioinformatics having a key role in the exploitation of genomic, transcriptomic, and proteomic data to gain insights into the molecular mechanisms that underlie disease and to identify potential drug targets (Jiang, Z, Zhou, Y, et al, 2005) Nowadays the in silico
scenario for drug design is totally dependent on structural biology and structural bioinformatics. A myriad of free bioinformatics applications and services have been posted on the web. This mini-review mentions web sites that are useful in structure-based drug design (Carpy, A.J.M, Marchand-Geneste, N, et al, 2006)

2.4.2 Drug Discovery

The disease target may be endogenous (a protein synthesized by the individual to whom the drug is administered) or, in the case of infectious disease, may be produced by a pathogenic organism. Drugs act by either stimulation or blocking the activity of the target protein.

2.4.3 Principles of drug Development

The development of a new drug is a complex, lengthy and expensive process. Drug development begins with the identification of a potentially suitable disease target, a process called target identification. In the past, target identification was based largely on medical need. Safety requirements for drugs to be used chronically are paramount. Assessments of the therapeutic benefit as opposed to the risks of a new drug are important criteria for approval. As a consequence of these strict requirements which have precipitated in rules and regulations for biomedical testing and marketing approval in most countries of the world, the drug development process has expanded and in many instances leaves little of the effective patent life to recover the considerable investment needed for an innovation. (Philipp, E, Weihrauch, T.R, et al, 1993) The process of cancer drug development is lengthy and highly structured. Preclinical evaluation involves assessment of in vitro and in vivo measures of efficacy and mechanism of action. Toxicological studies in two species are also required prior to human trials. The recent
initiative to harmonize requirements for preclinical evaluation may simplify the process on a global basis. Once in the clinic, the initial trials (phase I) have as their goal the definition of the recommended dose, the spectrum of toxicity and pharmacological behaviour. (Eisenhauer, E.A, Vermorken, J.B, et al, 2000)

2.4.4 Clinical Trials on Discovered Drug

Once a drug is discovered and formulated, clinical trials begin. In 1962 the Food Drug and Cosmetic Act were amended which required evidence of effectiveness before a drug could be marketed. All prescription drugs on the market today are categorised as members of existing drug classes. The stakes of drug selection within a class are especially high for chronic interventions that aim to prevent development of disease and its complications, since the evidence of efficacy or questions of safety may not be apparent for many years (MD Curt D Furberg, 1999). Currently, emphasis has moved to the efficiency and timeliness of the drug review process as both the public and industry demand prompt reviews and access to experimental drugs. Clinical trials in children have improved outcomes in areas such as neonatology and HIV. Trials in paediatric oncology are certainly notable for achieving high degrees of participation, yet trials in children infected with HIV have also been successful despite great obstacles (Esse N Menson, 2004). The regulatory process demands that a strict methodology be used in the design, implementation, and analysis of clinical trials. When reviewing a new drug application, a regulatory board is interested in a number of features of the trial. The population analyzed is important because it affects the generalizability of the findings. If the drug was tested on a group of men between the ages of 25-40, any drug effect found has not been proven for women above the age of 65, for example. A narrow population tested
makes it easier to find an effect, but restricts the applicability of the findings. On the other hand, too broad a population focus and an effect may not be found as it is diluted in the variety of the subjects tested. A pharmaceutical company would like to test on as broad a population as possible while still being able to detect any treatment effect. To determine if a treatment is having an effect, some response must be measured. One response is designated the primary response variable. Frequently, however, the outcome of real interest is not measurable. There are two main reasons why this may occur: the clinical response takes a long time to occur on average, or the response of main interest is difficult to observe or measure. The pharmaceutical industry spends more time and resources on generation, collation, and dissemination of medical information than it does on production of medicines. This information is essential as a resource for development of medicines, but is also needed to satisfy licensing requirements, protect patents, promote sales, and advice patients, prescribers, and dispensers. Such information is of great commercial value, and most of it is confidential, protected by regulations about intellectual property rights (Prof Joe Collier FRCP, 2002). Usually in a study using surrogate outcomes, more than one outcome is used in the examination of a treatment effect and then a means of coping with more than one response must be found (the normal procedure is to consider one outcome the primary end point and all others as secondary outcomes). Sample size is a very important determinant to finding an effect. Before beginning a study, the number of subjects needed to detect a treatment effect is calculated. Without enough subjects, no statements can be made concerning the effect. The polarization of views on how best to exploit new information from the Human Genome Project for medicine reflects our ignorance of the genetic architecture
underlying common diseases: are susceptibility alleles common or rare, neutral or deleterious, few or many? Single-nucleotide polymorphism (SNP) technology is almost in place to dissect such diseases and to create a personalized medicine (Wright, A.F., Hastie, N.D., 2001).

2.4.5 Issues in Drug Design

Current issues that are emerging in drug development include supplemental applications, surrogate endpoints, and the timeliness of the drug review process. It is important to conduct a drug abuse potential study for a new drug that may have potential to be abused. The acute dose-effect comparisons of the test, positive control, and placebo treatments are often performed on healthy volunteers with histories of drug abuse in drug abuse clinical trials. Because of large between-subject variability in the endpoint measurements based on self-evaluated responses and the difficulty in recruiting appropriate study subjects; the designs for such studies are typically crossover, with self-control. (Chen, L, Tsong, Y, et al, 2007). Once a drug has been approved, supplemental applications are commonly made. The use of surrogate endpoints is a consequence, in many cases, of the pressure to introduce drugs to the public in a timely fashion. This is especially important in treatments related to cancer or life-threatening diseases. Trials with death as the final outcome may take many years to obtain enough data to analyze. In an effort to reduce the waiting time, other outcomes are used to investigate effectiveness and the drugs can move to market much faster. In the design and analysis of clinical trials; renewed interest in alternatives to the 'intention-to-treat' analysis in the presence of non-compliance in randomized clinical trials; renewed interest in methodology to address the multiplicities resulting from a variety of sources inherent in the drug development.
process, and renewed interest in methods to assure data integrity. These emerging and recurrent issues provide a continuing challenge to the international community of statisticians involved in drug development. Moreover, the involvement of statisticians with different perspectives continues to enrich the field and contributes to improvement in the public health (Anello, C, et al, 1999).

Methodological standards for clinical pharmacogenetic studies should be developed to improve reporting of studies and facilitate their inclusion in systematic reviews. The essence of these studies lies within the concept of effect modification. Study Design and Setting: A narrative review discussing methodological issues in the design and reporting of pharmacogenetic studies (Smits, K.M, et al, 2005). Reducing the time spent in clinical trials is one component of getting drugs to market faster. The other factor concerns the review boards. As they are responsible for reviewing the drug applications, the faster this process can be completed, the sooner a drug can be released to the public. To facilitate the efficiency of the review boards, the FDA has developed an electronic submission process and has doubled the number of statisticians working on the review of new applications. There is also a shift towards globalizing the drug application process as companies attempt to satisfy the conflicting regulations in a number of countries.

2.5 Digital Medicine

The increasing diffusion and development of the information and communication technologies has allowed the introduction of new techniques, such as the virtual laboratories, in the world of research and education (Etxebarria, A, et al, 1999). Although Remote Sensing (RS) and Geographical Information Systems (GIS) have been employed for decades for diseases surveillance, prediction and intervention programs, its awareness
and application to Veterinary Medicine in Nigeria is a recent phenomenon (Babalobi, O, et al, 2003). There is an information explosion and geometric growth of knowledge in medicine. The individual physician finds himself having great difficulty coping with this ever increasing knowledge base. The recognition of a gap in such knowledge; while frustrating, may also have a direct impact upon patient care. Computer technology, information retrieval modalities, and teleprocessing between remote locations has been viewed as a partial solution to this issue. Microcomputers and their associated elements are able to be used as information retrieval devices tapping into vast reservoirs of data and information on all aspects of medicine (Rosenthal, L.E, et al, 1990) Information and communications technology (ICT) is increasingly being used in management of chronic illness to facilitate shared services (virtual health networks and electronic health records), knowledge management (care rules and protocols, scheduling, information directories), as well as consumer-based health education and evidence-based clinical protocols. Common applications of ICT include home monitoring of vital signs for patients with chronic disease, as well as replacing home visits by nurses in person with telemedicine videophone consultations (Celler, B.G, et al, 2003) The use of modern information technology to deliver health services to remote locations, poses both opportunities and problems for social work. Home health "visits" featuring a social worker in one state and a patient in another, therapy on the Internet, and the transmission of patient records across state and national boundaries raise important ethical and legal questions (McCarty, D., Clancy, C., et al, 2002)
2.5.1 Remote Monitoring

Information and communications technology (ICT) is increasingly being used in management of chronic illness to facilitate shared services (virtual health networks and electronic health records), knowledge management (care rules and protocols, scheduling, information directories), as well as consumer-based health education and evidence-based clinical protocols (Celler, B.G., et al., 2003). Modern information technology enables alternative strategies for education and communication. This is a description of a project for systematic utilisation of the internet for distant meetings and professional communication within geriatric medicine (Wyller, T.B., et al., 2003). The Information Technology (IT) has changed our life. People can communicate between them and students can study various courses at anywhere and anytime using the Internet. The IT can be helpful for mental healthcare, education, aftercare and counseling for patients and their families. It is very important to decrease the moving time because there are very few mental healthcare specialists. Also, it is very important to see the facial expression and speak to the people for mental healthcare education, aftercare and counseling (Sugita, K., et al., 2005). Meeting these needs technically requires the use of a distributed approach and the combination of many hardware and software techniques. We also describe the wide scope of new information, communication, and data-acquisition technologies used in home health care (Rialle, V., et al., 2002). Giving healthcare providers effective support for comprehensively browsing, visualizing and evaluating medical images and records located in different remote repositories, the developed prototype can represent an important aid in providing more efficient diagnoses and medical treatments (Masseroli, M., et al., 2004). Greater attention has been given recently to information technology and telecommunication reforms and their use for the improvement of health care service
delivery. Broadly defined, telemedicine is the use of advanced telecommunications technologies for the purposes of making diagnoses, conducting research, transferring patient data, and/or improving disease management and treatment in remote areas (Baquet, C.R., 1997). Computer and communication technologies can extend the caregiver's reach with remote patient monitoring. Health care providers' roles are changing because of the availability of health information on the Internet. Computer-based patient education can help improve the patient's awareness and understanding of his or her disease(s), which can help make the patient more of a partner in the patient-physician relationship. Currently, there are some limitations to and issues about using computers for patient education and monitoring (Belda, T.E., 2004).

2.5.2 Health Policy Issues Raised by Information Technology

The 21st century is said to be a century of the information society. We should be aware that continuing progress in information processing methodology (IPM) and information and communication technology (ICT) is changing our societies, including medicine and health care. At the start of the third Millennium we should ask ourselves, what progress can we expect from modern IPM/ICT for healthcare in the coming decade, what concerns does the information society have to face, and what steps have to be taken. These questions were addressed by clinicians, researchers and industrial representatives in a panel discussion at the joint conference ISCB-GMDS-99 of the International Society of Clinical Biostatistics and the German Society for Medical Informatics, Biometry and Epidemiology (Haux, R., et al, 2001). Health care technology has become an increasingly visible issue in many countries, primarily because of the rising costs of health care. In addition, many questions concerning quality of care are being raised. Health care
technology assessment has been seen as an aid in addressing questions concerning technology, including benefits and costs (Banta, H.D., et al., 1994). Healthcare systems are complex sociotechnical systems in which many information system innovations fail because of problems in planning or design. One of the reasons for this is that traditional analysis methods were designed for stable, relatively simple systems and single users. New analytical approaches are needed that can encompass the complexity of changing systems and multiple, interacting users (Effken, J.A., et al., 2002). Information technology has an important and expanding role in the delivery of high quality healthcare services.

Until recently health informatics systems have generally been developed as independent centralized databases. With computing communications technologies now being introduced into major hospitals, many new information services can now be provided to enhance the patient-care provider interaction (Egan, G.F., Liu, Z.-Q., et al., 1995). Holding a new promise for improving efficiency and quality and reducing cost, Health Information Technology (HIT) has become the latest national priority. Selecting three evidence-based national quality indicator systems/models as examples, this paper examines relationships between quality of care and HIT as well as their economic implications. The analysis focuses on the three systems' overall goals; targeted healthcare facilities; data sources; quality indicator measures; data format/standardisation; stages of development; levels of adaptation; and complexity of IT infrastructure including interoperability, patient involvement, resource requirements, and potential financial gains (Shen, J.J., et al., 2007).
2.5.3 Clinical Information Systems

The evaluation of clinical information systems is essential as they are increasingly used in clinical routine and may even influence patient outcome on the basis of reminder functions and decision support. Therefore we try to answer three questions in this paper: what to evaluate; how to evaluate; how to interpret the results. Those key questions lead to the discussion of goals, methods and results of evaluation studies in a common context. We will compare the objectivist and the subjectivist evaluation approach and illustrate the evaluation process itself in some detail, discussing different phases of software development and potential evaluation techniques in each phase. We use four different practical examples of evaluation studies that were conducted in various settings to demonstrate how defined evaluation goals may be achieved with a limited amount of resources. (Bürkle, T. et al., 2001) Information and communication technologies are presumed to play a critical role in improving productivity in the health-care sector and in containing exploding medical expenses. Among the most promising directions of technological development are microcomputer-based application generators for clinical information systems (CLIS), which manage data-processing activities during the patient-clinician session (Pliskin, Nava., et al., 1998). Several types of information technology will likely reduce the frequency of medication errors, although insufficient data exists for many technologies, and most available data come from adult settings. Computerized physician order entry with decision support substantially decreases the frequency of serious inpatient medication errors in adults. Certain other inpatient information technologies may be beneficial even though less evidence is currently available. These include computerized medication administration records, robots, automated pharmacy
systems, bar coding, "smart" intravenous devices, and computerized discharge prescriptions and instructions. In the outpatient setting, where adherence is especially important, personalized Web pages and World Wide Web-based information have substantial potential (Kaushal, R., et al, 2001). It also addresses the current barriers to implementation of digital technology, which include cost, cultural factors, and the reluctance to embrace new technology. However, despite the barriers, there is evidence from the Veteran's Administration, Partners' HealthCare, Kaiser Permanente, and other organizations that electronic medical records and clinical information systems are a worthwhile investment. The benefits of the electronic medical records include the reduction of errors, improvement in clinical decision making during patient encounters, and universal access to information in real time. From a managerial perspective, health care organizations should adopt such systems to improve quality of care and to stay competitive in the marketplace. From a policy perspective, the electronic medical record provides an opportunity for integration of patient information and improves efficiency and quality of care across a wide range of patient populations (Harrison, J.P., Palacio, C., et al, 2006). The major aims that will have to be achieved are the (1) patient-centered use of medical data, (2) process-integrated decision support, using high-quality medical knowledge, and (3) comprehensive use of patient data for clinical research and health reporting (Haux, R., et al, 2002).

2.6 Internet and E-Health Applications

E-health—any electronic exchange of healthcare data or information across organizations—reflects an industry in transition. Even as its form and structure continue to emerge, e-health is being used to change business and medical practices, affecting every
facet of the American health experience. Business, medical, social, and technological factors are converging to make wide-scale, continuum-based care functionally achievable perhaps for the first time. The Internet clearly drives the development and adoption of e-health applications; standing alone, it has the reach, the infrastructure, and the acceptance to achieve widespread change (DeLuca, J.M., Enmark, R., et al, 2000) However, the emergence of new shared media, such as the Internet and virtual reality are changing the ways in which people relate, communicate, and live. E-health, the integration of telehealth technologies with the Internet, is the next logical step of this process. To date, some e-health applications have improved the quality of health care, and later they will lead to substantial cost savings. However, e-health is not simply a technology but a complex technological and relational process (Riva, G., et al, 2000). E-health is an emerging field on the intersection of medical information technologies, public health and business, referring to health services and information delivered or enhanced through the Internet and related technologies. Portal technology, allowing services to be accessible over the Internet is a perfect tool for providing e-health services. The use of portal technologies has had deep influence on the architecture of the whole e-health system, both regarding new subsystems and older ones which we want to integrate with the portal. Portals provide new possibilities for creating novel types of e-health applications as well (Kosińska, J., Słowikowski P., et al, 2004). Doctors can access the database server to compare the patient's current status with his/her medical history. It can be used by one physician to monitor a group of patients simultaneously, or by a group of physicians who all monitor the same patient (Al-Rousan, M., et al, 2006).
In the last years the development of home based e-health applications, which use information, telecommunication and videoconferencing technologies, is increased because of their characteristics that allow reducing hospitalization costs and managing and monitoring patient health in real time. However, the development of a home based e-health monitoring system requires the contribution of different expertise, from medicine to engineering, and technologies, from Electronics to Medical Informatics and Telemedicine (Bonacina, S., Masseroli, M. et al., 2006). Home based e-health applications use telecommunication and videoconferencing technologies to enable a healthcare provider at the clinical site to communicate with patients at their home. Such an interaction is called a 'virtual visit'. Numerous applications are utilizing commercially available monitoring devices and the Internet to enable home based disease management and monitoring. The aim to meet older adults' desire to remain independent at home while controlling home health care costs has also led to the development of "smart home" technologies. A smart home is a residence equipped with technology that enhances safety of patients at home and monitors their health conditions. Therefore, the devices and sensors chosen to be installed and maintained in the older adults' residences need to address functional limitations and social and health care needs (Demiris, G. et al., 2004).

A home based e-health project that has been developed with the cooperation of several different research groups of the Bioengineer Department of the "Politecnico di Milano". They provided and integrated all required knowledge and background, including Biomedical Electronics and Biosensors, Biosignal Processing, Medical Informatics and Telemedicine, and Information and Communication Technologies. The aim of the discussed work was to design and implement a Web application that enables different
healthcare actors to insert and browse healthcare data, bio-signals, and biomedical images of patients enrolled in a program of cardiovascular risk prevention. Such application is intended to be part of a home monitoring system to be used during the home physical training program of cardiovascular risk patients. (Bonacina, S., Masseroli, M., et al., 2006)

2.6.1 Wireless Technology

E-health is closely related with networks and telecommunications when dealing with applications of collecting or transferring medical data from distant locations for performing remote medical collaborations and diagnosis. (Maglogiannis, I.G., et al., 2007)

As e-health is evolving into entities such as m-health (mobile) or u-health (ubiquitous), which focus on applications that provide healthcare to people anywhere, anytime using broadband and wireless mobile technologies, service-oriented approach based on semantics is finding its utility due to its ability to offer different description to different cases. The integration of Semantic Web services and agent technologies use the interactions' contextual information for advanced e-health applications to acquire information related to interactions using open software systems. In this system, the patient, healthcare professionals who provide on-site medical care, external emergency assistance organizations and administrators of local healthcare institutions play a key role. The system uses a taxonomy of social roles and interactions, and generalizes the social interactions to model these interactions (Cáceres, C., et al., 2006)

2.7 Future Technologies for Medical Applications

Diode lasers became more powerful and smaller with a broader range in wavelengths. In future new sources will also be used in medicine, fibre lasers, LEDs and
organic LEDs (OLED). Plastic foils as surface emitters could become important as irradiation source in PDT. But not only progress in light sources opened new fields in medical laser applications, application development with optimised applicators and tool holders widened the spectrum of applications for the same laser, e.g. in dentistry. Microsurgery is still a challenge where nanosurgery in cells already appears. Also new technology in medical diagnostics enter the scene. Optical coherence tomography with high resolution opens the view into the skin or new sophisticated fluorescence microscopy techniques image metabolism of cells(Steiner, R., et al, 2006) the developments that have been made in medical robotics, particularly in general surgery, orthopaedics and urology. In surgery, robots have found use mainly as localizers and telemanipulators. Other medical applications were for patient rehabilitation, transport and management. Future uses for robots are also explored, such as computerized simulation for medical training and for pre-planning of surgery operations, and telesurgery(Ornstein, Markus, et al, 1995) Handheld computers, or personal digital assistants (PDAs), have been used to assist clinicians in medical nutrition since the early 1980s. The term PDA was originally applied to programmable calculators; over time, the capabilities of these devices were expanded to allow for the use of more complicated programs such as databases, spreadsheets, and electronic books. Slowly, the device evolved into what is more commonly thought of as a PDA, that is, a device such as a PalmOS (PalmSource, Inc, Tokyo, Japan) or PocketPC (Microsoft, Redmond, WA) unit(Holubar, S., Harvey-Banchik, L., et al, 2007) Fuel cells are a clean technology with low emissions levels, suitable for operation with renewable fuels and capable, in a next future, of replacing conventional power systems meeting the targets of the Kyoto Protocol for a society based
on sustainable energy systems. Within such a perspective, the objective of the European project MOREPOWER (compact direct methanol fuel cells for portable applications) is the development of a low-cost, low temperature, portable direct methanol fuel cell (DMFC; nominal power 250 W) with compact construction and modular design for the potential market area of weather stations, medical devices, signal units, gas sensors and security cameras (Icardi, U.A., et al., 2008). Remote surgery is one of the most desired applications in the context of recent advanced medical technologies. For a future expansion of remote surgery, it is important to use conventional network infrastructures such as Internet. (Arata, J., et al., 2007) Speech recognition allows clinicians a hands-free option for interacting with computers, which is important for dentists who have difficulty using a keyboard and a mouse when working with patients. While roughly 13% of all general dentists with computers at chairside use speech recognition for data entry, 16% have tried and discontinued using this technology. Overall, limited speech functionality reduces the ability of clinicians to interact directly with the computer during clinical care. This can hinder the benefits of electronic patient records and clinical decision support systems(Yuhaniak Irwin., et al, 2007) The status of medical informatics, a comparatively new biomedical discipline beginning to develop in the second half of the 20th century, is described at the transition into the 21st century. The appearance of new information and communication technologies, among which Internet has special importance, was a major impulse to the development of medical informatics in its different fields. Health information systems are integrating, while at the same time, by distribution of their parts, they become available to the individual healthcare user. These processes put the problems of interoperability and standardization into the focus of contemporary medical
informatics. The electronic health record is recognized as a key instrument of modern healthcare systems, and its development and implementation are being planned at many places (Deželić, G., et al, 2007).

2.7.1 Ethics in Modern Medication

A new vision for genetic health care that integrates ethics as the foundation of decision making is needed. Nurses as individuals and professionals have an obligation to not only learn about the emerging genetic science but also to consider the pending impact on society. (Jenkins, J., et al, 2001). First, the advantages and disadvantages of e-mail as a means of doctor-patient communication are presented. Some of the ethical and legal issues arising in this context are discussed. Second, the Internet is changing neurologists' relationships to other professionals in the health care industry. Geographical isolation is less problematic than in the past. Telemedicine, including remote consulting via the Web, has special implications for neurologists in several areas, including stroke management, movement disorders, and epilepsy. Third, the growing availability of large databases, powerful search engines, and online full-text journals is discussed. Skill in navigating and managing these resources will become increasingly important. New computer-assisted decision support systems will continue to be implemented. Applications exist or are being developed for use by clinicians for many specific neurologic disorders. Finally, some of the problematic issues concerning medical use of the Internet are discussed, including availability, portability, security, quality, and outcomes. (Maulden, S.A., et al, 2003)

Human reproductive cloning (HRC) has not yet resulted in any live births. There has been widespread condemnation of the practice in both the scientific world and the public sphere, and many countries explicitly outlaw the practice. Concerns about the procedure
range from uncertainties about its physical safety to questions about the psychological well-being of clones. Yet, key aspects such as the philosophical implications of harm to future entities and a comparison with established reproductive technologies such as in vitro fertilisation (IVF) are often overlooked in discussions about HRC. Furthermore, there are people who are willing to use the technology. Several scientists have been outspoken in their intent to pursue HRC. The importance of concerns about the physical safety of children created by HRC and comparisons with concerns about the safety of IVF are discussed. (Elsner, D., et al., 2007) Reproductive medicine has developed to such an extent that numerous moral questions arise about the boundaries of applications of new reproductive technology. It is possible to imagine a future in which 'designer babies' are created and in which cloning, sex selection and male pregnancy become the instruments of individual desire or social policy. In this article, the concept of 'natural' is explored but rejected as an insufficient moral criterion for deciding these complex questions. (Campbell, A.V., et al., 2002). A model to be used to determine when it is acceptable to use HRC and other new assisted reproductive technologies, balancing reproductive freedom and safety concerns, is proposed. Justifications underpinning potential applications of HRC are discussed, and it is determined that these are highly analogous to rationalisations used to justify IVF treatment. It is concluded that people wishing to conceive using HRC should have a prima facie negative right to do so. (Elsner, D., et al., 2006). Insufficient attention has been given to ethical and social issues integral to nanomedicine. Part of this deficiency arises from some mistaken assumptions about ethics. I consider five of these: that ethics is only important when a technology is mature (reactionary ethics); that there are no new ethical issues in nanomedicine; that
ethics involves a kind of risk assessment that is already being conducted; that ethics is a hindrance to science; and that ethics is luxury for an ideal world. After critically assessing these assumptions, I consider two types of nanomedicine and the kinds of ethical issues they raise. Type 1 nanomedicine is of an incremental kind, and proper ethical assessment of the issues must involve a fine grained study of the specific application. Type 2 nanomedicine is of a more foundational, programmatic kind. Ethical issues raised by these more programmatic developments include challenges integral to formation of interdisciplinary teams; issues related to intellectual property, authorship and publication; development of informed consent and confidentiality protections associated with new data sets; future challenges to the clinician-patient relation and personalized medicine. (Khushf, G., et al., 2007). The rapid development in molecular biological technologies makes it possible to screen and to diagnosis thousands of genetic conditions, mutations and also predispositions to chronic diseases or traits, either prenatally or after birth. Clinical application of non-invasive prenatal diagnosis using fetal DNA in maternal plasma has become a reality. The arrival of the molecular genetic era also leads to many new ethical, social and medico-legal problems and dilemmas that obstetricians will have to face in the near future. (Lau, T.K., Leung, T.N., et al., 2005) Stem cells are proposed to provide the potential to cure degenerative diseases and to give important clues regarding human development and aging. However, stem cell research has evoked enthusiasm and passionate debate regarding the ethics of their use in medicine and reproduction. In this article, the current understanding of the biology of stem cells, their application in urology, and some of the controversies regarding their use are discussed. Although the clinical application of stem cell technologies to urologic
practice is likely to be well in the future, advances in this field hold great promise for the correction of a number of illnesses. Nevertheless, scientists and ethicists will continue to struggle with their ethical responsibilities to the patient and society (Lo, K.C., Whirledge, S., Lamb, D.J., et al).

2.8 Bioinformatics goal in medical practice

Bioinformatics has only recently experienced a similar debate about its scientific character. Both disciplines envision the development of novel diagnostic, therapeutic, and management tools, and products for patient care. A combination of the expertise of medical informatics in developing clinical applications and the focused principles that have guided bioinformatics could create a synergy between the two areas of application. Such interaction could have a great influence on future health research and the ultimate goal, namely continuity and individualization of health care. (Maojo, V., et al, 2001). The ultimate goal for the application of bioinformatics in practice, for example in the pharmaceutical and medical areas, is in the development of knowledge to impact the practice of medicine (i.e., diagnosis and treatment of predisposition and disease). Biomedical Informatics is relatively early in its evolution in that it examines the bioinformatic data from this systems-based perspective and attempts to integrate observations and knowledge about clinical disease to analyze the underlying biological processes. Success in these separate developments will come from their convergent evolution. To enable the interface between computation and experiment, stochastic and deterministic modeling including graph theoretical methods are being applied to the representation and evaluation of biological pathways and processes in normal and diseased states. These computational approaches attempt to deal with incomplete
information, unresolved molecular interactions and multiple modeling hierarchies. We hope that progress on them will result in their application in the analysis and interpretation of clinical disease, e.g., cancer, coagulation disorders, diabetes, in terms of gene identification for use in diagnostic and therapeutic target design. (Liebman, M.N., et al, 2001)
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