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TO COMPARE THE ACCURACY OF MEDICAL HISTORY DATA COLLECTION USING PAPER VERSES ELECTRONIC METHODS IN A CLINICAL DENTAL ENVIRONMENT

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ABSTRACT

Aims: This study compared the accuracy of paper verses digital methods of medical history gathering from dental patients.

Method: Two practices routinely used paper documents, the third routinely used an ipad to gather the same information, erroneous responses were compared after verbal confirmation.

Results: 44 individuals (20.3%) of the ipad group reported one or more erroneous result, compared to 45 (14%) using a paper format. A t-Test with degrees of freedom and 0.01 gave t=0.3931 indicating no significant difference, thus supporting the null hypothesis.

Conclusion: This report suggests there is no significant difference in the accuracy of self reporting on medical histories by dental patients using an ipad, digital method, when compared with a paper-based format.

Aim: The aim of this study was to test the null hypothesis that there is no difference between accuracy and validity of dental patient medical histories when collected using a paper-based collection method to that of a digital method.

KEYWORDS :

INTRODUCTION

Medical histories have historically been gathered from dental patients using paper questionnaires. With the growing advent of technologies and the environmental motivation for the paperless office, digital information gathering has been on the increase in the dental profession. Martin[1] reported in 2002 that 3% of Canadian physicians only used electronic media to store active patients records, whilst 24% used a combination of electronic and paper, with the majority of physicians (69%) using only paper. This research, however, now somewhat dated was focused on data storage rather than data collection. Moreover, some automated verbal medical history systems[2] have been reported as being as accurate in data collection as that achieved by personal interview or self-completed questionnaire. Indeed, Rockhard et.al.[3] did however admit, that conflicting responses were sometimes returned when patients were subsequently verbally questioned following an initial automated return. Further, it was also suggested that whilst automated systems were as accurate as traditional verbal methods, a greater number of false positives and false negatives were generated; whilst this was deemed an inevitable association with automated systems, it was noted that the number of variance correlated to the diligence of the recording physicians in the interpretation of the automated data.

For the dental care professional, medical histories are important for a number of reasons. For a clinician, these documents can provide insights into a patients general health through the medications that may have been prescribed from their medical practioner[4], often suggesting explanations for clinical pathology such as in cobbling of the buccal muscosa often associated with IBS[5] ; they can also highlight risks of drug incompatibilities, and provide valuable background information were a medical emergency to develop whilst the patient is at the practice. De Jong et.al. [6] investigated the validity of a verbal patient based medical history, which is considered the 'Gold Standard', comparing the results with a paper-based equivalent in Belgium, the conclusion indicated the sensitivity and specificity to be 88 per cent and 98 per cent respectively. Muter and Maurutto[7] compared the reading and absorption of paper based and computer screen information, concluding that comprehension were equivalent for the high-quality cathode ray tubes (CRTs) and a paper based presentation. Kenyan research by Njuguna[8] compared smart phone to paper-based data collection, concluding that "the electronic data collection system produced fewer incomplete data, fewer errors and inconsistent responses". Lane et.al[9] concluded that an electronic handheld device is an effective alternative to paper based data collection, and is preferred by

most users; Rivera et.al. [10] supported this, arguing that a digital based data collection instrument reduced the time spent on data gathering and significantly improved the data integrity. However, according to Patel et.al.[11] maintained that differences in the content and format, influenced data gathering strategies.

METHOD

Comparable patient medical history questionnaires were completed by patients attending three stand alone, primary dental care facilities in South West England. One practice employed an electronic data capture system accessed via an *ipad*, the remaining two facilities used an identical paper based medical history document. Each data collection method and format presentation to the patient was routine to that particular practice. Patients were asked to complete/update their personal medical history on arrival at the practice for either a routine dental examination, emergency appoint or regular dental treatment if they had not been seen by the attending dental surgeon prior to this attendance episode. The same male clinician attended patients simultaneously across all three sites on separate clinical days, during the same calendar period. The study cohort comprised all patients who were booked in for treatment with this specific dental practitioner during normal routine clinical sessions. Medical histories were issued at the reception desk on the patient's arrival for their dental appointment. Patients were requested to complete their medical histories whilst in the waiting area, prior to being called into the clinical area. Once in the clinical area, the clinician reviewed their medical history data with the patient, each question was reviewed individually with the patient, and the verbal response recorded. The verbal responses were correlated against the responses disclosed in the initial self completed medical history. Omissions/anomalies in the responses were recorded under the headings; medications; significant medical conditions; smoking history. The patient's medical histories were updated according to amendments disclosed during the verbal confirmation of their medical history declaration.

Both the paper-based and the digital format of the medical history questionnaires were standard industry based questionnaires, and would have been presented to the patient in the same manor regardless of whether they were included in a study or not. Indeed, the review of a patient's medical history prior to dental treatment whether via the requisite paper or digital format, along with a verbal confirmation of this disclosure, would constitute an omission of professional duty. The data collected and presented in this study, preserve the patient's anonymity and the disparity between the

paper/digital declaration and the verbal responses were not recorded on the patients clinical notes; as such, no ethical approval was considered necessary nor sort prior to presenting the results of this study.

RESULTS

A total of 538 medical history questionnaires were collected. These were composed of 217 ipad medical history questionnaires from one mixed, private/NHS practice; and 321 paper based medical history questionnaires from two practices (PP1, PP2)(one private, one mainly NHS) all in either Devon or Cornwall. No questionnaires were rejected. Table 1 and 2 shows the distribution of participants from the three practices in this study: ipad practice comprised 217 patients, 57 (26.27%) aged 17 and under, 160 (73.73%) aged 18 and over) over 11 clinical days; PP1 and PP2 comprised 27 and 294 (patients in total 2 (7.4%) and 52 (17.69%) aged 17 and under, 25 (92.6%) and 242 (82.31%) aged 18 and over (total 54 aged 17 and under, 267 aged 18 and over)respectively. The same clinician conducted the reviews across all three sites.

Table 1. Composition of patients included in survey

	No. Of clinicians surveying	No. Of clinical days	Total no. Of patients		No. Of patients aged 17 and under		No. Of patients aged 18 and over	
Ipad practice	1	11	217		57		160	
Paper practice 1	1	5	26	27 321	2	54	25	267
Paper practice 2	1	21	294		52		242	
Total		37	538		111		427	

Table 2. Composition of patients surveyed by age

	Total no. Of patients		% Of patients aged 17 and under		% Of patients aged 18 and over	
Ipad practice	217		26.27%		73.73%	
Paper practice 1	27	321	7.4%	16.82%	92.6%	83.18%
Paper practice 2	294		17.69%		82.31%	

Of the ipad practice, 173 (79.7%) made an accurate initial disclosure and 44 (20.3%) inaccurate disclosures. For the paper based practices, (PP1, PP2), 20 (74%) and 256 (87%) made accurate disclosures; whilst PP1 recorded 7 (26%) erroneous responses and PP2 38 (13%) erroneous responses. In Table 3, inaccurate disclosures were recorded as a single result, some disclosures did include multiple erroneous disclosures across one or more of the three headings surveyed (medications; medical conditions, smoking status). When PP1 and PP2 results are combined and aggregated out, the results show: ipad = 79.7% accurate responses, PP1+PP2 = 86% accurate responses.

Table 3. Overall responses

	Total no. Of patients		No. of patients making accurate initial disclosure		No. of patients making erroneous initial disclosure	
Ipad practice	217		173 (79.7%)		44 (20.3%)	
Paper practice 1	27	321	20 (74%)	276 (86%)	7 (26%)	45 (14%)
Paper practice 2	294		256 (87%)		38 (13%)	

Table 4 shows the breakdown of responses by patient age, further divisions include whether the patient was a new patient to the clinician, or whether the clinician had previously ever seen the patient before. Patient gender was also recorded.

Table 4. Breakdown of responses by Age; and new or previously treated patients

	Existing patients aged 17 and under				New patients aged 17 and under				Existing patients aged 18 and over				New patients aged 18 and over			
	Accurate response		Erroneous response		Accurate response		Erroneous response		Accurate response		Erroneous response		Accurate response		Erroneous response	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Ipad practice	3	1	0	0	23	28	2	0	14	28	0	3	35	45	12	27
Paper practice 1	0	0	0	0	1	1	0	0	2	6	1	0	4	5	3	3
Paper practice 2	6	0	0	0	22	24	1	0	45	48	1	2	52	63	13	21

Table 5 gives the data from table 4 as percentages of the total erroneous responses by each sub-group. For the ipad practice, 75% of the accurate responses from the existing patients 17 years and under group, were yielded by males and 25% by females. For the ipad practice - new patients aged 17 and under, accurate responses were given by 43.4% males, 52.8% females. 4% of male new patients aged 17 and under gave an erroneous response. No females in this group gave an erroneous response.

For existing patients aged 18 years and over recorded at the ipad practice, 31.1% of male responder's and 62.2% of females gave accurate responses, no males in this group gave inaccurate answers, whilst 6.7% of female existing patients yielded inaccurate responses.

New patients aged 18 years and over attending the ipad practice showed 29.4% of male patients and 37.8% of females gave accurate answers, whilst 10.1% of males and 22.7% of females gave inaccurate responses.

Pp1 and PP2 yielded the following responses respectively. PP1 saw no existing patients aged 17 years and under, with one new male, and one new female patients aged 17 years and under, providing accurate responses. PP1 yielded 100% of existing patients aged 17 years and under giving accurate results. PP2 reported 46.8% of its male; and 51.1% of its female new patients aged 17 years and under giving accurate responses, with 2.1% of new 17 year and under male patients giving erroneous responses. No females in this category were recorded.

Of the existing patients aged 18 and over, the results for PP1 and PP2 were: accurate male responses = 22.2% / 46.9%. Accurate female responses = 66.6% / 50%. For erroneous results = 11.1% / 1% male; and 0% / 2.1% for female.

Of new patients aged 18 and over, the results for PP1 and PP2 were: accurate male responses = 26.7% / 34.9%. Accurate female responses = 33.3% / 42.3%. For erroneous results = 20% / 8.7% male; and 20% / 14.1% for female.

Table 5.% breakdown of responses by Age; and new or previously treated patients

	Existing patients aged 17 and under %		Erroneous response		New patients aged 17 and under %		Erroneous response		Existing patients aged 18 and over %		Erroneous response		New patients aged 18 and over %		Erroneous response	
	Accurate response				Accurate response				Accurate response				Accurate response			
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Ipad practice	75%	25%	0	0	43.4%	52.8%	4%	0	31.1%	62.2%	0	6.7%	29.4%	37.8%	10.1%	22.7%

Paper practice 1	0	0	0	0	50%	50%	0	0	22.2%	66.6%	11.1%	0	26.7%	33.3%	20%	20%
Paper practice 2	100%	0	0	0	46.8%	51.1%	2.1%	0	46.9%	50%	1.0%	2.1%	34.9%	42.3%	8.7%	14.1%

Whilst inaccurate responses were recorded as one event in table 3, often patients recorded more than one erroneous response. Table 6 shows that no patients in the study aged 17 years and under, omitted declaring any medications. In the study group aged 18 and over; for the ipad practice, two male and 12 females omitted declaring a medication. For the paper practices, PP1 = 1 x male and 1 x female response, and PP2 = 3 x male and 3 x female were recorded.

For the declaration of omissions of diagnosed medical conditions; only one male for the ipad practice was noted for all 17 year olds and under in the study, in contrast to those in the 18 years and over category. For those individuals attending the ipad practice, six male and 16 females were recorded. For the paper based practices, PP1/ PP2 recorded 4 /9 male and 4 /19 female medical omission participants.

Regarding the results for non-disclosure of historic or current smoking, no participants were recorded in the 17 years and under age group. For those aged 18 years and over - the ipad practice recorded seven male and 11 female omissions. For PP1 and PP2 – 0 / 4 male and 0 / 3 female were noted.

Table 6. Breakdown of erroneous responses

	No. of patients omitting medications				No. of patients omitting an existing medical condition or incident				No. of patients failing to declare either current or historic smoking			
	Aged 17 and under		Aged 18 and over		Aged 17 and under		Aged 18 and over		Aged 17 and under		Aged 18 and over	
	M	F	M	F	M	F	M	F	M	F	M	F
Ipad practice	0	0	2	12	1	0	6	16	0	0	7	11
Paper practice 1	0	0	1	1	0	0	4	4	0	0	0	0
Paper practice 2	0	0	3	3	0	0	9	19	0	0	4	3

Table 7. Declared omissions for medications and conditions in patients aged 17 and under

	Aged 17 and under No. of medications omitted								Aged 17 and under No. of medical conditions omitted							
	1		2		3		4		1		2		3		4	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Ipad	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Paper 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paper2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 7 shows that for the 17 years and under age group, only one erroneous response was recorded, that was for a 17 year old male who failed to disclose one diagnosed medical condition. No omissions were recorded in current medications.

Table 8. declared omissions for medications and conditions in patients aged 18 and over

	Aged 18 and over No. of medications omitted								Aged 18 and over No. of medical conditions omitted							
	1		2		3		4		1		2		3		4	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Ipad	1	9	1	0	3	0	0	0	5	14	0	2	0	0	0	0
Paper 1	1	1	0	0	0	1	1	2	0	1	0	0	0	1	0	2	4	10	1	13	0	4	2	7	0	0	1	3	0	4	0	0
Paper2	0	0	1	1	1	0	1	2	6	12	3	5	0	2	4	0

Table 8 illustrates the responses for the study group aged 18 years and over for medication omissions and diagnosed medical condition omissions. For the ipad practice, one male and 9 females failed to declare one prescribed medicine; one male and three females failed to declare two prescribed medicines. No quantities above two different medications were recorded for this group. For the paper based practices, one male and zero females failed to declare one prescribed medicine; one male and two females failed to declare two prescribed medications; one male and no females failed to declare three prescribed medications; and one male and two females failed to declare four prescribed medications. No multiples above four were recorded for failed medication declaration in this group.

During the study, where patients declared a medication but were unable to name it, this was considered and recorded as an accurate response.

The results for the erroneous reporting on diagnosed medical conditions show that for the ipad group; five male and 14 females failed to declare one medical condition; two females omitted declaring two diagnosed medical conditions. For the paper based practices; 10 male and 13 females failed to declare one medical condition. Two male and seven females failed to declare two medical conditions; no males and three females failed to declare three medical conditions and four males and no females failed to declare four medical conditions. No values above these were recorded.

A total number of 538 patients were included in this study, 217 reporting using an ipad device from one practice, and 321 reporting from 2 separate practices using an identical paper-based form. Of these, 44 individuals (20.3%) of the ipad patients reported one or more erroneous results on their medical history form, compared to 45 individuals (14%) of those reporting using a paper format. Using the t-Test to determine the critical value for t with degrees of freedom and 0.01, t=0.3931. This result indicates that there is no significant difference in the results of this analysis, and as such the null hypothesis must be accepted.

DISCUSSION

A potential criticism of this study is that only one clinician reviewed and assessed the responses from patients who completed their medical history either digitally or on paper. However, this seeming weakness in this study in fact eliminates an important variable in the data collection process, namely that of the psychological personality influence of the researcher on the subject. Loftus & Palmer[12], and Rockhard [3] both described how distortions in reports made by participants of studies can be influenced by the interviewer. Whilst interviewer bias could possibly influence the respondees answers[13], whether through personality or indeed gender, any influences can be reduced during the verbal integration stage of the study through only the repetition of the questions on the appropriate questionnaire and not by paraphrasing any of the questions. As such, the fact that only one interviewer was engaged in this study acts as a strength, because it reduces the number of variables present within the methodology, resulting in only one variable being present, namely, the method employed for the patient to

make their original declaration, vis. Paper or digital. It could be argued that this interviewer bias may be subject to gender bias, between the respondent and the interviewer, and perhaps this is an influential factor in the results, however, the focus of this study is the accuracy of the patients initial declaration, not of that of the subsequent verbal review of the responses which is used solely to confirm the validity of the initial responses. Rockhard et.al.[3] however, made a further observation, namely that of the influence of human nature when the clinician is reporting, by its nature, the taking of medical histories can be a repetitive and boring activity, which may be reflected in reporting, stating that often 'qualifier questions' are omitted by reporting clinicians; concluding that automated systems whilst reporting more data also contains more errors, and in spite of patients preferring them to the oral option, n save significant clinical time.

It must be noted that medical histories for patients under 17 years of age invariably were completed by the accompanying adult, usually a parent. To this end, it would be expected that the disclosures would be correct. However, potentially sensitive, private information such as the use of oral contraceptives and smoking in this study cohort may not have been accurately reported, even when verbal responses were courted.

A number of existing medical conditions were uncovered during the secondary, verbal review of the medical history questionnaire, which the patient had failed to declare but which included: diagnosed schizophrenia with associated medications; historic broken mandible; un-hospitalised unconsciousness following a 4m fall onto concrete three months previously; treated systemic cancer. Such omissions in disclosure could have significant consequences for the patients care, for example, a frequent manifestation with schizophrenia are roused tactile and olfactory hallucinations as described by Yaltirik, Kocaelli and Yargic [14] whereby delusional halitosis is frequently a variety. Mandibular fractures can result in neuromuscular complications, and Anyanechi and Saheeb [15] indicate that such trauma can be manifest in occlusional derangement . Worsaae and Thorn [16] expanded on this, highlighting the increased risks of malocclusion, and mandibular asymmetry, as well as an impaired masticatory function. Mild traumatic brain injury (mTBIs), is a possible result of a fall onto concrete, and was studied by Broglio et.al. [17] who argued that 'they can no longer be thought of as a transient injury resulting in short-lived neurological impairment. As for the presence of cancerous pathology, a previous history can heighten a clinicians awareness of recurrence and prompt a timely referral, should sinister pathology be noted, reducing the impact should a positive detection be recorded[18].

The erroneous responses eluded too during review regarding smoking status, tended to stem for historic habits rather than recent of current smoking habits. It may be suggested that erroneous responses to this line of questioning resulted from genuine forgetfulness rather than any other intention on the part of the patient. Herlitz et. al [19] argued that the under reporting of 'smoking deceivers', whilst possibly was considerable, that for a large majority stating that they had quitted smoking, their responses could be trusted. Again, knowledge of historic smoking and alcohol habits can raise a clinicians awareness of signs and symptoms of oral cancer and liver conditions, of which the latter has be linked to diabetes[20].

Moreover, there may be a question of culpability. Whilst the patient is required to sign their medical history declaration as being truly representative of their current circumstance

CONCLUSION
With the increasing trend to convert the clinical environment to a paperless system, there is increased pressure to adopt digital record systems in preference to traditional paper-based systems. Moreover, in a post-Covid-19 environment there is also a heightened tendency to adopt both automated and remote systems of data collection, for reasons which include, but are not limited to, the patients preference and the saving of clinical time. When employing such remote triaging and digital technology, there is always the risk of over reliance on certain methods which can be perceived to impact adversely on clinical activity, and it must be accepted as inevitable that there will always be differences in accuracy and validity between different data gathering systems, whether they be electronic, manual or organic and each method has intrinsically both strengths and weaknesses.

Thus this study suggests that there is no significant difference, in the accuracy of self reporting on medical histories by dental patients using an ipad, digital method, when compared with a traditional paper-based format, acknowledging that whichever system is deployed, erroneous results at some point are inevitable. As such the null hypothesis must be accepted, concluding that there is no statistical difference of accuracy and validity of dental patient medical histories when collected using a paper-based collection method to that of a digital method.

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