



# Constructing a dental electronic information resource (DEIR)

W. Paul Lang

*Department of Periodontics, Prevention, Geriatrics, School of Dentistry, University of Michigan, Ann Arbor, MI 48109-1078, USA*

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## Abstract

This paper discusses the construction of a dental electronic information resource (DEIR). Development is based on the Internet gopher client/server model. Information is organized in a series of hierarchical menus. A DEIR can be browsed by traversing the menu hierarchy or by performing keyword searches. Searches can result in a menu of found items from across the Internet. Initially, contents of the DEIR will be text files. Electronic copy will be given to an editorial board that will review submissions for conformity to publication standards. A current estimate for electronic storage costs of a DEIR is **\$1.25/Mb** per year. There will be additional costs associated with any purchases of data (e.g. **Current Contents**), production of data (e.g. development time), and editorial and managerial activities. The DEIR will be accessible from any computer or terminal that can connect to the Internet. Primary user groups will be faculty, staff, and students of dental schools. However, access to the DEIR will be free, and an extensive user community will be encouraged, including practicing dentists, dental associations, public health agencies, and dental insurance companies.

**Key words:** Dentistry; Informatics; Information systems; Computer communication networks

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## 1. Introduction

Historically, dentistry has relied on human memory, print, and spoken communication for information storage and exchange [1]. Traditional information resources used by dentists include colleagues, consultants, textbooks, professional meetings, journals, detail people, and continuing education [2]. These resources are displayed in Fig. 1 along with new electronic resources that are available using **telecommuni-**

Traditional Resources	Electronic Resources
<b>Colleagues</b>	Electronic mail
Consultants	Electronic conferences
Professional meetings	Listservers
Study clubs	Commercial networks
Detail people	Electronic catalogs
Product catalogs	<b>&amp; ordering</b>
Index to dental literature	MEDLINE, online library catalogs
Textbooks	Electronic textbooks
Journals	Electronic journals
Newsletters	Gophers
Continuing education	Distance education

Fig. 1. Traditional and electronic information resources for dentists (a one-to-one relation is not implied by the ordering of these resource lists).

cations. Use of electronic information resources by practicing dentists has been negligible, but this situation is understandable. In 1990, only 43% of dentists used computers in their practices [3], and practice management was the primary function. To access electronic resources outside the practice, additional equipment and software must be purchased. These items — a modem, communications software — are not expensive, but dentists are unlikely to acquire this equipment if there is no perceived need for electronic information resources. To what extent are dentists using these resources?

Electronic mail, conferences, and listservers are being used by academic institutions and at least one dental specialty [4–6]. The American Dental Network (ADN) was an online information service specifically designed for dentists [7]. The ADN contained news, continuing education listings, a calendar of events, and dental abstracts. Dentists can access commercial resources such as MCI electronic mail, Prodigy, and America Online. Supplies and service can also be electronically ordered via computer and modem [8].

Several online services — Grateful Med, PaperChase, BRS Colleague — are available for searching biomedical bibliographical databases such as MEDLINE from the National Library of Medicine (NLM). However, dentists do not routinely access these databases [9]. A bibliographic database specifically for dentistry called DENTLINE has been proposed to facilitate use of NLM databases [10]. Online catalogs of academic libraries can be accessed electronically, and an electronic journal for dentistry has been proposed [11]. An electronic text-based atlas of oral pathology is also available within a dental diagnostic expert system [12]. A new development is the gopher, a distributed information delivery system around which a local/worldwide information network can be constructed [13]. Currently, little dental information is available through this resource. Distance continuing education in dentistry has used television [14], telephone [15], and videotapes [16]. Computer

mediated communication has not been used extensively in dental continuing education.

Despite the availability of these resources, dentists' awareness and use of them have been limited. However, advances in other areas of dental information management may create interest in electronic resources. Dental imaging, electronic records, and expert systems are commercially available. Expectations and need for other information tools should increase as dentists adopt these new devices. Therefore, it is timely to consider the development and potential uses of an electronic information resource for dentistry.

This paper discusses the construction of a DEIR (dental electronic information resource). The DEIR would be accessible from any computer or terminal that can connect to the Internet, a large 'network of networks' that encircles the world [17]. The DEIR would be housed at a school of dentistry, and users would primarily be faculty, staff, and students. However, access to the DEIR will be free, and an extensive user community outside the institution will be encouraged. This community could include other schools of dentistry, practicing dentists, dental associations, public health agencies, and dental insurance companies.

## 2. Theoretical concept

The DEIR will be constructed using the Internet gopher client/server model. This client/server model is a file system that uses two types of machines to perform different specialized functions. Client machines perform computation for users, and server machines store data and transfer it to other client machines on request [18]. Besides providing local information, a gopher facilitates access to other gopher and information servers throughout the world [13]. The DEIR would be a gopher server accessed through the Internet. A locally resident client program or a public client would be needed to access the DEIR.

A gopher is navigated by using menus. Successive layers are traversed until a desirable file is encountered. At present, most information on gophers is published as text files. Other forms — images, sounds, and programs — can be published, but a user would need a computer that can interpret the particular file format. Files can also be sent to an electronic mail address. Computer mediated communication is presently not available through a gopher system although one can create a menu item that launches a telnet conferencing session. Gopher-like entities will eventually contain all forms of information. A prototype of such, a system — an Electronic Community System — has been developed by Schatz [19].

An Electronic Community System (ECS) attempts to encode and manipulate the range of information and values necessary to function in a community or organization [19]. An ECS can be considered an electronic library that contains multimedia objects such as text (data, literature), electronic conferences and mail, images, and software. Information and knowledge contained in the system range from formal (literature, images, and software) to informal (conferences, e-mail, anecdotes, news). Hypertext links can be established between objects. Users interact with the ECS on three levels: browsing, filtering, and sharing [19]. Browsing is accomplished by searching on keywords or by navigating hyperlinks. Filters are available to permit object

culling by keyword, date, or object type. Sharing allows users to add to the library and to establish links between objects. How closely does a gopher resemble an electronic community system?

Currently, a gopher may represent small or large communities — a university math department or a whole university. Contents range from general interest items like favorite recipes to specific items like computer system down-times. It is likely that as gophers proliferate, information richness — content and specificity — will increase exponentially. At present, dental information and knowledge are limited.

A gopher can be browsed by traversing menu hierarchies or by performing keyword searches. Search engines can construct a menu of found items from across the Internet that can be directly accessed. Filtering is done manually although desirable items can be saved in a user's bookmark list. Sharing is accomplished by publishing on the gopher. To add to a gopher, users would follow an organization's guidelines to produce publishable text files. Embedding hyperlinks within a file is not possible. However, Internet links can be established between organizations (e.g. other dental schools) to permit linking of gophers. For example, the gopher of school X can be a menu item on the gopher of school Y. In sum, gophers can be considered nascent electronic community systems.

### 3. The DEIR construct

The reason for establishing a DEIR is to create an electronic resource that contains information and knowledge useful to the dental community. Constructing the DEIR at a school of dentistry seems logical because this organization will generally have the human and computer resources necessary for development activities. Initially, the DEIR will reside on a single server as this configuration will control development. The DEIR should be managed by a committee that represents the school's administration, departments and library. The committee would be responsible for DEIR organization, content, data submission procedures, editorial activities, and server development.

#### 3.1. **Organization and content**

Information will be organized through a series of hierarchical menus. A menu selection can be either another menu (ends with /), a data file (ends with .), or a way to search a data file (ends with (?)). Keyboard arrows are used to move around the menu. Presently, gophers and their menus are in a constant state of flux as new items are added to resources, new connections are made in the gopher web, and developers explore indexing schemes. Conceivable menus for a DEIR are displayed in Fig. 2.

Administrative content could include faculty meeting minutes, parking and construction announcements, school admission requirements, continuing education offerings, quality assessment and risk management documents, and directories. The dental school's directory could be published along with links to a university directory and a local community directory.

In Academic Programs, each department could publish course syllabi, lecture outlines, research activities of faculty, and manuscripts. Further sophistication could be achieved by having domain experts at different institutions 'commingle' resources

### Main Menu

#### **DEIR (Dental Electronic Information Resource) University School of Dentistry**

1. About Using This **DEIR**/  
Administration/
3. Academic Programs/
- 4: Directories/
5. Library Services/
6. Other Information Resources/

Press ? for Help,      *q* to Quit,      *u* to go up a menu

### Examples of Submenus

#### **1. About Using This DEIR**

1. About DEIR, the School of Dentistry's Gopher.
2. Guides for Using **DEIR**/
3. About Minnesota's Gopher Software.
4. Frequently Asked Questions (FAQ) about Gopher software.

Press ? for Help,      *q* to Quit,      ***u*** to go up a menu

#### **2. School of Dentistry Administration**

1. Announcements & Events/
2. Administration/
3. Admissions/
4. Alumni Relations & Continuing Education/
5. Business and Finance/
6. Computing
- 7: Development/
8. Educational Resources/
9. Minority Affairs/
- 1b. Patient Services/
11. **Research**/
12. Student **Affairs**/

Press ? for Help,      *q* to Quit,      *u* to go up a menu

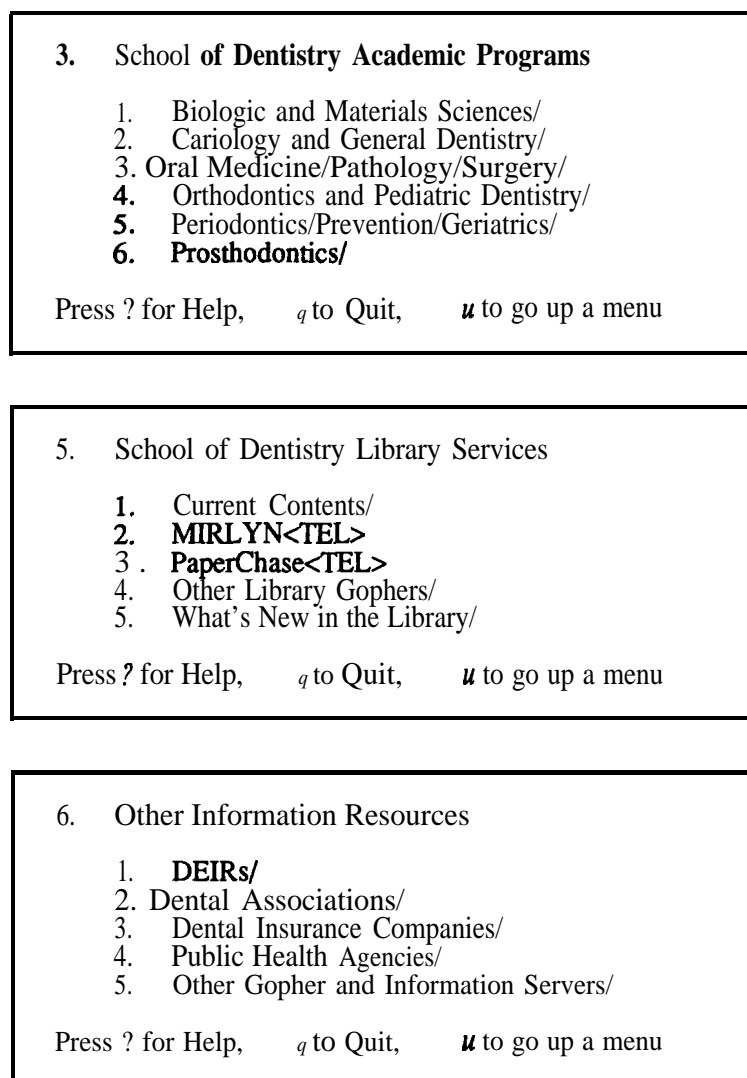


Fig. 2. Examples of menus for a DEIR.

in the menus to create transparently distributed information. For example, within a department's menu, a faculty member could develop an informatics menu that contained menu pointers to useful information and knowledge on DEIRs at other institutions.

Library services could include current contents of journals. The University of Minnesota has published *Current Contents* as an experimental gopher. Author/title, keyword and full text searches are available. Author names, article titles, journals, keywords, authors' addresses, and abstracts can be retrieved. A direct connection

could be made to a university's online library system that would permit access to library catalogs, indexes, and databases. Direct connections to MEDLINE using services like **PaperChase** could also be placed on this menu.

An important feature of a DEIR will be access to other **DEIRs**, gophers, and information servers. As dental schools and dental organizations begin to host servers, direct connections to these servers could be placed on menus. **DEIRs** would be placed foremost on the menu so that browsers could go quickly to other dental resources. Local gopher and information servers could also be listed. A key to developing a broad user community (particularly among general dentists) will be to include information from dental associations, public health agencies, and dental insurance companies. Initially, these organizations might submit 'electronic copy' to the school's DEIR for publication. Eventually, these groups might host their own servers accessible through menu pointers in the DEIR. A dental association could publish news briefs, a calendar of events, members in the news, classified advertisements, and continuing education courses. The dental division of a state health department might publish Medicaid treatment guidelines, health education materials, and schedules for mobile preventive programs that provide fluoride treatments or fissure sealants. Dental insurance companies could publish policies and guidelines related to treatment and reimbursement, lists of newly insured groups, and dates of educational seminars.

Content of the DEIR will be driven by user and developer interest, maintenance costs, and gopher-web growth. The preceding menus only hint at potential content.

<Return>	View current item.
o-9	Move to a line #.
k or Cntrl-p <Up>	Move pointer up.
j or Cntrl-n <Down>	Move pointer down.
u	Go up a level.
m	Go to the <b>first</b> screen.
q	Exit Internet Gopher.
>	Next Page
c	Previous Page
=	Display Technical information about current item.
?	This help screen.
Each object can be identified by its "extension"	
/	Item is a directory.
	Item is a text file.
<?>	Item is a search index.
<CSO>	Item is a CSO phone book.
<TEL>	Item is a telnet session.

Fig. 3. Gopher help commands.

To assist users, help should also be available from any menu. In a typical gopher, help is invoked by pressing ? Fig. 3 displays help commands available in the browsing mode.

### 3.2. **Data submission and editorial boards**

Initially, data will be text files. Contributors will submit hard and electronic copies of files to the DEIR editorial board. All text would be reviewed for conformity to publication standards. Once approved, files would be placed on the server. Eventually, units — administration, departments, library — will develop their own servers as the volume of publishable material grows. Server distribution would be overseen by the original DEIR committee. Each unit would appoint a manager/editor or editorial board. Data revision cycles would be established for all servers. Periodic meetings of all editors with the school DEIR committee would occur. Editorial boards should ideally consist of computer literate domain experts. Members should have experience with text file management including file conversion, down- and uploading to and from remote sites, and basic word processing. As editorial boards migrate to institutional units, content specificity will increase.

### 3.3. **Navigation and searching**

Like current gophers, the DEIR will be menu-based. If a user selects another gopher, that connection would be made transparently across the Internet. Returning up through menus reconnects the user to the original gopher. As the number of gophers grows, the problem of resource discovery will become significant. To address this problem, VERONICA (Very Easy Rodent-Oriented Net-wide Index to Computerized Archives) was developed at the University of Nevada [20].

VERONICA offers a keyword search of most gopher-server menus in the entire gopher web. A VERONICA search automatically generates a gopher menu, customized according to the user's keyword specification. Items on the menu may come from many gopher servers. The items are functional, allowing immediate access via the gopher client [20]. The user will not know which server fills the information request. A VERONICA search is of menu titles not of full-text files. Thus, there is a significant need for very descriptive menu titles.

### 3.4. **Costs**

The cost of electronically storing data is relatively cheap. A current estimate for storage costs of a DEIR is \$1.25/Mb per year. There can be costs associated with data generation based on purchase of data (e.g. **Current Contents, PaperChase**) or production of data (e.g. development time). However, organizations generate data (at a cost) as part of their operation. Savings may be realized by electronic publishing. For example, publishing an electronic copy of faculty meeting minutes may be cheaper than generating several hundred paper copies.

A major cost will be editorial and managerial activities of the DEIR. It is likely that data volume will eventually overwhelm a single editorial board. Thus editorial and managerial responsibilities, content development, and storage (servers) will ultimately be distributed to units of the organization. The institutional editorial board will still oversee consistency of presentation and organization among the many servers of the DEIR.



### 3.5. Access

To access the DEIR, a user must be able to connect to the Internet. The most fortunate user will have his/her computer (with its own IP address) directly connected to the Internet. Other users can connect using public clients. Once connected, navigation and data transmission speeds will be dictated by the type of Internet connection (direct, modem), communication software, and local machine processor speed.

How would a general dentist access a DEIR? In Michigan for example, a dentist could dial into MichNet, a state-wide data network. MichNet dial-in is free, while there are surcharges for using commercial connections like **SprintNet**, **Autonet**, or Michigan Bell. Typical access speeds by telephone range from 1200 to 9600 bits/s. Once connected to the network, a Which Host? prompt appears. If uncertain how to proceed, a user can bring up the MichNet Online Help System by typing ?. The user can then select: (a) MichNet information (contacts, policies), (b) Network Resources (hosts, services, information sources), (c) Access information (dial-in numbers, Internet access) or (d) Announcements (recent or upcoming network changes). Gophers are listed under network resources. Alternatively, the user can go directly to a gopher by entering its name (e.g. UM-GopherBLUE, **UM-ULibrary**). Log-ins and passwords are requested depending on any access restrictions. Then, introductory menus appear.

### 3.6. Users

The viability of any resource will depend upon its value to the user community, but usefulness must be preceded by awareness. There must be skillful marketing of the resource. Access issues are also problematic as many users (general dentists) may not have the means — computers, modems — to get to the resource. This dilemma will only be solved by time. A starting point will be to identify user groups with computers and potential for an Internet connection. These users will include faculty, staff, and students of dental schools. However, infrastructure and potential users are not sufficient for viability. There must be compelling reasons to access the DEIR. An institutional commitment to electronic publishing must be made, and this commitment means that certain information is only available on the DEIR. How would a DEIR be used by various groups?

Faculty would be able to access minutes from meetings, announcements, and other administrative information. Faculty could publish course syllabi and assignments, readings, and class announcements. Manuscripts, preliminary research **findings**, and data **files** could also be published. Menu pointers could be placed that direct users to other pertinent information located anywhere in the world. Faculty would need to be willing to submit materials, keep content and menus current, and use the DEIR.

Staff could retrieve announcements, event schedules, and maintenance schedules (backups, shutdowns) from the institution's computer division. Job descriptions and job postings could be placed on the DEIR along with training and policy manuals. For example, infection control policies could be published on the DEIR and be available for review or downloading from any computer or terminal in the organization. Staff would need a computer and an Internet connection to access the DEIR, be proficient in searching and navigation, and sign on at regular intervals.

Students would be able to retrieve items related to their academic program such as course handouts, syllabi, and reading lists. Likewise, training and policy manuals would be accessible. If sufficient interest were shown, students could publish their own information such as announcements for student organizations and dates of public service clinics (oral screening and mouthguard clinics). Also, materials generated by course requirements could be published including literature reviews and health education program plans. As part of information management courses, student exercises could be developed that would require DEIR 'hunting' and retrieval of information. Student experiences with a DEJR are critical for developing a user constituency among practicing dentists. Limited access to computers could inhibit student use of the resource. Less than one quarter of dental students own computers [21], so students may need to go to a centralized computing area to sign on to the resource. The placement of computers and printers in accessible areas like clinics and public spaces should attenuate this problem.

A significant challenge for the DEIR will be creating awareness and use by dentists in the community. As noted, use of electronic information resources is limited. Marketing efforts will be needed, and could include notices in journals, announcements at professional meetings, and continuing education courses in information access and retrieval. Known groups of users — those with computers and modems — could be mailed instructions for accessing and using the DEIR. Information could also be included in mailings by organizations that are publishing on the DEIR. Given the lengthy timeline of technology transfer in dentistry, it is likely that adoption of electronic information resources by dentists will occur slowly.

### 3.7. *Connections*

It is desirable that the DEIR be integrated with the information environment of the university generally and the health sciences specifically. Integration should extend beyond simply placing menu pointers on other university gophers. Within the health sciences, linkages with Integrated Academic Information Management Systems (IAIMS) would be desirable. IAIMS projects typically reside in academic medical centers, and involve linking of information resources, systems integration, and creation of new organizational units for information management [22–24]. A DEIR should be easily accessible to all users in the health sciences, and be shown on any information source maps developed by the institution.

Connections to resources of the National Library of Medicine (NLM) would be desirable. One link could be a menu pointer to the Educational Technology Network (E.T. Net) maintained by the Educational Technology Branch of the National Library of Medicine. E.T. Net is a conference designed to link developers and users of interactive technology in health science education [25]. Other DEIR links to NLM might include direct Internet connections to MEDLINE.

Connections to DEIRs at other dental schools would be made as these resources are established. DEIRs could be promoted through professional associations of dental research and dental schools. Depending on the portability of the DEIR construct (software code, menu formats), another school could acquire a prototype that could be modified to its particular requirements.

### 3.8. *Evaluation*

A method has been proposed by Perreault and Wiederhold for evaluating infor-

mation systems [26]. Steps include defining measures of success, evaluating the system in a limited test site, evaluating the system in its intended environment, evaluating system performance and user acceptability, and periodic reevaluation.

Measures of success for a DEIR should be defined. For example, numbers of sign-ons and the geographical distribution of users might be measures of interest. Gopher software can collect the date of a sign-on, the IP number or host name of the client that is connecting, and the nature of the retrieved item whether a directory or file. Other measures might include ease of access and adequacy of content.

A prototype DEIR should be constructed for evaluation by a limited set of users. This user set might include faculty, staff, and students of a dental school, several community dentists, and a community dental organization. This limited user group could perform a preliminary assessment — accessibility, navigational ease, content adequacy — from their particular perspective. Once the DEIR is acceptable to the group, it could be connected to the Internet.

A model proposed by Donabedian [27] for evaluating health care may be useful in evaluating a DEIR's performance. The model has three dimensions: structure, process, and outcome. In health care, structure is the adequacy of the setting in which care occurs; process is the adequacy of the services provided; and outcome describes improvements in or maintenance of health. For the DEIR, structural evaluation could include measuring the completeness of information, the logic of menu structures and indexing, and the availability of help and searching. Process evaluation could include measuring ease of navigation, migration of user information sources from traditional to electronic, and reductions in requests for paper-based information. Outcome measures are more difficult to measure but may have administrative and oral health implications. Is the DEIR a more cost-effective way to provide information in an organization? Will users apply its information in ways that improve oral health of the public? User surveys can collect answers to these questions and perceptions of structural and process quality of the DEIR. Evaluation will be, perforce, a continuous, evolutionary process.

#### 4. Conclusions

Electronic resources have not been used significantly by dentists when they need information. Growing awareness of new information management tools in dentistry makes consideration of a dental electronic information resource (DEIR) timely. The Internet gopher client/server model is suitable for constructing a DEIR. Building a user community of dental health professionals in teaching institutions, professional organizations, and the community will be a challenge for developers, but education and marketing activities should increase awareness and use of the resource. Evaluation of a DEIR must be thorough and continuous. In time, linked DEIRs from around the world may become the electronic community system for dentistry.

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## 6. References

- 1 Abbey LM: Mastering change. In ***Dental Informatics. Integrating Technology into the Dental Environment*** (Eds: LM Abbey and JL Zimmerman), Springer-Verlag, New York, 1992, pp. 3-17.
- 2 Kunzel C and Sadowsky D: Dentists' **sources** of information about patient medications and other issues of medical management, ***J Dent Educ***, 55 (1991) 322-326.
- 3 Kiser AL: Dental informatics and the evolution of computers — the roles of organized dentistry. In ***Dental Informatics. Integrating Technology into the Dental Environment*** (Eds: LM Abbey and JL Zimmerman), Springer-Verlag, New York, 1992, pp. 53-64.
- 4 Eklund SA: Is it time for CONFER, a computer-based conference for dental public health? ***J Public Health Dent***, 44 (1984) 73-77.
- 5 Weintraub JA and Eklund SA: Development of a computer-based communication network for a dental specialty group, ***J Dent Educ***, 52 (1988) 525-529.
- 6 Lang WP: An application of computer conferencing in dental education, ***Int J Biomed Comput***, 31 (1992) 221-231.
- 7 Castaldo DA, Coates VH, and Silber SA: The American Dental Network. Dentistry's information source, ***Dent Clin North Am***, 30 (1986) 721-729.
- 8 Chasteen JE: A computer database approach for dental practice, ***J Am Dent Assoc***, 123 (1992) 27-33.
- 9 American Dental Association: Grateful Med performs well for dentists in 6-month study, ***ADA News***, Chicago, October 7, 1991, 26-27.
- 10 Lipton JA: Research frontiers. In ***Dental Informatics. Integrating Technology into the Dental Environment*** (Eds: LM Abbey and JL Zimmerman), Springer-Verlag, New York, 1992, pp. 259-294.
- 11 Makinson OF, Haynes TR and Kirkwood ID: The electronic journal for dentistry, ***Intern Dent J***, 39 (1989) 17-24.
- 12 Halstead CL: ***Diagnostic Aid and Resource Tool (DART)***. Eiden Systems Corp, Charlottesville, VA, 1992.
- 13 University of Michigan Libraries: ***Frequently Asked Questions (FAQ) About Gopher Software***. University of Michigan Libraries, Ann Arbor, 1992.
- 14 Lange BM and Wood RM: Television in continuing dental education: a comparison of three methods, ***Gen Dent***, 36 (1988) 388-389.
- 15 Adamson TE and Gullion DS: Small group teaching via telephone in continuing medical education, ***Mobius***, 2 (1982) 13-19.
- 16 Woolfolk MW, Lang WP, Farghaly MM, Ziemiecki TL, and Faja BW: Varying the format of continuing dental education: Practitioners' perceptions of need and usefulness. ***J Continuing Educ Health Professions***, 11(1991) 215-224.
- 17 Kehoe BP: ***Zen and the Art of the Internet***, Widener University, Chester, PA, 1992.
- 18 Information Technology Division: ***Institutional File System. User Overview***, University of Michigan, Ann Arbor, MI, 1992.
- 19 Schatz BR: Building an electronic community system, ***J Man Info Sys***, 8 (1992) 87-107.
- 20 Barrie F and Foster S: ***VERONICA: Very Easy Rodent-oriented Net-wide Index to Computerized Archives***, University of Nevada, 1992.
- 21 Lang WP, Green TG, and Jacobson JJ: Dental informatics and computer applications: assessing students' knowledge, opinions, and behaviors, ***J Dent Educ***, 52 (1992) 195-199.
- 22 Miller PL, Paton JA, Clyman JI and Powsner SM: Prototyping an institutional IAIMS/UMLS information environment for an academic medical center, ***Bull Med Libr Assoc***, 80 (1992) 281-287.
- 23 Broering NC and Bagdoyan HE: The impact of IAIMS at Georgetown: strategies and outcomes, ***Bull Med Libr Assoc***, 80 (1992) 263-275.
- 24 Roderer NK and Clayton PD: IAIMS at Columbia-Presbyterian Medical Center: accomplishments and challenges, ***Bull Med Libr Assoc***, 80 (1992) 253-262.
- 25 Educational Technology Branch: ***E. T. Net and Nursing Care Research***, National Library of Medicine, 1991.
- 26 Perreault LE and Wiederhold G: System design, and evaluation. In ***Medical Informatics. Computer Applications in Health Care*** (Eds: E Shortliffe and L Perreault), Addison-Wesley, Reading, MA, 1990, pp. 151-178.
- 27 Donabedian A: ***The Definition of Quality and Approaches to its Assessment***, Health Administration Press, Ann Arbor, MI, 1980.