

Original Research Article

Cardiac patients' information integration in dental and medical records: A four-year study

Abstract

Background: Dental records involve documents related to the history of present illness, treatment, and disease prognosis. All decisions and evidences on which those decisions were based should be included. **Aim:** Analyze the integrity of health information in dental documentation of cardiac patients attending dental care and correlates affecting this relationship. **Methods:** Dental records of 323 cardiac patients in Qena University Hospital (QUH) in 2012 - 2015 were compared with corresponding medical records of cardiac patients to achieve study aim. Medical information studied included medications and an array of health condition inquiries. **Results:** The patients' mean age was 56 ± 16.9 years. Male c cardiac patients dominated (58.2%, n=189). Most dental exams were attended by resident/registrar dentists (72.1%). A total of 887 discrepancies were identified in studied pairs of dental and medical records. More than half (53.7%; n=995) of disease and health items as in medical records were missing in dental records, and 0.8% (n=35) of items not among patients' medical history were "falsely" endorsed in dental records [$\chi^2(df=1)= 2385.5$, $p<0.0001$]. Patients' age was risk factor for accurate and complete endorsement of patients' health data in dental records [Fisher's exact = 15.2, $p<0.0001$]. Male dentists report more discrepancy incidents [$\chi^2(1)= 7.3$, $p=0.007$]. Junior staff and less experienced dentists record concordant health information more frequently than senior and more experienced peers [55.6% vs. 16.7%; Fisher's exact 8.4, $p=0.028$]. **Conclusion:** Poor integrity in communicating cardiovascular disease patients' general health and disease-specific data into dental records is a concern. A unified, electronic, health information recording system assures higher safety standard for cardiac patients submitting to dental procedures in enthusiastic hospitals.

Keywords: Cardiac patients, discrepancy dental records, medical information

Introduction

Medical and dental care evolved as separate entities, each with its own professional diversity, terminology, associated technologies, and information methods. Absolute knowledge of a patient's health information is an essential aspect of the dentist's responsibility and one of the keys for providing safe and appropriate dental treatment in context of any systemic disorders [1]. Evidence is accumulating on the association between dental and medical conditions including diabetes, cardiovascular disease (CVD), and chronic renal disease [2, 3]. In a three-year study on the integration of dental and medical service records, 99 discrepancies were identified for 178 joint patients that represent records of about 40% of the patients. Six of these discrepancies were classified as "life-threatening" [4]. In order to assure accurate integration of the patient's basic health information into documentation when pursuing dental care, all data related to medical history, morbidity and diagnoses should be addressed into the created dental record. That in mind, a reliable dental record supposedly contains documents reflecting the patient's medical profile, as above, and including clinical examination, diagnosis and treatment done [5]. The documentation content should also include all decisions taken and documentation of the evidence upon which those decisions were based [6]. Reliable communication channels for sharing this information among health practitioners on an ongoing basis should be established and conscientiously evaluated. However, concerns have arisen

about informational discrepancies regarding the handling of this information, as well as other technical arrangements.

Since 1977, the US Department of Defense has been aware that up to 10% of dental records of active duty staff could have discrepancies when compared with their medical records; of which, 11 major discrepancies were found” [7]. The study recommended that patients presenting for dental examination bring their medical records with them. Other studies supported the same recommendation [8]. The idea to assure timely availability of patients’ health information at any healthcare process sounds logic; yet it may now be implemented using more efficient and secure approaches, such as electronic medical record (EMR) and digital communication technology. Patient’s health information could be obtained from different sources, such as medical record, health questionnaires and patient’s self-report of the condition, reports from other healthcare providers or a combination of these sources. Until present, a self-administered health questionnaire approach is the most commonly used method in dental settings. This vehicle requires that the patient understands the questions to provide appropriate answers. It also gives the clinician a starting point for the dental team to conduct more in-depth medical queries and fulfill its professional obligations. The health history questionnaires vary between simple and comprehensive formats, where the patient can mark the problem among the list or write down in blank spaces. The effect of the designs of the medical questionnaires as a source of information gap was tested by comparing two medical questionnaires [9]. The comparison showed that neither the more concise form nor the more comprehensive and detailed form was able to exclude the occurrence of false-positive or false-negative answers. This lack of validity and the associated high risk mandates the improvement and possible reorientation of interdisciplinary co-operation between the dentist and the general practitioner. On the dentist part, frequent reviewing of patient health history is essential to gather up-to-date data, especially that there is always room for a change in the health condition of chronic patients in between dental visits. Helminen et al. 1998 [10] report that only 26% of the oral health records had up-to-date health history. The study also showed that female dentists and dentists younger than 37 years tended to record more information. In 2011, the World Health Organization (WHO) reported that CVD, including coronary heart disease (CHD), stroke, and peripheral vascular diseases (PVD), constitute major public health problems worldwide. [11] Although trends in CVD mortality in the last few years showed a minor reduction due to preventive efforts especially against smoking, an operational action plan to reduce the burden of tobacco use, it accounts for 46% of total deaths, all ages and both sexes. [12]. In the US, CVD is also leading cause of mortality, as it accounts for near 40% of all deaths among men and women, and nearly half of all deaths in Europe [13]. As in other Arab countries, ischemic heart disease (IHD) in Egypt, and stroke, were the second and fourth common cause of death in 1990 until 2010 when they have shifted to be the first and second cause respectively. [11]. According to the “Egyptian national hypertension project,” it was found that the adjusted overall prevalence of CHD among Egyptians reached 8.3%. [14] This was somewhat higher in women (8.9%) relative to men (8.0%), but was more clearly associated with an urban versus rural location (8.8% vs. 7.2%), and age >50 years vs. <50 years (11.1% vs. 5.1%).

Cardiac patients constitute risk cases in dental practice, particularly in the absence of adequate medical control [15]. Dental care providers may have to modify treatment or procedures for patients with co-existent CVD to be consistent with the medical constraints of the patient, such as modification of anticoagulant therapy and pain control. Importantly, dentists need to consult the patient’s treating physician prior to treatment initiation. Poor communication among medical and dental providers often leads to lack of integration between medical and dental records, duplication and inconsistency [16]. On the other hand, the growing number of ageing patients necessitates careful documentation of patients’ health history and all related aspects of treatment. This becomes even more essential when the patient is being treated by a number of practitioners as the transportability of the patient health information between healthcare providers becomes more important in the continuum of patient care. Until the time

of this research, the medical and dental records of QUH are separate into two different folders in two different locations. Such traditional separation in addition to the reliance of dental professionals on the information available in the written reports or referrals from other disciplines or on patient self-reporting rather than complete integrated medical record or EMR may form a gap of information that can suggest dangers to the overall health of a patient and may lead to serious medical problems and further complications. The work, aims to identify and measure compatibility and integration of the medical information of cardiac patients' records when transported to dental record or corresponding patient. Within this context, the prevalence of discrepancy of medical information items and factors contributing to such discrepancy would be identified. The research creates an opportunity to evaluate the depth of information gap in the hospital's dental and medical record system, and whether holes in the system can be reason through which errors jeopardizing cardiac patient's care and safety can penetrate. An integral dental -medical record system will eventually support quality of care, safety, and any futuristic cost reduction initiatives.

Methods

The study was conducted at a joint setting of dental service and the medical records system (MRS) in QUH. A retrospective design was selected to achieve study aim. Records of patients who have visited QUH dental clinics at least once between 2012 and 2015 and those diagnosed with cardiac diseases were retrieved. The QUH is a 400 -bed secondary healthcare institution receiving referrals from other institutions in Qena, Red Sea, and South Valley governorates in Upper Egypt. The hospital offers a variety of secondary and some tertiary health services, including inpatient, outpatient, intensive care, operative, and emergency services.

Sample size and sampling technique: A representative sample was selected using Epi-info, software version 3.01 [17], based on a source population size of 30,000 (above least number a reasonably large sample size to allows generalizability of results, knowing that sample sizes obtained from source population sizes $> 30,000$ are not significantly different). A sample size (n) of 322 records was calculated, which was increased to 350 to make up for the probability of missing data or entry errors. Admittance into the analysis required completing $\geq 80\%$ of screened fields of the medical records, ending up with 323 records (92.3% inclusion rate). In the beginning of the sampling process, we first found a total of 1154 medical records fulfilling basic status needed to be included in the study, i.e., being a cardiac patient who had at least one dental visit at QUH during the study duration were recognize (sample frame). The number of sample frame found in each year out of 1154 cardiac patient records was as follows: 2012: 277 (24.0%), 2013: 254 (22.0%), 2014: 303 (26.3%), 2015: 320 (27.7%). In order to reflect the proportionality between the number of selected records per year (n_i) and the number of records in each of the study years, stratification was done by multiplying 323 (sample size) times the proportion of sample frame respective to each year. Medical records in each year were given serial numbers and a proportionate number of records for that year (n_i) were collected. Randomization of the study sample strata was done using online free random number generators. Out of total 323 sample records, the following sample strata were collected: a) n_{2012} : 78 (24.0%), b) n_{2013} : 71 (22.0%), c) n_{2014} : 85 (26.3%), d) n_{2015} : 89 (27.7%). In parallel, the dental records belonging to the same cardiac patients (whose medical records have been selected) were retrieved. Medical information and co-morbidity items under investigation include: 1) medications, 2) hyperlipidaemia, 3) hypertension (HTN), 4) anti-coagulants, 5) cardiovascular diseases (CVD), 6) artificial implants, 7) diabetes mellitus (DM), 8) renal diseases, 9) bronchial asthma (BA), 10) stroke, 11) thyroid problems, 12) blood disorders, 13) allergy, 14) communicable diseases (CDs), 15) rheumatic fever, 16) epilepsy, 17) kidney transplant, 18) cancer/chemotherapy/radiotherapy, and 19) systemic lupus erythematosus (SLE). [The

“International Classification of Diseases- version IV (ICD-IV) (WHO, 1992) [18] was used to compare disease diagnoses in or built dataset for coding pursuant to this research only]

Dental record design: The patient dental record of QUH is provided with “general health questionnaire” form to document patient health information as a baseline for any future medical procedures or interventions. The form contains lists of medical and surgical conditions and medicinal information to be filled up by the patient in their first visit. The form may be updated with subsequent visits to keep updated with patient’s health condition progression and changes. The form is reviewed by nursing staff in charge for appropriate completion of required fields, to be finally reviewed by the attending dentist upon commencing patient check-up. In addition, there is a progress notes form that is regularly attached to the patient’s file with every dental visit, and which contains a filed about medical information where the dentist has to endorse her or his patient’s medical history in. Based on the above, the medical information and included items documented and dealt with in each patient’s pair of records (medical record and dental record as above) were compared for similarity (agreement) or discrepancy (disagreement), item by item in all relevant fields of the records.

Data collection tool and study variables: Data were collected using a proforma mainly adapted from American Dental Association (ADA) “health history form.” The proforma items address four major fields: a) dentist demographic characteristics, b) patient demographic characteristics, c) source of patient, and d) medical information. The first three fields provide an overview about the study population and their association with discrepancies between dental and medical records, while data from medical information field would measure the prevalence of the discrepancies. Independent variables included the following: demographic characteristics and detailed professional characteristics for dentists, such as job title [consultant/professor, senior registrar (SR)/specialist, registrar/resident], and work experience in years. As per the study design, “discrepancy” as the state of “disagreeing or being at variance mismatches of patient’s health information between the patient’s dental records compared to the medical record” was perceived as the dependent variable of study’s interest. Two groups of observers each consists of two medical records staff headed by a medical consultant/professor were formed to review the medical records of the sample frame and confirm the presence of CVD. We now had 323 cardiac disease cases to study, consisting of 323 pair of dental and medical records, 323 attending dentists, 323 attending clinicians, and 323 lists of 19 included medical data (6137 items). Otherwise no records would be excluded due to any demographic, occupational, or health status information. Collected data were entered into a Microsoft program with adequate backup lines. Data were analyzed using statistical package for the social sciences (SPSS) software version 18 (SPSS, Inc., Chicago, IL, USA).

Statistical analyses: Nomino-ordinal data, e.g., sex, and educational level, would be summarized in Tables as counts and proportions. Interval ratio scale data, namely age would be summarized as mean $\pm$ standard deviation (SD) or the median and interquartile range (IQR), where appropriate (based on normality distribution, which in turn could be assessed, e.g., by one-sample Kolmogorov-Smirnov test). (Continuous data would mostly be transformed into ordinal data and entered into descriptive and analytical calculations of interest. For instance, age stratified as 21-40y, 41-60y, >60yr, and physicians’ experience as <3yr, 3-5yr, 6-9yr, and ≥ 10 y). For the most research, the strength of association between the study correlates of categorical nature, e.g., gender or work experience and the outcome variable could be assessed using chi-square test of independence (χ^2) (or Fisher’s exact, where appropriate). Often, such association may be assessed in terms of odds ratio (OR) and the 95% confidence interval (CI). Our tolerable level for alpha error (α) is 0.05; results with p -values <0.05 are deemed statistically significant.

Ethical consideration: The research project with methodology was first approved by “Research Ethics Committee” in QUH. All information related to patients’ information, dentists, and data obtained throughout the research, including data analysis and retention were kept confidential and only group data was displayed in scientific and research settings.

Results

Table 1: Patients’ demographic characteristics (n=323)

Characteristic	Category	n	%
Age (yr)	21-40	61	18.8
	41-60	120	37.1
	>60	142	44.0
	Range: 21-4	-----	-----
	Mean $\pm$ SD: 55 $\pm$ 15	-----	-----
	Median: 58	-----	-----
Gender	Male	189	58.5
	Female	134	41.5

As in Table 1, the patients’ age average 56 $\pm$ 16.9 years, (minimum 28yr; maximum 84yr). More than half of the patients (52.2%, n=151) were males (58.5, n=189). Also, the majority of patients are above 60 (44%).

Table 2: Attending dentists’ characteristic

Characteristics	Category	n	%
Professional title	Prof/consultant	19	5.9
	Senior registrar/specialist	71	22.0
	Registrar/ resident	233	72.1
Gender	Male	204	63.1
	Female	119	36.9
Experience (yr)	<3	150	46.4
	3-5	85	26.3
	6-9	63	19.5
	$\geq$ 10	25	7.7

Table 3: Transportability of patients’ information by disease group

Health information group	Discordance*				Concordance**		Total
	n	% in raw	% in column	Cumulative %	n	% in raw	
Treatment (medications, anticoagulants, implants, chemotherapy)	363	60.2	40.9	40.9	241	39.8	604
CVD & circulatory dis. (CHD, HTN, blood, lipid disease) †	338	48.0	38.1	79.0	369	52.0	707
Renal condition (kidney disease, renal transplant)	37	78.7	4.2	83.2	10	21.3	47

Endocrinal disease (Diabetes, thyroid disease)	59	31.4	6.7	89.9	128	68.6	187
Other (Allergy, BA, SLE, CDs)	62	77.5	7.0	96.7	18	22.5	80
CNS disorder	28	77.8	3.2	100.0	10	21.2	38
<i>Total</i>	887	53.3		100.0	776	46.7	1663

* Mean discrepancy: 887/323=2.7/patient. ** Mean concordance: 776/323= 2.4/patient)

† DM 56%, hypercolosterolemia 64%, HTN 70% of total patient population (from MRS)

Most dentists (72.1%, n= 233) were residents/registrars while 19 (5.9%) were consultants/professors. Also most were males (631%, n = 204). Less experienced dentist predominated (46.4% had <3yr, 7.7% had ≥10y experience) (Table 2). Dental records of all patients disagreed with the corresponding medical records in the medical history information (Table 3). A total of 887 disagreement incidents in 1663 health-related conditions affecting study subjects were reported (average 2.7 discrepancy/record). Only 776 agreement incidents were reported for the examined pair of records (average 2.4/record). An average comorbidity rate per patient mounted 5.1 (1663/19). *NB.* Four major disease items (medications, CVD, circulatory, lipids) which constitute almost 20% of all disease items (21%) contribute to almost 80% (79%) in cumulative discrepancy effect of medical information in records.

Table 4: Medical data matching of dental and medical records

Medical information		Dental record		Total n (%)
		Data present n (% in row)	Data absent n (% in row)	
Medical record	Data present n (%)	855 (46.2) * (Truly documented)	995 (53.7) ** (Falsely omitted)	1850 (100)
	Data absent n (%)	35 (0.8) † (Falsely documented)	4288 (99.1) † (Truly not documented)	4323 (100)
Total		890 (14.4)	5283 (85.6)	6173 (100) ‡
Test statistic	$\chi^2(df=1) = 1789.5, p<0.0001^{††}$			

*Present in medical &dental records (true +ve). ** In medical but not dental record (false -ve).

† Not in medical but in dental record (false +ve). †† Not in both records (true -ve).

‡ Medical items reviewed: 19*323=6173. †† OR=105.3, 95% CI 75-148

In cross-tabulation, the probability of concordance/discordance on representation of medical data simultaneously in dental and medical records was analyzed (Table 4). 995 (53.7%) medical items reported in the medical reports were missing in corresponding dental records. Less number (855) (46.2%) of information was synchronized in dental records. Further, 35 (0.8%) of items not reported in medical records were “falsely” reported in dental records [$\chi^2(df=1)=2385.5, p<0.0001$].

Table 5: Patients’ data transportability between dental and medical records over the study duration

Year	Discordance (n, % in row)		Total row	Test statistic, p-value
	Present	Absent		
2012	63 (100)	0 (0.0)	63	Fisher’s exact = 7.9 p= 0.38
2013	72 (96.0)	3 (4.0)	75	
2014	80 (89.9)	9 (8.1)	89	
2015	90 (93.7)	6 (6.3)	96	
<i>Total</i>	305 (94.4)	18 (5.6)	323	

Analyzing discrepancy over time (Table 5), no statistically significant differences in discrepancy rate were found [Fisher's exact = 7.9, p=0.38].

Table 6: Transportability of medical data by patient's criteria

Characteristic		Discordance (n, % in row)		Total row	Test statistic, p-value
		Present	Absent		
Gender	Male	178 (94.1)	11 (5.9)	189	χ^2 (df 1)=0.419 p = 0.78
	Female	127 (94.8)	7 (5.2)	134	
	Total	305 (94.4)	18 (5.6)	323	
Age (yr)	21-40	49 (83.6%)	10 (16.4)	61	Fisher's exact=15.2 p<0.0001
	41-60	112 (96.6)	6 (3.3)	116	
	>60	144 (98.7)	2 (1.3)	146	
	Total	305 (94.4)	18 (5.6)	323	

Demographically (Table 6), only age significantly impacted such discrepancy; gender was not. For instance, the vast majority of records (98.7%, n = 144) of patients >60 reported discrepancies in the examined items. Least discrepancy reported was for patients 21-40 years of age (83.6, n = 52) [Fisher's exact=15.2, p<0.0001].

Table 7: Transportability medical data by referring source

Referring source	Discordance (n, % in row)	Concordance (n, % in row)	Total row	Test statistic, p-value
Inpatient	7(63.6)	4 (36.4)		χ^2 (df 4) = 1.989 p = 0.738
Outpatient	15 (75.0)	5 (25.0)	20	
Directly to dental care	198 (75.9)	63 (24.1)	261	
Cardiology	15 (65.2)	8 (34.8)	23	
Emergency	6 (75.0)	2 (25.0)	8	
Total	305 (94.4)	18 (5.6)	323	

In Table 7, dental records of patients directly submitting to dental examination showed highest detected discrepancy (75.5%), e.g., compared with discrepancy for patients referred from the inpatient hospital wards (63.6%). However the difference in such discrepancies was not statistically significant [$\chi^2(df\ 4) = 1.989, p = 0.738$].

Table 8: Transportability medical data by dentists' criteria

Criterion	Category	Discordance (n, % in row)	Concordance (n, % in row)	Total raw	Test statistic, <i>p</i> -value
Gender	Male	198 (97.0)	6 (3.0)	204	$\chi^2(1) = 7.3$ $p = 0.007$
	Female	107 (90.0)	12 (10.0)	119	
	<i>Total</i>	305 (96.5)	18 (3.5)	323	
Professional title*	Prof/consultant	16 (84.2)	3 (15.8) 16.7	19	<i>Fisher's exact</i> = 8.3 $p = 0.025$
	SR/ specialist	64 (90.2)	7 (9.8) 38.9	71	
	Registrar/ resident	225 (96.6)	8 (3.4) 44.4	233	
	<i>Total</i>	305 (96.5)	18 (3.5)	323	
Experience**	<3	146 (93.3)	10 (6.7) 55.6	150	<i>Fisher's exact</i> = 8.4 $p = 0.028$
	3-5	84 (95.5)	4 (4.5) 22.2	88	
	6-9	60 (98.4)	1 (1.6) 5.5%	61	
	≥10	15 (83.3)	3 (16.7) 16.7%	18	
	<i>Total</i>	305 (96.5)	18 (3.5)	323	

* % in column: Professor/consultant 16.7%, SR/specialist 38.9, registrar/resident 44.4

** % in column: <3y 55.6%, 3-5y 22.2%, 6-9y 5.5%, >10y 16.7%

As in Table 8, male dentists tend to report discrepancy incidents most (97%) [$\chi^2(1) = 7.3, p = 0.007$]. Dentists of all capacities report discordant information more frequently than concordant ones. However, registrars/residents report concordant data more frequently than senior staff, e.g., 8/18 = 44%, compared to 16.7% (3/18) – to – 38.8% (7/18) senior staff in column [Fisher's exact 8.3, $p = 0.025$]. The same trend applies for years of experience comparison (in column), e.g., 10/18 (55.6%) concordance for those with <3 years of experience vs. 5.5% - to- 22.2% for more experienced staff [Fisher's exact 8.4, $p = 0.028$].

Discussion

This research strives contributing to a better understanding of “traditional” information gap between medical and dental records, suggesting measures to bridge this gap. Little, if any, research highlighting discrepancy issues within dental and medical records of cardiac patients in Egypt is released. Our findings show that there was sufficient evidence to indicate that discrepancy exists as a trend and the way it is presented. Such discrepancy could be envisioned from a multitude of critiquing angles. In terms of health data endorsed, discrepancy was observed in all examined items and also in all records. All 323 dental records suffered disagreement with medical records in one or more of the medical items tested, and the average disagreement frequency mounts 2.7 items per case (887/323), while they agreed in only 776 documentation incidences, averaging 2.4 incidents per case. It follows that the health status of our study population proves as high a risk as 5.1 comorbidities per patient. This risk inflates the burden of the improper patient health condition reporting to dental service in QUH. Whether any dental malpractice reflected by this study could be sign for a larger documentation management problem in QUH is a concern, too. In literature, the trend of reporting medical history in 115 dental records was also examined [19]. We ascertain that > 86% of records failed to reflect patient data as reported in medical documents. Other studies provide similar disagreement in medical data handling between dental and medical records perhaps with lower rates reported, e.g., 10% [7] 40% [20], and 65% [13], were also produced. Envisioned

from the proportion of concordance / discordance of the presence of all medical history items in all records, 53.7% of items were significantly missing in dental records, compared with 46.2% of items matched in records. Further, when medical conditions were assembled into disease groups, discrepancy pattern showed dispersion toward the tails of the comparison. For instance, medications, CVD, circulatory, lipids group (21% of all disease items) contribute to 79% of discordance in the medical information endorsed in records, and the remaining 81% of disease items contribute to the rest (21% of discordance effect) Considering this discrepancy pattern can lead us to recommend directing and examining policy options to resolve obstacles which hinder easy introduction of patients' data into their dental documentation process.

In 2013, Stewart and collaborates assessed the completeness and validity of both medical and demographic data in 246 randomly selected dental charts, compared to medical records in a military healthcare setting (Northwest Military Hospitals) [21]. Unlike ours', the study did not specifically target CVD patients. The sensitivity of discrepancy in medical conditions in dental charts was low, especially in conditions such as hepatitis-B, blood transfusion, HTN, and renal disease; and for most for diabetes and anemia. In our study, diabetes and nutritional anemia contribute to around 35% of discrepancy volume, and other diseases, such as CVD, CDs, including hepatitis infections, contribute to higher discrepancy volume. Stewart and colleagues also note that most dental records did not include the medications used by patients and some only included the medication class, such as cardiac medications or antihypertensive. In our study, too, medication reported 60.2% discordance in transportability of medication data to dental records, and almost 41% of all medical data reporting malpractice in dental setting. In fact, medication reporting malpractice is not a major documentation malpractice of dental care but many other healthcare arenas. The problem has overwhelmed health and quality observers worldwide. A study to evaluate the frequency of medication and allergy/adverse events -related discrepancies in a family medicine residency clinic found that 97% of patients (n=157) had at least one discrepancy between medications listed in record and those they were taking [22]. Another study [23] reports that 70.4% of medications recorded in the hospital's EMRs were no longer being taken by the patient. Thereby, the incomplete reporting of medication items of systemic disease patients in dental recording systems ranges between 60.2% (this study) and 97% [22, 23] in literature. From these studies we may anticipate that medications documented in medical charts may not be an accurate source to base precise comparisons. Although the medications listed were not validated, as this was beyond the scope of this work, patients' pharmacologic profile in the MRS of QUH fortunately was occasionally checked to confirm some illegible handwriting of the physicians.

Both varieties of hypotheses testing outcomes at the α -level for rejecting a true null hypothesis selected for this research (0.05) have been obtained. The "no difference" finding was met with e.g., in study duration, gender, and referral source analyses against data integration in between dental and medical records. On the other hand, the significantly different findings were met with, e.g., in concordance/discordance trend, age, and dentist criteria analyses. Time could not improve medical data reporting in QUH dentistry service, and a similar trend was universal across all referring departments. When we first hypothesized on the completeness of medical conditions information in dental documentation, our desire was against the null in the direction of a greater concordances finding. In testing for concordance / discordance hypothesis, the odds of having data in dental records as in concordance with the corresponding medical record was greater that of having data falsely reported in dental record (OR =105.5, 95% CI 75 - 148). This result was only obtained as a result of a great frequency of a true negative reporting (data absent in both records). The challenging quality issue in this debate is not the fear of introducing factitious data not ever exist in the patient's history into dental recording system; this is least likely to happen and least to be feared; perhaps that is why it is only experienced in 0.1% of the time (35 false positive cases). The

source of error of more of a concern is missing to transport valid medical data into a dental record. This malpractice constitutes a major source of errors, which compromises the quality of service, patient safety and overall health outcomes. In the analysis above, the frequency of “false negative”, i.e., data erroneously omitted and not reported in dental records is still significantly greater than that mutually documented in the two types of records (53.5% vs. 46.2%, respectively), and this is what we should be watchful of. The significant difference here is another proof against data integration in QUH recording systems, and suggests that dental records tend to contain different (mostly deficient) amount and quality of patients’ information not in concordance with true information, a condition which further poses imminent risk to safe dental care. Neither a tendency towards the null in data transportability performance nor that toward the alternative hypothesis of a disagreement with true patient health information was desired. The latter scenario was typically found in this research. Whether an experienced physician or one with higher professional degree, both were not in favor of adequate reporting. Helminen et al. [10] provide that female dentists and dentists younger than 37 significantly tended to record more information. In our research, younger physicians (registrar/residents) do register concordant patient information more frequently, 44% (8/18) vs. 16.7% (3/18) – to – 38.8% (7/18) for senior colleagues. The same trend applies to experience, 55.6% (10/18) concordance for those with <3 years of experience vs. only 5.5% (1/18) – to – 22.2% (4/18) for more experienced staff. Our female dentists also report in concordance with the patients’ true medical history more efficiently than male counterparts [66.7% (12/18) vs. 33.3% (6/18)].

Second, the null hypotheses stated about correlates of discrepancy in medical data transposition to dental documentation system were all virtually not rejected, except for age. Other researched reported similar findings with variable degrees of prevalence. For example, only 26% of the oral health records had up-to-date health history, e.g., compared 46.2% discordant health information incidents in our study. [10] Definitely the predominance of failing to reject the set of null hypotheses, especially in duration, and sources of referral, analyses was not that we wished when we first had started this work. Factors such as time or limitation of discrepancy to certain referral sources could have been more efficiently deployed to support improved information reporting, e.g., benefiting from evolving efficient documentation techniques, where appropriate, or provoking leadership skill among experienced dentists to appreciate the value of information documentation among peers. Actually this very discrepancy trend is the core of our concern and the most important finding which should be diligently worked on.

The discrepancy trend in this work largely does not vary by the source of patient referral. Cardiac patients referred for dental care from different departments, whether inpatient, outpatient, cardiology, or emergency services, all were treated with same negligence, so that the rate of discrepancy was uniformly high (48% - 77.8%). As above, too, dentists of all range of demographic and experience criteria shared the same predominant discrepancy behavior (83.3% - 98.4%). It is also important to point out that the patient cohort were seen by almost the same group of dentists which led to repeated pattern of documentation and discrepancy. Not only the dentists’ attitude toward patients’ data documentation is questionable, but general practitioner colleagues’ referral and data communication style may also prove alarming and urges to engage both clinicians in any intervention plan designed to improve patient information reporting practice. And especially dentists should appreciate general health information as a genuine component of any dental management plan offered to clients.

Age as a correlate to discrepancy: Even when patient’s age was a significant correlate, its influence on discrepancy occurrence was in a direction opposite to what could fairly be thought of, i.e., thinking of old age in a sense of the need for a better care and precision managing their underlying data, not

behaving otherwise due to the same age factor. Our physicians should have realized that most cardiac patients tend to have an older age profile ($56 \pm 16.9y$) than that of the general population (CIA, 2013) [24]. Yes younger cardiac patients could often have congenital heart diseases that were not originally associated with risk factors as those in older cardiac counterparts, yet in health care, advanced age, if anything should be motive for more care but not a less enthusiasm for diligent work to improve the health-related quality of life (HRQOL) of older people. The ambiguity of age-discrepancy relationship found in our study is more or less endorsed by other studies. Stewart et al. (2003) [21] also report that the rates of positive reports of medical conditions, particularly diabetes, HTN and hyperlipidemia, were higher with age; however this age-related observation was merely based on self-reported data, i.e., by the patients not by the attending dentists. Thereby, both studies have reason to come to the same conclusion that medical information reporting by dentists may suffer a common discrepancy risk in a variety of healthcare settings and geographical locations.

Now that some patient demographics, time factor, and referring source correlates could not provide valid explanation to the discrepancy trend revealed by this work, suggesting other causes may be justified, and which can be seat for future research to rectify the data documentation practice in QUH. Given these ambiguities, factors believed to be related to systems not people could be argued. In our early search of this work, we realized that medical information was mainly obtained through the “four-page comprehensive health history questionnaire” used in QUH the time of the study. This form was first introduced in 2013 among the effort to improve the quality of the MRS of QUH. Although there was some decrease of the data discrepancy rate the year after (2014) (89.9% instead of 96% in 2013), the new form had no significant advantage over the previously used single-page concise form in reducing the medical information gap. Comparable results associated with changing size and design of patient administered health questionnaires and forms have been achieved. Neither a concise form nor a comprehensive one significantly improved the discrepancies in the responses to inquired health condition items [9]. Further, we could not identify an association between the type of health questionnaire and discrepancy, perhaps that is why the slight reduction in discrepancy in a certain point in time could be attributed to other factors. From the communication standpoint, we saw how flow of data between physicians and dentists through consultation and referral has resulted in more or less similar level of discrepancy as with the information of patients who have directly accessed the dental services. Searching all documents contained in patients’ files, we came across a multitude of incidents where medical information supplied in the referral letters were all messed up. Literally, some data in these referrals were neither reflected in the dental progress notes nor in the general health history form. Additionally, some referrals were so deficient since some physicians tended to write the part of the medical history they believe relevant to the dentist or require precautions. Improper referral documentation is often so impaired so that referrals from some clinics included the dental complaint only and no mention of the patient’s health condition. From these findings, we can conclude that either QUH general health questionnaire per se or the mode it is being administered might have contributed to incomplete or inaccurate medical information documentation, since in the cases of very young or old and illiterate patients, a different person other than the patient would usually fill out the form and jointly with the lack of appropriate dentists’ scrutiny bigger gaps resulted. In addition, the existing paper-based structure of the medical records makes it difficult to obtain complete, up-to-date, and relevant information, especially that some patients have several volumes of the medical record. Moreover, the non-standardized documentation method, together with the fact that employee medical records are kept in employee health clinic which is a third location for patients records within the hospital, all compromise the flow of health information documentation process. The higher prevalence of discrepancy in this study could arguably be attributed to the fact that the study was restricted to cardiac patients who are most likely to have underlying risk factors, and

while the predominant risks for CVD are comorbidities such as obesity, hyperlipidemia, diabetes, and HTN, the mimicking characteristics of our patients support this evidence.

Now that most of our patients have comorbidities, (e.g., diabetes, impaired serum lipid profile, HTN), such risks which also characterize the general Egyptian population [14] could have not been recognized and correlated to patients' characteristics by our dentist population. Further, the detected cardiac cases were not correlated with possible risks during collecting the medical information which led to missing, e.g., more than half of hyperlipidemia cases and around one third of HTN cases.

Strengths and limitations: The study is purposefully focused on a population category which is already high risk owing to the underlying cardiac conditions they bear. Getting exposed to a poorly informed situation as a dental procedure where the underlying health condition is not fully and carefully recognized magnifies that risk. Dental procedures themselves have their own risks, whether or not the patient's health is maintained [25, 26]. Adopting a "common risk factor approach" (CRFA) through a concerted action against such risks helps achieve improvements in a wider spectrum of care with more resource-efficiency than isolated approaches [27]. Further, the sample frame of this patient group actually included all heart disease individuals who have had any previous experience with dental procedures in the study period. This inclusive sample background broadens generalizability potential and can make up for any unforeseen factors that might compromise generalizability. For instance, some may argue that restricting the study to cardiac patients furthers the restriction to higher ages and thereby furthers the jeopardy attempting to generalize the findings upon younger age groups. Restricting some studies to a particular risk group is a common practice in population-based research; and we have to live with the fact that certain health risks are often "confounded" by demographic traits, e.g., age, and so forth [28]. Especially age has been a confounding in a plenty of epidemiological studies, including CVD, to the degree that age becomes part of the risk assessment function such studies have been designed to evaluate [29]. The sampling strategy in the current work is rather meticulous so that a proportional representation of sample strata per year to the actual number of cardiac records in that year could be ascertained. Further, important patient – and health practitioner - associated correlates were hypothesized and analyzed, which helps speculate future solutions to bridge gaps in the current documentation policy. A unified disease coding system was not in place in the original hospital's diagnoses, and this somehow limited our ability to release the research based on diagnosis. Eventually, the current structure of both medical and dental records requires enormous efforts to change existing practice found in this research. Until dramatic improvements in the current hospital's HIS and an updated comprehensive and integrated patient EMR system has been in place, future researches, e.g., with larger samples or longer periods to examine the dental-medical patient data integration and completeness coming up with findings that could be generalized upon the dental patients population will be difficult.

Conclusions: Critical gaps have been identified between dental and dental records, a high proportion of which is attributed to system level problems. A well-established model for efficient communication among medical and dental providers caring for the same patient is essential but does not exist. Fragmented approach in managing medically compromised patients in general and high risk patients in particular might place these patients at further risk and can best be addressed within an integrated medical-dental system. Health information system is an important key in providing an overview on patients' visit registers and medication profile across all settings. A systems level approach to reduce discrepancies between records of interest might also be driven by cost containment since some of these discrepancies may lead to greater use of hospital and emergency reserve. Missing medical information may well interfere with therapeutic efficacy and result in suboptimal management of

health conditions and subsequently a missed opportunity to provide safe and integral service which is one of the hospital's missions. Further, the structural barriers and non-standardized documentation also suggest a role for quality improvement activities to consider extending focus to include patients receiving care across settings, identify gaps in continuity and communication between healthcare providers and include a mechanism for feedback QUH the patient has reached the next care venue.

References

- 1 Aggarwal A, Panat SR, Talukder S. Self-Reported Medical Problems among Dental Patients in Western Uttar Pradesh, India. *Journal of Dental Education*, 2011; 1.75:1635-1640.
- 2 Theis MK, Reid RJ, Chaudhari M, Newton KM, Spangler L, Grossman DC, et al. Case Study of Linking Dental and Medical Healthcare Records, *The American Journal of Managed Care*, 2010; 16.2 :e51-e56.
- 3 Wahid A, Chaudhry S, Ehsan A, Butt S, Ali Khan A. Bidirectional Relationship between Chronic Kidney Disease & Periodontal Disease. *Pak J Med Sci*. 2013; 29(1):211–215. doi: 10.12669/pjms.291.2926.
- 4 Haughney MG, Devennie JC, Macpherson LM, Mason DK. Integration of primary care dental and medical services: a three year study, *British Dental Journal*, 1998; 184(7):343-7.
- 5 Charangowda BK. Dental records: An overview. *Journal of Forensic Dental Sciences*, 2010; 2(1):5-10.
- 6 The Medical and Dental Defense Union of Scotland (2009). Essential Guide to Medical and Dental Records. <http://www.mddus.com/mddus/resource-library/mddus-essential-guides/records3.Asp x?iam=GDP/Hospital+and+Community+Dentist>
- 7 Lewis DM, Krakow AM, Payne TF. An evaluation of the dental-medical history. *Military Medicine Journal*, 1987; 143.11785-7.
- 8 Gilhooly M L M, McGhee S M. Medical records: practicalities and principles of patient possession. *Journal of Medical Ethics*, 1991; 17:138-143.
- 9 Pistorius A, Kunz M, Jakobs W, Willershausen B. Validity of patient-supplied medical history data comparing two medical questionnaires. *European Journal Of Medical Research*, 2002; 7(1):35-43.
- 10 Helminen SE, Vehkalahti M, Murtomaa H, Kekki P, Ketomäki T-M. Quality evaluation of oral health record-keeping for Finnish young adults. *Acta Odontologica Scandinavica* 1998; 56: 288-292.
- 11 World Health Organization (2011). NCD Country Profiles. 2011, Geneva: WHO.
- 12 Rahim HF, Sibai A, Khader Y, Hwalla N, Fadhlil I, Alsiyabi H, et al. Non-communicable diseases in the Arab world. *The Lancet*, 383(9914): 34-45. doi: 10.1016/S0140-6736(13)62383-1.
- 13 Glick M, Greenberg BL. The potential role of dentists in identifying patient's risk of experiencing coronary heart disease events. *The Journal of the American Dental Association*, 2006; 136:1541-1550.
- 14 Almahmeed W, Arnaout MS, Chettaoui R, Ibrahim M, Kurdi MI, Taher MA, et al. Coronary artery disease in Africa and the Middle East. *Ther Clin Risk Manag*. 2012; 8: 65–72. doi:
- 15 Cruz-Pamplona M, Jimenez-Soriano Y, Gracia Sarrión-Pérez MG. Dental considerations in patients with heart disease. *J Clin Exp Dent*. 2011; 3(2):e97-105. doi:10.4317/jced.3.e97.
- 16 Rudman W, Hart-Hester S Jones W, Nadine C, Madison M.. Integrating Medical and Dental Records: A New Frontier in Health Information Management. *Journal of American Health Information Management Association*, 2010; 10: 36-39.
- 17 Dean AG, Sullivan KM, Soe MM. OpenEpi: Open Source Epidemiologic Statistics for Public Health, Version 7. www.OpenEpi.com, updated 2011/23/06. http://www.openepi.com/Menu/OE_Menu.htm
- 18 World Health Organization. (1992). ICD-10 Classifications of Mental and Behavioral Disorder, Geneva: WHO.

- 19 Lutka,RW and Threadgill,JM. Correlation of dental-record medical histories with outpatient medical records ,General Dentistry, 1995; 43(4):342-5.
- 20 Haughney MGJ, devennie JC, Macpherson LM, Mason DK. Integration of primary care dental and medical services: Three-year study. British dental journal 1998; 184(7):343-. doi: 10.1038/sj.bdj.4809620.
- 21 Stewart BL, Sabbah WA, Alrasheed AM. Validation of self-reported medical history data in dental charts, Saudi Dental Journal, 2003; 15: 33-37.
- 22 Stephens M, Fox B, Kukulka G, Bellamy J. Medication, Allergy, and Adverse Drug Event Discrepancies in Ambulatory Care. Clinical Research and Methods, 1999; 40(2): 107-110.
- 23 Orrico KB. Sources and types of discrepancies between electronic medical records and actual outpatient medication use. J Manag Care Pharm. 2008; 14(7):626-31.
- 24 Central Intelligence Agency. (2013). The world fact book.
<https://www.cia.gov/library/publications/the-world-factbook/geos/sa.html>.
- 25 Mann D. Some Dental Treatment is Linked to Heart Risk. Study Shows Short-Term Risk after Invasive Dental Procedures. WebMed Archives. Oct. 18, 2010. <http://www.webmd.com/oral-health/news/20101018/some-dental-treatment-is-linked-to-heart-risk#1>
- 26 CDC Guidelines for Infection Control in the Dental Setting,
<http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5217a1.htm>
- 27 Chapman C. The Common Risk Factor Approach (CRFA) to Oral Health Promotion.
<https://www.dentalcare.com/en-us/professional-education/ce-courses/ce435>
- 28 Laskowski M, Mostaço-Guidolin LC, Greer AL, Wu J, Moghadas SM. Scientific. The Impact of Demographic Variables on Disease Spread: Influenza in Remote Communities Reports 1, Article number: 105. (2011). doi:10.1038/srep00105.
- 29 Collins GS, Altman DG; Predicting the 10 year risk of cardiovascular disease in the United Kingdom: independent and external validation of an updated version of QRISK2. BMJ. 2012;21;344:e4181. doi: 10.1136/bmj.e4181.