

# Perceived Knowledge, Attitude and Barriers Among Dentists Towards Handling Digital Information – A Saudi Arabian Perspective

Sharat Chandra Pani<sup>1</sup>, Bander AlAbdulwahhab<sup>2</sup>, Ebtsam AlEdaili<sup>1</sup> and Fahdah AlQahtani<sup>1</sup>

<sup>1</sup>Riyadh Colleges of Dentistry and Pharmacy, Riyadh, Saudi Arabia, <sup>2</sup>Dental Department, Royal Clinics for the Custodian of The Two Holy Mosques, Saudi Arabia

## Abstract

**Aim:** This study aimed to address the perceived knowledge, attitude and barrier gap towards the adoption and use of digital dental information among dentists across Saudi Arabia.

**Methods:** A questionnaire of 25 questions was developed to assess knowledge, attitude and barriers of dental professionals towards the digitalization and/or the computerization of dentistry. A proportional stratified random sampling technique was used with stratification according to the region. Questionnaires were distributed among dentists in the Riyadh (n=255), Makkah (n=155), Eastern Province (n=50), Abha (n=66) and Hail (n=55) regions of the Kingdom of Saudi Arabia.

**Results:** A total of 581 dentists completed the study (383 males and 198 females). The mean knowledge score was 6.74 (+/-3.4) out of a maximum of 14; while the mean attitude score was 29.54 (+/- 3.7) out of a maximum score of 35.

**Conclusion:** The results of this study indicate that even in a country that is heavily invested in the digitalization of dental information, knowledge on the subject remains low and steps need to be taken to educate the dental workforce

*Key Words: Digital dental information; Dental informatics; Knowledge attitude perception; Saudi Arabia*

## Introduction

Computers and the Internet have changed many aspects of our life and dental practice is no different. As early as the 1970s, programs were being developed and used in Europe and the USA for the management of hospital data, giving rise to the field of Health Informatics (HI) [1]. Even though the first IT applications in healthcare were mainly administration and financial oriented, gradually, clinically oriented systems emerged establishing HI as a medium for enhanced and quicker sharing of health records [2]. Scheyler states that the term “dental informatics” was first used by Zimmerman et al in 1986 to describe the dental applications of the concepts of Mikhailov who defined informatics as the “study of the structure and general properties of scientific information and the laws and processes of scientific communication” [3].

The history of computer technology in Saudi Arabia dates back to the 1940s, when Saudi Aramco introduced the electrical tabulated machines, followed by the installation of the first mainframe in Dhahran in the 1950s [4]. Since the first internet connection in Saudi Arabia was made at the King Fahd University of Petroleum and Minerals in 1993, the process of digitalization has rapidly emerged in across the health-care sector [5]. The ministry of health, the largest healthcare provider in Saudi Arabia has developed a, National e-health strategy which aims at digitalization of patient records to enable better connectivity among health care professionals, improve evaluation of healthcare delivery and overall care given to patients [6]. Pilot programs for complete digitalization of patient records and communication between healthcare professionals are already in place [7]. Dentistry is part of this changing health care scenario in Saudi Arabia, and it is safe to assume that dental professionals in Saudi Arabia would need

to be prepared to meet the challenges that digitalization would bring about.

An understanding of the goals of dental informatics is essential for the dental researcher to understand how the digitalization of dental practice can be transformed into daily practice [3]. Saudi Arabia is a large country with a population of around 28.2 million individuals, over half this population is under the age of 12 years [8]. The Kingdom of Saudi Arabia also has a land area of 2,149,690 km<sup>2</sup> making it the largest country in the Arab world. Recently the government of Saudi Arabia has embarked on a process of digitalization of information in the health care sector [9]. However, little data exists on the knowledge, attitude and perceived barriers among dental practitioners in Saudi Arabia towards the digitalization of dental practice. This study aimed to address the above mentioned gap in literature and the impact this could have on the efficacy of the digitalization process that is underway among both private and governmental institutions in the Kingdom.

## Methodology

The study was registered with and received ethical clearance from the research center of the Riyadh Colleges of Dentistry and Pharmacy and was registered as project number UGSRP/13/59. The study was carried out between September 2013 and January 2014.

### Development of the questionnaire

A questionnaire of 25 questions was developed to assess knowledge, attitude and barriers of dental professionals towards the digitalization and/or the computerization of dentistry using previously published literature [10-12]. The questionnaire was divided into 14 questions that tested knowledge, 7 questions

that tested the attitude and 8 questions that looked at the barriers faced by the dental professionals in applying digital dentistry to their practice. The questions regarding perceived knowledge were scored as 1 mark for a yes answer and 0 for an answer of “no” or “not sure”. The total knowledge score was then obtained by adding the scores of each individual question in the knowledge section. Attitude and Barriers were scored on a 5 point likert-type scale (strongly agree to strongly disagree) with 5 indicating the most positive attitude and barrier while 1 indicated the most negative attitude and barrier. In addition demographic data including gender, age, years of practice and location of practice of the participants were collected.

#### **Reliability of the questionnaire**

The questionnaire was validated for reproducibility on a sample of 20 general dental practitioners who were given the questionnaire after a gap of three weeks. The Cronbach's alpha was used to measure the overall reproducibility of the questionnaire. The Chronbach's alpha was found to be 0.8 which showed acceptable reliability for a new questionnaire. These questionnaires were not used in the final study.

#### **Distribution of the sample**

The sample power calculation was based on the minimum number of questionnaires required to obtain a 95% confidence interval with an alpha value of 0.05 in a population which was 500. To factor in non-response by participants a total of were distributed across 5 different regions of Saudi Arabia.

A proportional stratified random sampling technique was used with stratification according to the region (five of the 13 regions in the Kingdom were chosen) and proportion according to the distribution of the dental workforce [13]. Questionnaires were distributed among dentists in the Riyadh (n=255), Makkah (n=155), Eastern Province (n=50), Abha (n=66) and Hail (n=55) regions of the Kingdom of Saudi Arabia. The number of questionnaires distributed in each region was proportional to the number of dentists registered with the Saudi Commission for health specialties in each region.

Informed consent was obtained from each of the participants before administration of the questionnaire. A total of 581 completed responses were obtained giving a response rate of 96.8%.

#### **Statistical analyses**

All data collected was processed using the Statistical Package for Social Sciences (SPSS) ver.20 data processing software (IBM corp. Armonk, NY). The mean knowledge, attitude and barriers among the different groups was calculated and tested for significance among groups using the one way Analysis of Variance (ANOVA). The barriers to dental informatics were further ranked by using the Friedman test to calculate the mean rank of each barrier. A linear regression analysis was performed with age as the dependent variable to assess the influence of age on the knowledge, attitude and barrier perception of the participants.

## **Results**

A total of 581 dentists completed the study (383 males and 198 females). The mean age of the sample was 33.6 years (range: 22-62 years) and had been practicing on average for

10.3 years (range 1 - 40 years). Of the 581 respondents, 440 had received some form of computer training. The sample was divided into those who were board certified (n=84), held a PhD (n=28), master degree (n=138) bachelor degree (n=331). They had received their dental training either in Saudi Arabia (n=346), or abroad i.e. Asia/ Middle East (n=156) and 79 in USA/Europe/Australia (n=79). The ministry of health had the largest number of participants (n=284) followed by those in the private sector (n= 113), university faculty (n=87), national guard (n=41), military (n=24), ministry of interior (n=20) and King Faisal Specialist hospital (n=12).

When the knowledge of the entire sample was assessed it was seen that the sample had a mean knowledge score of 6.74 (+/-3.4) out of a maximum of 14. However, the values ranged from 1 to 14 with the median value being 6 and the modal value being 5, suggesting a poor perception of knowledge about dental informatics among the population. When specific demographic variables were assessed it was seen that dentists practicing in the Abha region had significantly higher perceived knowledge than those in the other regions (7.77 +/- 3.5) however this score was still lower than specific institutions (in the central region) such as the king Faisal Specialist hospital (9.45 +/- 3.93). Age of the dentist, number of patients seen daily, any previous training in computer skills and the country of acquiring their academic degree did not have a significant effect on the perceived knowledge of digital dental information among the respondents (*Table 1*).

When the attitude of the respondents towards digital dental information was assessed it was found the respondents had a mean attitude score of 29.54 (+/- 3.7) out of a maximum score of 35. It was also observed that the scores ranged from 17 to 35 with a modal score of 28, suggesting that despite the apparent lack of perceived knowledge there was a positive attitude towards digital dental information. It was found that numbers of patients seen daily influenced attitude of the respondents towards digital dental information, with a more positive attitude being reported as the number of patients seen was greater. Dentists trained in the United States, Europe and Australia showed a significantly more positive attitude than those trained in Saudi Arabia or elsewhere in the Middle East. The institution in which they practiced also seemed to influence the attitude of the dentists towards digital dental information, with the respondents from King Faisal specialist hospital reporting significantly higher (33.5 +/- 2.5) attitude scores than those in the other institutions (*Table 2*). Practitioners who saw more than 20 patients per day also reported higher attitude scores than other practitioners.

When the total score of barriers towards the use of digital dental information were assessed, it was seen that dentists in the Abha region reported significantly lower barriers (30.6 +/- 3.8) towards handling of digital dental information than their compatriots in other regions. It was also seen that dentists who reported seeing more than 20 patients per day had the highest reported barrier scores (32.2 +/-6.3) (*Table 3*).

The sector in which the respondent worked had the most significant impact on the perception of barriers towards digital dental information with those in the King Faisal specialist hospital reporting significantly higher perception of barriers towards digital dental information (*Table 3*).

Table 1. Factors affecting perceived knowledge of dental informatics among the respondents.

Characteristics		Number	Percentage	Mean Knowledge Score	Standard Deviation	F	P Value
Gender	Male	383	65.9	6.72	3.52	.041	.840
	Female	198	34.1	6.78	3.29		
Region	Centre	255	43.9	6.87	3.47	2.579	.037*
	West	155	26.7	6.21	3.10		
	South	66	11.4	7.77	3.56		
	North	55	9.5	6.56	3.74		
	East	50	8.6	6.58	3.58		
Number patients seen daily	<4	120	20.7	6.47	3.12	.784	.503
	5-10	296	50.9	6.96	3.41		
	11-20	139	23.9	6.55	3.63		
	>20	26	4.5	6.62	4.14		
Where did you obtain your highest dental academic degree	In Saudi Arabia	346	59.6	6.62	3.33	.560	.572
	USA/UK/Europe/Australia	79	13.6	6.94	3.75		
	Asia/Middle East and North Africa	156	26.9	6.92	3.52		
Institution	Ministry of health	284	48.9	11.33	6.72	5.983	.0001*
	Military	24	4.1	9.50	5.52		
	National Guard	41	7.1	10.58	4.90		
	Ministry of Interior	20	3.4	9.95	4.35		
	University	87	15.0	8.90	5.08		
	King Faisal Specialist Hospital	12	2.1	9.08	3.99		
	Private institution	113	19.4	11.00	5.06		
Degree	Bachelor	331	47.2	10.59	6.16	1.388	.227
	Master	138	23.8	11.63	5.78		
	P.H.D	28	4.8	9.17	4.72		
	Board	84	14.5	9.57	5.51		
Any training in computer skills	No	141	24.3	10.46	6.06	.029	.865
	Yes	440	75.7	10.77	5.90		

\*significant at  $p < 0.05$  using the One-Way ANOVA

Table 2. Factors affecting attitude towards dental informatics among the respondents.

		Mean Attitude Score	Standard Deviation	F	p
Gender	Male	29.52	3.60	.066	.798
	Female	29.44	3.87		
Region	Centre	29.14	4.02	1.916	.106
	West	29.81	3.61		
	South	30.05	2.53		
	North	30.11	3.48		
	East	28.94	3.55		
Number patients seen daily	<4	28.68	4.29	2.908	.034*
	5-10	29.57	3.54		
	11-20	29.94	3.23		
	>20	30.04	4.32		
Where did you obtain your highest dental academic degree	In Saudi Arabia	29.16	3.75	3.915	.020*
	USA/UK/Europe/Australia	30.29	3.77		
	Asia/Middle East (except Saudi Arabia) (including North Africa)	29.83	3.45		
Institution	Ministry of health	29.52	3.59	6.481	.0001*
	Military	27.40	4.12		
	National Guard	31.46	3.81		
	Ministry of Interior	27.45	3.44		
	University	29.01	3.94		
	King Faisal Specialist Hospital	33.50	2.54		
	Private institution	29.56	3.36		

		Mean Attitude Score	Standard Deviation	F	p
Gender	Male	29.52	3.60	.066	.798
	Female	29.44	3.87		
Region	Centre	29.14	4.02	1.916	.106
	West	29.81	3.61		
	South	30.05	2.53		
	North	30.11	3.48		
	East	28.94	3.55		
Number patients seen daily	<4	28.68	4.29	2.908	.034*
	5-10	29.57	3.54		
	11-20	29.94	3.23		
	>20	30.04	4.32		
Where did you obtain your highest dental academic degree	In Saudi Arabia	29.16	3.75	3.915	.020*
	USA/UK/Europe/Australia	30.29	3.77		
Degree	Dental student	30.18	3.83	1.642	.147
	Diploma	29.31	3.57		
	Bachelor	29.33	3.90		
	Master	29.85	3.07		
	P.H.D	30.88	4.10		
	Board	29.31	3.88		
Any training in computer skills	No	29.21	3.76	1.192	.275
	Yes	29.66	3.68		

\*significant at  $p < 0.05$  using the One-Way ANOVA

Table 3. Factors influencing perceived barriers towards dental informatics among the respondents.

		Mean Barrier Score	Standard Deviation	F	p
Gender	Male	31.43	4.52	.753	.386
	Female	31.78	4.56		
Region	Centre	31.22	4.69	2.641	.033*
	West	32.12	4.76		
	South	32.64	3.38		
	North	30.65	3.81		
	East	31.02	4.71		
Number patients seen daily	<4	31.62	4.50	.885	.347
	5-10	31.11	4.74		
	11-20	30.49	4.67	3.287	.020*
	>20	31.98	4.33		
Where did you obtain your highest dental academic degree	In Saudi Arabia	31.44	4.34	.983	.375
	USA/UK/Europe/Australia	32.15	6.34		
	Asia/Middle East (except Saudi Arabia) (including North Africa)	31.49	4.62		
Institution	Ministry of health	32.20	4.75	4.978	.0001*
	Military	28.80	3.39		
	National Guard	33.11	4.56		
	Ministry of Interior	29.85	3.22		
	University	30.40	4.91		
	King Faisal Specialist Hospital	36.67	3.82		
	Private institution	32.07	4.17		
Degree	Bachelor	Bachelor	31.38	1.658	.143
	Master	Master	32.05		
	P.H.D	P.H.D	32.67		
	Board	Board	31.56		
Any training in computer skills	No	No	31.10	1.413	.235
	Yes	Yes	31.77		

\* significant at  $p < 0.05$  using the One-Way ANOVA

The barriers were then ranked according to sector in which the respondent worked and it was found that respondents in different sectors had different perceptions of barriers towards digital dental information. Except for respondents in the

military and in private practice, all other sectors reported that lack of information about digital dental information was the greatest perceived barrier (Table 4).

The linear regression model with age as a dependent

Table 4. Barriers to dental informatics ranked according to each sector\*.

	Ministry of health	Military	National Guard	Ministry of Interior	University	King Faisal Specialist Hospital	Private
Lack of information about Dental Informatics	3.76	3.44	3.84	3.75	3.70	4.13	3.68
Lack of computer skills	3.59	4.21	3.49	3.70	3.68	3.46	3.69
Lack of interest	3.62	3.67	3.40	3.93	3.56	3.54	3.67
Lack of time	3.12	2.79	3.16	3.18	3.18	3.46	3.35
Lack of governmental recognition and approval	3.40	3.60	3.37	3.23	3.49	3.38	3.29
Lack of organization recognition and	3.51	3.29	3.74	3.23	3.39	3.04	3.32

\* Ranks Calculated using the Friedman Test

Table 5. Linear Regression Model showing the impact of age on knowledge and attitude.

Model	Coefficients <sup>a</sup>			t	Sig.
	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta		
(Constant)	23.693	2.812		8.424	0
KNOWLEDGE	0.015	0.055	0.012	0.279	0.78
Attitude	-0.269	0.112	0.133	2.407	0.016
barriers	0.037	0.092	0.022	0.399	0.69

a. Dependent Variable: age

variable showed that while the age of the dentist had no significant impact on either knowledge ( $p=.780$ ) or perception of barriers ( $p=.690$ ). However there was a significant negative association between age and attitude score (Table 5).

## Discussion

This study was conducted to assess the knowledge, barriers and attitude towards the use of digital dental information among Saudi dental professionals. Saudi Arabia is the largest country in terms of land area in the Arab world and has the second largest population, served largely by governmental healthcare providers that include the Ministry of Health, Ministry of Interior, Military and an emerging private sector [9]. This study aimed at obtaining a representative sample from each of these sectors. Since the ministry of health provides 60% of all dental care in Saudi Arabia, it was decided to distribute the greatest part of the questionnaire among dental professionals from the ministry of health [9,13]. Professionals from the Ministry of Interior, National Guard, military and the private sector were also included in this study. The King Faisal Specialist Hospital is a tertiary referral center which is an autonomous body that started its program of complete computerization in 2010 [7]. It was for this reason that it was decided to include a sample of dentists from this institution.

Knowledge of dental practitioners about digital dental information varied significantly among the different regions. The dental practitioners in Abha region in the south of Saudi demonstrated the highest reported level of knowledge about digital dental information. The results are important in view of the findings of Scheyler et al. [12] who showed that regardless of computer literacy over 78% of dentists in the United States used computers and/or electronic methods to keep track of patient data. The Abha region is a relatively less densely populated mountainous region comprised of several small towns, compared to the other, more urban regions studied. Given this fact, our results are contrary to those of Gibson et al. who stated that people in larger cities and capitals might

be able to have access to the internet and are more trained to use computers more than those in smaller cities and towns [10]. But more recent literature from China showed that the spread of computer use in dental practice is often the result of a policy by the government or clinic management rather than the dentists' comfort with the use of computers [11]. The finding of a greater perceived knowledge in the region farthest removed from the capital city must be viewed in the light of two findings unique to the healthcare model in Saudi Arabia. Firstly the large influence of the government sector makes the adoption of technology uniform across the Kingdom [13]. Secondly there has been a concerted effort to increase broadband connectivity across Saudi Arabia, with efforts to digitalize banking commerce and governmental services beginning as early as 2007 [14].

In 2007, Giles and Howard pointed out that the use of computerized digital dental information would depend on how practitioners were modeled. They stated that a busy practitioner might see the use of computers as a boon or a bane depending on how he or she was trained [15]. The fact that in our study practitioners who saw more than 20 patients per day had the most positive attitude towards digital dental information is an encouraging sign. However, these practitioners were also more likely to see barriers towards the implementation of digital dental information. In general there seemed to be a very positive attitude towards the adoption of digital dentistry in particular and digital dental information in general. This could possibly be explained in the light of the findings of Sait et al., who termed the internet and digital revolution in Saudi Arabia as a social change [16]. Interestingly previous formal training in computer skills did not seem to significantly influence perceptions of knowledge, attitude or barriers among the respondents.

Barriers and/or obstacles can hinder many dental practitioners from using information technology, thus it was important to assess the factors that are perceived as barriers to the adoption of digital dental information. It was observed

that the sector of work significantly influenced the way in which barriers were perceived. While lack of information was universally recognized as the greatest barrier to the implementation of digital dental information, the extent to which it was perceived as a barrier varied significantly among respondents from different sectors. The case of King Faisal Specialist hospital is interesting in this regard. As a semi-autonomous body with a futuristic vision, it was the first institution in the Kingdom to implement a pilot digitalization program [7]. The doctors were the most knowledgeable about digital dental information and had experience with a fully digitalized system. However, they were also more likely than any other to see lack of information about digital dental information as a barrier to its implementation. This seems to suggest that implementation of the digitalization process, leads to a greater recognition of the limitations of the process and challenges in adapting to the process.

Interestingly, while a significant association existed between age and attitude towards dental informatics, this

change in attitude did not result in a corresponding increase in knowledge or decrease in the perception of barriers towards dental informatics.

### Conclusion

The results show that there is a considerable effort being made by the different governmental agencies to digitalize dentistry in Saudi Arabia and to implement the use of computerized digital dental information. However, the knowledge of computerized digital dental information remains low and steps need to be taken to educate the dental workforce.

Saudi Arabia is relatively wealthy country with a comparatively small population and high per-capita income. The digitalization of information though is a global phenomenon, and the results of this study may not be applicable in other countries. Further research in different countries, keeping in mind socio-demographic parameters is needed to fully understand the impact that digitalization of dental information will have on the dental workforce.

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