บทความปริทัศน์
Review Article

The Need for an IT-Based Geriatric Information System (GIS) for Clinical Use in Dentistry
ความต้องการระบบเทคโนโลยีสารสนเทศผู้สูงอายุต่อการปฏิบัติงานทางทันตกรรม

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ชม.ทันตสาร 2549; 27(1) : 7-15
CM Dent J 2006; 27(1) : 7-15

บทคัดย่อ

ระบบข้อมูลของผู้สูงอายุมีความสำคัญอย่างมากต่อผู้กำหนดนโยบายและผู้ให้บริการทั้งในระบบบริการสาธารณสุข และระบบสวัสดิการสังคม ปริมาณความต้องการ การให้บริการทางทันตกรรมที่เพิ่มขึ้นของผู้สูงอายุ จึงเป็นตัวขับเคลื่อนแสวงหาเทคโนโลยีสารสนเทศเข้ามาบูรณการร่วมกับองค์ความรู้วิชาชีพทันตกรรม เพื่อที่จะได้นำข้อมูลมากำหนดนโยบายและเพิ่มประสิทธิภาพต่อการให้บริการอย่างเหมาะสม อย่างไรก็ตามการนำเทคโนโลยีสารสนเทศมาใช้ร่วมกับการปฏิบัติงานทางทันตกรรมยังไม่เป็นที่แพร่หลาย เมื่อเปรียบเทียบกับสหวิชาชีพแขนงอื่นซึ่งมีผู้นำมาให้บริการอย่างต่อเนื่อง รวมทั้งช่วยเพิ่มคุณภาพของการให้บริการ และการเข้าถึงของข้อมูลข่าวสาร การนำเอาเทคโนโลยีสารสนเทศของผู้สูงอายุมาใช้ร่วมกับการปฏิบัติงานทางทันตกรรมของทันตแพทย์ ทั้งในด้านการส่งเสริม ป้องกัน รักษาและฟื้นฟูสุขภาพของผู้สูงอายุ โดยเฉพาะการปฏิบัติงานร่วมกับสหวิชาชีพจะสามารถสนับสนุนการรักษาและช่วยเพิ่มศักยภาพการทำงานของทันตแพทย์ได้อย่างต่อเนื่อง และตอบสนองต่อความต้องการของทันตแพทย์ อันจะก่อให้เกิด

Abstract

An information system for use with older people has acquired an increasingly important profile for both policy-makers and service providers within health care and social care agencies. The growing demand for geriatric dental care services has generated an increased interest in the use of technology-based information systems to provide knowledge for policy decision-makers and service providers. They are increasingly interested in exploring avenues by which the latest technology can be utilized to provide information to enhance the provision of dental care for older people. Information Technology (IT), when integrated into a range of multidisciplinary health care scenarios, holds great promise for improving the quality of, and access to, health care services. Therefore, investigating the role of IT in the improvement of the quality of geriatric dental care services promises valuable returns for dental health care

ประโยชน์สูงสุดต่อวิชาชีพ

คำไขรหัส: ระบบข้อมูลของผู้สูงอายุ ระบบเทคโนโลยีสารสนเทศ การพัฒนาคุณภาพอย่างต่อเนื่อง วิชาชีพทันตแพทย์

professionals, who presently face enormous challenges in an increasingly competitive geriatric dental care environment. If this technology can demonstrate its capability to reduce costs while maintaining and improving the existing quality of geriatric dental care services, it will be more readily accepted by professionals.

Key words: geriatric information system, information technology, continuos quality improvement, dental professional

Introduction

Oral health is a complex issue involving both the prevention of oral disease and the promotion of oral health. The ability to promote oral health in addition to preventing oral disease has become increasingly possible during the past several decades[1]. During these decades the medical and dental knowledge of the aging process has increased significantly world-wide with the achievement of many technological advances[2,3]. The results of these advancements have contributed to a significant increase in the number and proportion of senior citizens. This world-wide trend can also be seen in Thailand, where the number of over-60-year-olds has increased dramatically[4]. While the aging population is increasing in numbers, the oral and general health of this elderly group is improving as well[4-6]. Because oral disease is rarely life threatening, oral health is typically not of major concern to policy-makers or geriatric health care professionals, or even to the elderly themselves[7,8]. Nevertheless, oral disease has a significant impact on both social and psychological well-being, and adversely affects an individualís quality of life[7,9,10]. The interrelationship between oral health and general health is of major concern in improving the quality of life of the elderly[11,12].

The universal geriatric oral health care package introduced by the Thai National Health System Reform in 2001[13] offers a wide range of geriatric dental care services (e.g. removable acrylic partial dentures, complete dentures, restorative treatment, periodontal treatment, community care, etc). Furthermore, the changes in therapeutic procedures in geriatric dental care call for a multidisciplinary dental care team to pursue the goal of patient satisfaction[14]. Optimal care is now dependent on careful use of data produced by the Geriatric Information System (GIS) to provide assessment and planning across different care settings to ensure continuity in geriatric dental care. Elderly patients now move across numerous care settings during treatment procedures (e.g., the transition from being an in-patient at a hospital to being an out-patient or vice versa). Thus, successful geriatric therapeutic outcomes require collaboration between a multidisciplinary geriatric dental care team with access to a good Geriatric Information System (for delivery of the necessary dental care), and an involved and committed patient and/or family, as well as the availability of

ongoing support and education for the patient and family.

There has been a paradigm shift in professional views on the role of a GIS for decision-making support in clinical treatment procedures in dentistry[15,16]. Formerly, the development of electronic systems focused on electronic dental records, information retrieval and reporting, scheduling, and various communication functions, as well as financial and billing applications[17]. However, the focus of development has now moved more in the direction of cost-effectiveness, error prevention, safety, and improvement of the quality of geriatric dental health care information[18-20]. These new areas of interest require an emphasis on incorporating executable knowledge and point-of-care decision support into geriatric information systems. Acquisition and management of the underlying dental knowledge bases have thus become imperative, and tools for facilitating the dental treatment process have become essential. Integration of geriatric information with the Electronic Health Record (EHR) system provides an improved evidence base at the point-of-care, making information readily available in dental and health care practices[15,21,22]. This paradigm shift in technologies allows decision-makers to answer relevant questions from the combined perspectives of a range of professional disciplines to achieve quality clinical outcomes.

Part I: Major Change from Traditional Geriatric Information

Geriatric information is shifting from the traditional model focused on record keeping and accounting to an Information Communication Technology (ICT) information environment[23-25]. This shift in focus has been accomplished by adapting information technology to cope with changes in the quality of information and to improve consumer satisfaction[26,27]. This ICT approach challenges traditional assumptions and dental practices, and involves shifting through the best processes in order to obtain quality dental services at the point-of-care, and to achieve effective dental practice management. These benefits can be achieved by identifying delays in the information transfer process, avoiding unnecessary steps in the information flow, and by redesigning the information flow process to improve the quality of information being delivered. It is also important that professionals realize the potential benefits to be gained in dental care by improving the information flow[28-30]. There are three stakeholders directly affected by changes in the information system: the consumers, the dental care providers and the accreditation authorities. The roles of these three stakeholders will now be examined.

Stakeholders provide information for consumer services (internal and external) and should seek to prevent any interruption in the flow of information in order to achieve Continuous Quality Improvement (CQI). Figure 1 demonstrates these relationships and indicates that, when stakeholders' needs are met, all parties experience satisfaction, thereby ensuring the best possible information service for the consumer. These outcomes depend on several factors: equality of partnership, reciprocal education, common assessment of needs, shared information, mutual understanding, agreed values and clear specifications. If quality consumer service is to be achieved, avoiding conflict and maintaining a stable culture in the system is essential. This requires an ongoing review of service standards that should facilitate the development of the CQI process, thereby achieving the organization' s vision to improve the quality of geriatric information[31]. Continuous Quality Improvement in the area of consumer service management is not merely a trend but rather a better way of conducting consumer care so

that improved information management is practised at all service levels, and the goals of the dental care service are accomplished efficiently.

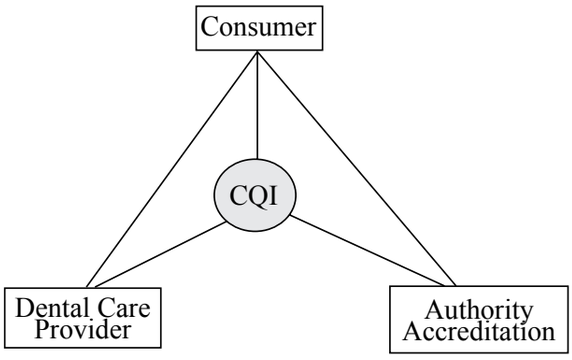

Figure 1 *Interaction between Stakeholders and continuous quality improvement*

Consumer Empowerment

Both consumers and health care professional service providers demand more information critical to their judgments in diagnosis and treatment procedures[26,32,33]. Eysenbach[27] suggests that the availability of consumer health care information increases interest in accessing it through telecommunication. Wiecha and Barrie[34] also reported that a web-based course designed to improve physicians' skills in caring for individuals with type 2 diabetes was effective in changing physicians' practice, and also received positive feedback from participants. Medical health care professionals need to receive information on exactly what they should do when providing treatment. Consumers are banding together in groups aimed at increasing awareness of their health conditions, and are providing input as to how they wish health professionals to deal with them. Consumer to consumer communication via the internet is bringing improvement to the lives of those who are handicapped, enabling them to interact with others with the same condition[33]. The dental profession is not only keeping up with modern dental technologies, but is also increasingly turning attention to the efficient utilization of more complex health care and clinical dental information.

Change in Dental Care Provision

Dental information management systems are passing through a significant period of transition as they attempt to provide consumers with better information resources. Information Communication Technology (ICT) has had a major impact on dental information system management, changing the dental environment in which professionals provide and deliver consumer services. The increasing use of ICT has implications also for dental care practice. It extends to all areas of dental administration, education and research, bringing about radical changes in the management environment to which dentists must adjust. They no longer have to make decisions based on existing paper work, but can now access current information being generated during the actual procedures themselves[35].

Critical to the utilization of administrative data by health care providers is the protection of professional values, improved outcomes of dental practice, the communication of performance indicators, and the understanding of customer values. The advancement in information technology such as dental decision support systems, quality assurance systems, cost analysis, and technology networks, also has an impact on how health care providers view the use of Information Communication Technology (ICT).

Changes in Authority

The shift that has occurred in dental care can be seen in the re-organisation of dental care to include dental consultative bodies who have become a third stakeholder in the process of delivering dental care. These professional care individuals and organizations form hierarchies that

are more complex than is the case in a typical business setting[36,37]. They can influence the direction of change, such as the restructuring of dental careers, redesigning the roles of administrative staff and the formation of strategic dental health care authorities. Many dental care organisations are facing significant changes in their culture, moving away from traditional structures and procedures. Implementation of these changes, whether the process be rapid or slow, is a difficult task and success depends on leadership, for it is the leaders who will determine whether change will be enforced from above or whether it will be accomplished through collaborative consultation among stakeholders.

Within organisations, management structure can often be a hindrance to the implementation of new technologies. Fixed and rigid hierarchies often prevent rapid organisational and structural change[38]. Traditional dental care services are under pressure to demonstrate effective and efficient use of scarce resources. The development of the dental information system provides dentists and management with an opportunity to benefit both their organizations and their consumers by using up-to-date information[16,17].

Part 2: Transferring Dental Knowledge into Practice

As the scientific dental knowledge base increases, the gap between the quality of dental care actually delivered and the quality of care made possible by professional advances widens. The goal of the profession should be to improve the quality of dental health care delivered so that it equates to best practice achievable given the present state of dental knowledge[15]. To achieve this goal, a three-part strategy is being proposed in this paper. First, quality must be recognized as a priority at the point-of-care[39,40]. Second, if we are going to rely on consumer empowerment to drive decision making, we need to examine the present health care information systems to see how well they support the empowerment of consumers in the decision-making process[27,41]. Third, we must find ways to build the capacity of the health care system and dental information systems to deliver accurate and current information to consumers and providers to improve the quality of care[26].

Many researchers have described the phases involved in the transfer of dental knowledge. They have concluded that all transfer occurs at the organizational level. Sveiby[42] proposed that there are two kind of knowledge transfer: Direct and Indirect. Direct knowledge transfer follows Polanyi's model, based on his observation in a dental school laboratory, where senior dental clinicians told junior dental clinicians about their dental treatment procedures when conducting dental treatments. What he observed is an example of direct knowledge transfer into dental practices. On the other hand, information theory can be utilized to support indirect knowledge transfer. For example, dental students use textbooks and articles as a medium to transfer dental knowledge from the professional authors to themselves.

Davenport and Prusak[43] stated that the transfer of knowledge includes conveying information to a recipient and its absorption and transformation by that person or group. They reviewed knowledge management programs in practice and identified the difference between the formalized transfer mechanisms and informal exchanges. The formalized transfer methods include documents, databases, Intranets and Groupware. Informal exchanges refer to the more casual events that usually take place face to face such as in a conversation.

Gansky[44] suggests that there are five steps in knowledge discovery and data mining. (1) Collection and Storage: Before utilising knowledge, it is necessary to get knowledge. An organization could

derive new knowledge from its past experience on the job, or it could borrow from others, or it might constantly search or scan possible sources of potential knowledge. (2) Pre-processing: Standardized written or verbal communications can be an efficient source of usable knowledge if it is processed to extract relevant components. (3) Analysis: Knowledge that has been acquired must be analysed to determine how it can be applied in the context of the organization that has acquired it. Unless it can be applied it is of no value. (4) Validation: In order to act consistently within an organization, the members must agree to adopt new knowledge. Before knowledge becomes assimilated into the core routines, individuals in the organization must mentally accept the knowledge. (5) Application: Application is the most important step in the knowledge discovery process. In the application step newly acquired knowledge is transformed into organized routines, being assimilated into policies that are necessary and important for progress.

Greenes[45] studied the benefits of incorporating clinical information into dental practice and applying it to the patient-doctor decision making process at the point of care. Further, evidenced based information benefits the patient-doctor relationship by enabling the patient to share in the decision making process when treatment is being considered. Integrating quality clinical information systems into clinical practice and applying it the clinical setting will improve the quality of care. Dental professionals should maintain sufficient ‘well-qualities’ information from a competent knowledge base to share with their patients.

Part III: Quality of Geriatric Information

Figure 2 portrays the Geriatric Information System (GIS) as the centre of the dental care environment within which the Continuous Quality Improvement (CQI) cycle operates. There must be a flow of information directly between the three stakeholders, the Consumer, Dental Care Provider, and the Regulatory Authority, but these three must also have strong links with the Dental environment, and contribute to the Geriatric Information System (GIS) that enables the CQI cycle to operate effectively. The GIS provides the information base that feeds the CQI cycle, a concept based on Deming’ s PDCA cycle.

Deming based his model on his post-war management experience with the US Command in Japan, and proposed a never-ending cyclical model of management. His plan-do-check-act cycle (**P**lan–*define* needs; **D**o–*measure* needs implementation; **C**heck–*analyze* performance according to critical measures; **A**ct–*improve* quality based on past lessons and experience) has been adapted in Figure 2 to indicate that the Geriatric Information System is fed by, and in turn supports, an on-going cycle of continual improvement in dental practice.

Deming suggested that the learning cycles produce information which can be described and evaluated on 14 variables within three dimension categories: **C**haracteristics **D**imension (CD), **Q**uality **D**imension (QD) and **I**nformation **M**anagement **D**imension (IMD). In Table 1 these dimension categories have been adapted for application to the Geriatric Information System (GIS) model. The GIS model includes links to indicate the fact that the information output from the CQI process has value that is transferable to the consumer.

The contextual framework in Figure 2 highlights the fact that the quality of geriatric information must be considered within the context of the dental care environment, and must be enhanced by information flowing from all the stakeholders. Quality information must also be able to flow from the GIS to the stakeholders. This

framework presents a macro view of what is needed to obtain the best over-all quality information about geriatric dental care for dental professionals, patients, and regulatory authorities to use in decision-making processes.

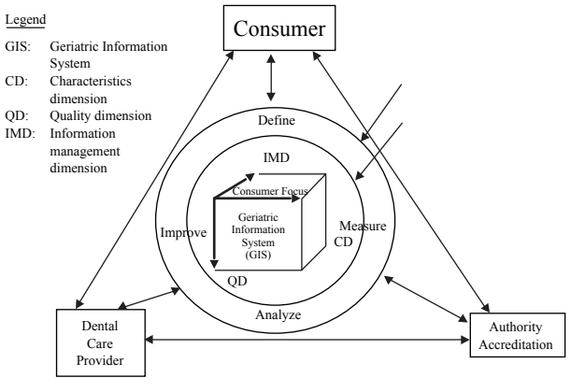

Figure 2 *A contextual framework of the Geriatric Information System (GIS)*

Table 1 *Information dimension categories (Based on the Deming Model)*

Information Dimension	Information variables
Characteristics Dimension	Access, Security
Quality Dimension	Relevancy, Valued-Added, Quantity of data, Completeness, Timeliness, Ease of understanding, Interpretability, Conciseness, Consistency
Information Management Dimension	Accuracy, Objectivity, Believability, Reputability

Conclusion

Dental professionals rely heavily on quality information. It is evident that health care information and the evidence-based Geriatric Information System (GIS) are both essential to enable these professionals to improve their practice. The utilization of information communication technology and the integration of the two components (health care and the Geriatric Information System (GIS), will provide great benefit for dental professionals in terms of communication with colleagues, continuing education, learning resources, patient management, practice administration, financial management, and dental research, to name a but a few aspects of dental practice to which benefits will accrue.

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