

Case Report ■

Are Chinese Dentists Ready for the Computerization of Dentistry? A Population Investigation of China's Metropolises

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Abstract The authors studied current levels of computerization in dental clinics and the attitudes of dentists towards dental computerization in metropolises in China. A survey consisting of 22 questions was e-mailed or mailed to a random sample of 354 dentists. Of all respondents, 80.5% reported using a computer in their practice. The authors found that administrative tasks were the first to be computerized. A majority of respondents supported the statement that computerization is a benefit to patient care. The authors found that the computerization of dental clinics in Chinese metropolises is a few years behind that of western nations.

■ *J Am Med Inform Assoc.* 2009;16:409–412. DOI 10.1197/jamia.M2827.

Introduction

Computers are an increasingly common feature of health-care systems throughout the world.¹ In addition to clinical care, computerization in clinical practice can also improve both front- and back-room administrative efficiency.^{2–4} In regards to dentistry, computer applications offer benefits in patient registration, admission, computer-based Patient Records (CPR), recalls and regular follow-ups, and knowledge-based clinical decision support systems.^{5–7}

The data from the Ministry of Health (MoH) in China, shows approximately 60,000 active dentists. Meanwhile, there is a sharp increase of graduates starting careers in dentistry. However, access to dental services in China is still low. The development of dentistry in China includes the promotion of information technology. Although the computerization of dentistry within China began in the late 1970s, development was slow until the late 1990s. In 1999, a Dental Computer Technology Board (DCTB) was established by the Chinese

Stomatological Association (CSA). The MoH report “Health Care Development: The 11th Five Year Project” again highlighted the need for a better use of information technology in dentistry.⁸

The aim of this case study was to examine dental computerization in China's metropolises and the attitudes of dentists in these areas towards it.

Methods

The survey was pilot-tested. The questionnaire, designed by three specialists (two in dentistry and one in computer technology) at Wuhan University, was reviewed and revised by another 14 outside specialists (nine in dentistry, three in computer technology, one in survey design, and one in statistics). The final survey and the research protocol were submitted to the Institutional Review Board, Wuhan University.

Selection of Subjects

We included active dentists working in major Chinese cities (282 cities and 4 municipalities). Dentist: population ratios range between 1:25,000 to 1:9,000 in these cities and municipalities. We screened a sample of 738 dentists, two–three from each city and eight–ten from each municipality. Names were obtained from a published manual “China Dental Information 2005”, assisted by a random number table. The questionnaire, with a cover letter was e-mailed or mailed to the selected sample.

Questionnaire

The questionnaire consisted of 22 questions grouped into four categories: practice characteristics, computerization of clinical and administrative tasks, internet use, and attitudes toward computer application (please refer to online appendix).

Statistical Analysis

Frequency tables and descriptive statistics were generated for the collected data. The SPSS statistical package (SPSS for windows 13.0, SPSS Inc, Chicago; United States) was adopted and the significance level was 0.05. The differences between groups were analyzed using Pearson's χ^2 -test.

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Supported both by the Open Funding granted by Moe Key Laboratory for Image Processing and Intelligent control, Huazhong University of Science and Technology, and by the Hi-Tech Research and Development Program of China [Grant No. 2006AA02Z347]. Jian Hu and Hao Yu contributed equally to this work.

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Received for review: 04/13/08; Accepted for publication: 01/28/09.

Table 1 ■ Subject Demographic and Practice Information

Practice Characteristics	Study Sample	
	%	N ³⁵⁴
Work Sector		
Government Hospital	75.7	268
Private Clinic	24.3	86
Age		
below 30	21.2	75
30–39	40.1	142
40–49	19.5	69
50–59	15.5	55
60 and above	3.7	13
Sex		
Male	62.7	222
Specialties		
General	41.8	148
Prosthodontics	23.2	82
Endodontics	16.4	58
Surgery	8.2	29
Orthodontics	9.0	32
Others	1.4	5

Results

Forty-eight percent of subjects (354/738 dentists) responded to the questionnaire, covering 201 cities and 4 municipalities.

Practice Characteristics

Table 1 presents the subjects' demographic and practice information. Majority (285/354) of the sample used a computer in their practice. Only a small portion (94/354) had chair-side computers. Chair-side computers were more likely to be adopted by a Government Hospital rather than a private practice ($p < 0.001$).

Internet Use

Only a few computerized respondents reported having internet access in their dental offices (74/285). Fewer (40/285) had internet access from a chair-side computer. However, over half (239/354) of the respondents had their own website or Bulletin Board Service (BBS) online, for advertisement and patient education. Larger practices (generally within Government Hospitals) were more likely to have websites than private practices ($p < 0.001$).

Nearly one-third (23/74) of the practices with internet access used e-mail for clinical purposes. E-mail communication with colleagues was cited as the most frequent usage. Two thirds (50/74) of Internet users used online searchable bibliographic databases. MEDLINE was their first choice for international publications.

Computerization of Clinical and Administrative Tasks

Table 2 details the specific clinical and administrative tasks that subjects were asked about in the questionnaire. Contrasting clinical functions, administrative tasks were the first to be computerized in both types of practices. Less than half (115/285) of the respondents having computers in their offices used CPR in their daily practices, but the other half (140/285) wanted to have this function within two years.

Attitudes towards Computerization of Dental Practice

Table 3 details respondents' statements and attitudes towards computers in clinical use. A majority of both CUs

Table 2 ■ Current Status and Future Intentions of Computerization in Clinical Practice

Function	Overall (N = 285)			Private Practice (N = 72)			Government Hospital (N = 213)			Private Practice Versus Government Hospital		
	Function Already Computerized			Function Already Computerized			Function Already Computerized			Function Already Computerized		
	Yes	Number, but Intends to Computerize Within 2 yrs	p Values	Yes	Number, but Intends to Computerize Within 2 yrs	p Values	Yes	Number, but Intends to Computerize Within 2 yrs	p Values	Yes	Number, but Intends to Computerize Within 2 yrs	p Values
Clinical												
Recording dental history	179 (62.8%)	91 (31.9%)	36 (50.0%)	21 (29.2%)	143 (67.1%)	0.009	70 (32.9%)	0.009	< 0.001			
Making treatment plans	153 (53.7%)	68 (24.2%)	51 (70.8%)	21 (29.2%)	102 (47.9%)	0.001	47 (22.1%)	0.001	0.222			
Receiving electronic information (such as laboratory results or specialist reports)	41 (14.4%)	106 (37.2%)	17 (23.6%)	37 (51.4%)	24 (11.3)	0.010	69 (32.4%)	0.010	0.004			
Taking intraoral/extraoral images	222 (77.9%)	57 (20.0%)	58 (80.6%)	8 (11.1%)	164 (77.0%)	0.529	49 (23.0%)	0.529	0.032			
Taking radiographs	214 (75.1%)	70 (24.6%)	49 (68.1%)	23 (31.9%)	165 (77.5%)	0.111	47 (22.1%)	0.111	0.092			
Oral Health education	99 (34.7%)	105 (36.8%)	38 (52.8%)	34 (47.2%)	61 (28.6%)	< 0.001	71 (33.3%)	< 0.001	0.035			
Administrative												
Patient registration	258 (90.5%)	25 (8.8%)	60 (83.3%)	9 (12.5%)	198 (90.1%)	0.016	16 (7.5%)	0.016	0.196			
Appointment scheduling	181 (63.5%)	71 (24.9%)	42 (58.3%)	32 (44.4%)	139 (65.3%)	0.291	39 (18.3%)	0.291	< 0.001			
Billing and payment system	261 (91.6%)	22 (7.7%)	62 (86.1%)	8 (11.1%)	199 (93.4%)	0.053	14 (6.6%)	0.053	0.212			
Stock and store control	107 (37.5%)	31 (10.9%)	50 (69.4%)	19 (26.4%)	57 (26.8%)	< 0.001	12 (5.6%)	< 0.001	< 0.001			

Table 3 ■ Attitudes toward Computer Use in Clinical Practice

Attitude Statement	Proportion of Respondents Who Agree with the Attitude Statements						Computer Users Versus Nonusers p Value
	All ³⁵⁴		Computer Users ²⁸⁵		Non-Users ⁶⁹		
	n	%	n	%	n	%	
Computers are a benefit to patient care							
Computers offer more advanced devices for application in the clinic (such as CAD/CAM and digital radiographs)	312	88.1	254	89.1	58	84.1	0.211
Computers create a great impression with patients	320	90.4	271	95.1	49	71.0	< 0.001
Computers enable dentists to update their knowledge and communicate with colleagues	259	73.2	213	74.7	45	65.2	0.111
Computerization negatively impacts clinical treatments							
Using a computer means longer consultations	74	20.9	60	21.1	14	16.3	0.889
A computer is not necessary in clinical procedures	25	7.1	12	4.2	13	18.8	< 0.001
A patient may not be used to receiving their treatment assisted by computer	49	13.8	21	7.4	28	40.6	< 0.001
Using a computer can negatively influence the communication between dentists and patients	206	58.2	141	49.5	65	94.2	< 0.001
Reasons why adoption of information technology is slow							
the cost of computerization is great	205	57.9	148	51.9	57	82.6	< 0.001
Effectiveness will not improve by adopting computers	117	33.1	73	25.6	41	59.4	< 0.001
More problems will arise (such as the security of CPR, the exchange of digital files and data)	139	39.3	117	41.1	22	31.9	0.162

CAD/CAM = computer-aided design/computer-aided manufacturing; CPR = computer-based patient records.

(Computer-users) and NUs (Non-users) supported the statement that computerization is a benefit. In contrast, statements concerning the potential negative effect of computerization had a significantly lower level of inter-agreement between CU's and NU's, indicating apparently divergent cognitions on the negative impacts of computers. Meanwhile, we found that younger dentists presented more positive attitudes towards computer use (age ≤ 40 v. age > 40 , $p < 0.05$), and detected no differences between specialties in dentistry ($p > 0.05$).

Discussion

We assumed that globalization and information technology had shrunk the distance between east and west. However, few reports reveal the status of dental computerization in China, which has the greatest population in the world. It is significant for dentists, informaticians, and dental IT investors to have a general picture of the progress of dental computerization in China. This case study indicates a considerable level of dental computerization in China's metropolises.

We found that a majority of respondents had computers in their offices, while a minority used chair-side computers. Data are similar to Schleyer's 2006 report for the United States.^{9,10} Data suggest that China, although an undeveloped country, has an equal opportunity to progress dental informatics as does the west. China's great population seems to create a larger market for dental IT investors. This survey reveals that computerization is more likely to be adopted by Government Hospitals, probably because of financial support from government, than by private clinics. Additionally, few respondents adopt CPR or use the internet for clinical service. Thus China may implement dental computerization in ways that differ from the west. Further research concerning this topic must take

many factors into consideration, including politics, economics, culture, and patients' education levels.

In China, government hospitals receive a much higher number of patient visits than private clinics. It is urgent for them to adopt information technology to assist and streamline administrative affairs. The competitive advantage of a private practitioner lies in service delivery. Investment in technology to assist in clinical service delivery offers a great return. Differences detected between two types of practice on certain issues inform us that we must have diverse thinking in developing and applying information technology under different dental clinical environments.

Dentists' attitudes are a decisive factor to implementing dental computerization.¹⁰ We found that Chinese dentists' attitudes were generally positive. The negative impacts of computer use may be amplified by some nonusers, but proper instruction in computer use may reduce resistance. The enthusiastic attitudes of younger Chinese dentists anticipates a favorable future for dental computerization in China.

References ■

1. IOM. Crossing the Quality Chasm: A New Health System for the 21st Century. Washington, DC: National Academy Press, 2001.
2. Mitchell E, Sullivan F. A descriptive feast but an evaluative famine: Systematic review of published articles on primary care computing during 1980–97. *BMJ* 2001;322(7281):279–82.
3. Thakurdas P, Coster G, Gurr E, Arroll B. New Zealand general practice computerisation; attitudes and reported behaviour. *NZ Med J* 1996;109(1033):419–22.
4. Sullivan F, Mitchell E. Has general practitioner computing made a difference to patient care? A systematic review of published reports. *BMJ* 1995;311(7009):848–52.
5. Delpierre C, Cuzin L, Fillaux J et al. A systematic review of computer-based patient record systems and quality of care:

- More randomized clinical trials or a broader approach? *Int J Qual Health Care* 2004;16(5):407–16.
6. Balas EA, Austin SM, Mitchell JA et al. The clinical value of computerized information services. A review of 98 randomized clinical trials. *Arch Fam Med* 1996;5(5):271–8.
 7. Bossen C. Evaluation of a computerized problem-oriented medical record in a hospital department: Does it support daily clinical practice? *Int J Med Inform* 2007;76(8):592–600.
 8. MoH. Of People's Republic of China, health care development: The 11th five years project. Available at: 2007.<http://www.moh.gov.cn/newshtml/19160.htm>. Accessed Nov 10, 2007.
 9. Schleyer TK, Thyvalikakath TP, Spallek H, Torres-Urquidy MH, Hernandez P, Yuhaniak J. Clinical computing in general dentistry. *J Am Med Inform Assoc* 2006;13(3):344–52.
 10. Schleyer TK. Why integration is key for dental office technology. *J Am Dent Assoc* 2004;135(Suppl):4S–9S.