Journal of Advanced Medical and Dental Sciences Research

@Society of Scientific Research and Studies ***NLM ID:*** *101716117*

Journal home page: www.jamdsr.com doi: 10.21276/jamdsr Indian Citation Index (ICI) Index Copernicus value = 100

(e) ISSN Online: 2321-9599; (p) ISSN Print: 2348-6805

Original Research

A need analysis for centralized dental data bank architecture in India- time for its establishment

[1]Nimmy P, [2]Prabu D, [3]Dinesh Dhamodhar, [4]Sindhu R, [5]Raj Mohan M, [6]Savitha S

[1,6]Postgraduate, [2]Professor and Head, [3,5]Reader, [4]Senior Lecturer, Department of Public Health Dentistry, SRM Dental College, Ramapuram, Chennai, India

ABSTRACT:

Aim: To emphasize the importance of data bank architecture about oral diseases and management in the field of dentistry among the general population of India and to provide an idea for developing a Centralized Electronic database for the country's oral health data bank. **Materials and methods:** Data search was conducted using MeSH terms: Oral Health Surveys in India, Oral Health Status in India, Dental Record Management in Forensic Odontology, Dental Manpower in India and Dental Record Management in India, Health information system in dentistry in different countries in electronic databases like PubMed, Science Direct, Google Scholar, Cochrane library, Directory of Open Access Journals, Biomed Central. Articles are collected from the year 1999- 2022. The inclusion criteria were only articles in English and full-text articles, and the articles that were not clear were excluded from the study. **Results:** There are only three surveys regarding oral health conducted by the Dental Council of India and the Government of India so far in the last three decades. A comprehensive oral health survey should be conducted by the Government of India to gather information on individual oral health records and the burden of oral disease. The implementation of QR Codes in dental record management eventually helps in the precise collection of patients' dental health records (personal information, dental health status, dental treatment records), data on epidemiological studies, and dental manpower in India.There is no centralized data Centralized, uniform, continuous Electronic Dental oral health databank in India. There are no studies done regarding record management in forensic odontology, dental manpower in India, dental record management in India, and electronic dental health recording systems in various countries by the public sector. **Conclusion:** Oral health is an integral part of overall health. A new oral health policyshould be implemented by the Government of India together with the Dental Council of India from a brand-new Oral health survey. Success in this task will assist the dentists and the Government of India in formulating a strong epidemiological database and Dental record management system. Blending dental health records into a centralized database would be just the beginning of further initiatives such as proper treatment plans, solving medico-legal cases, and managing dental manpower.

Received: 23 December, 2023 Accepted: 17 January, 2024

Corresponding author: Prabu D, Professor and Head, Department of Public Health Dentistry, SRM Dental College, Ramapuram, Chennai, India

This article may be cited as: P Nimmy, D Prabu, Dhamodhar D, R Sindhu, M Raj M, S Savitha. A need analysis for centralized dental data bank architecture in India- time for its establishment. J Adv Med Dent Scie Res 2024;12(2):16-24.

INTRODUCTION

The dental records are legally binding documents that contain information about the patient and are maintained by the dentist. It has a record of all the patient-related history and treatments done in the dental clinic.[1] Adding to it, dental records have information on the patient's past medical history, past dental history, present clinical condition, and prognosis. Deep knowledge of dental records is important for dentists due to the emergence of numerous medical-legal complications and insurance acquisitiveness. [2] While maintaining dental records is required by law in the United States and Europe, the situation is very different in developing nations like India. [3] Dentists in India are largely unaware of this, and the majority keep poor-quality dental records. Numerous mass disasters claim thousands of lives annually, leaving a large number of unidentified victims in their wake. Forensic odontology plays a significant part in victim identification through dental records as each patient's dental condition is unique, where some restorations withstand pressure changes, humidity, and high temperature. [4,5] Also, comparing postmortem and antemortem records is the

most cost-effective method compared to DNA analysis. Forensic odontology is an important science behind victim identification in various mass disasters. [6]

The existing situation demands the formulation of a new oral health survey for India. The country can be divided into major states and Union Territories and sub-divided into districts. The samples can be collected with calibrated dentists and dental nurses. The Government of India and the Dental Council of India together have the responsibility to highlight the oral disease burden of the country through a centralized record management system. As dentistry increasingly concerns itself with the general health of a patient. The ultimate aim of this study is to emphasize the importance of data bank architecture about oral diseases and management in the field of dentistry among the general population of India and to provide an idea for developing a Centralized Electronic database for the country's oral health data bank.

MATERIALS AND METHODS

Data search was conducted in the following electronic database:

1. Pub med
2. Science Direct
3. Google Scholar
4. Cochrane Library
5. Directory of Open Access Journals
6. Biomed Central

The keywords from relevant articles were utilized to identify relevant MeSH [Medical Subjective Heading] terms. A finalized list of MeSH terms was constructed after eliminating redundancies, which are as follows: Oral Health Surveys in India, Oral Health Status in India, Dental Record Management in Forensic Odontology, Dental Manpower in India and Dental Record Management in India, Health information systems in dentistry in different countries. The inclusion criteria were only articles in English and full-text articles. Articles are collected from the year 1999- 2022. The data that was not clear and obvious were excluded from the study. A descriptive analysis was done.

RESULTS

TABLE 1: PREVIOUS ORAL HEALTH PROGRAMS CONDUCTED BY GOVERNMENT OF INDIA

S. No	YEAR	PREVIOUS ORAL HEALTH PROGRAMS IN INDIA
1.	2003	National Oral Health Survey & Fluoride Mapping by Dental Council of India
2.	2004	"Pilot Project" in collaboration with AIIMS by the National Institute of Health and Family Welfare
3.	2005	Report of multicentric oral health survey by Ministry of Health and Family Welfare in collaboration with Dental Department AIIMS

Table 1 represents previous Oral Health Survey programs by the Government of India.

TABLE 2: SOME ORAL HEALTH STATUS EPIDEMIOLOGICAL STUDIES IN INDIA BY PRIVATE SECTOR

S. No	AUTHOR NAME	ARTICLES ON EPIDEMIOLOGICAL STUDIES ON ORAL HEALTH IN INDIA	YEAR
1.	Shah N, et. al [7]	Oral Health in India A Report of the Multi centric Study	2007
2.	Kumar TS, et. al [8]	Oral health status and practices of dentate Bhil adult tribes of southern Rajasthan, India	2009
3.	Purohit BM, et. al [9]	Oral health status of 12-year-old children with disabilities and controls in Southern India	2012
4.	George B, et. al [10]	Oral health status of 5, 12, and 15-year-old school children in Tiruvalla, Kerala, India	2015
5.	Athuluru D, et. al [11]	An epidemiological data of oral health status and treatment needs of the rural population of Nellore district, Andhra Pradesh, India	2016
6.	Thakur AS, et. al [12]	Oral health status and oral health behaviors of 12-year-old urban and rural school children in Udupi, Karnataka, India: A cross-sectional study	2017
7.	Salunke S, et. al [13]	Prevalence of dental caries, oral health awareness and treatment-seeking behavior of elderly population in rural Maharashtra	2019
8.	Vikneshan M, et. al [14]	Oral Health Status of Children between Five Years and Eight Years of Age in Rural Areas of a District in India: A Cross-sectional Study	2019
9.	Varghese CM, et. al [15]	Prevalence of oral diseases and risks to oral health in an urban community aged above 14 years	2019
10.	Neha Reddy LV, et. al [16]	Assessment of Oral Health Status and Access Barriers of	2019

		Patients Reporting to a Dental College in Lucknow	
11.	Avasthi A, et. al [17]	Oral health status of middle-aged (45–55 Years) rural women: A cross-sectional study from North India	2019
12.	Shanmugavadivel G, et. al [18]	Dental caries status of children receiving Highly active antiretroviral therapy (HAART) - A multicentric cross-sectional study in Tamil Nadu, India.	2020
13.	Mittal N, et. al [19]	Prevalence of dental caries among smoking and smokeless tobacco users attending dental hospitals in the Eastern region of Uttar Pradesh	2020
14.	Kavitha D, et. al [20]	Prevalence of Dental Caries in Adult South Indian Population in Association with Dietary Pattern: A Comparative Study.	2020
15.	Shwethashree M, et. al [21]	Prevalence of Oral diseases among school children of Mysuru and Chamarajanagar Districts, Karnataka, India	2020
16.	Reddy P, et. al [22]	Dental Caries Profile and Associated Risk Factors Among Adolescent School Children in an Urban South-Indian City	2020
17.	Aggarwal C, et. al [23]	Prevalence of dental caries and dental fluorosis among 7-12-year-old school children in an Indian subpopulation: a cross-sectional study	2021
18.	Sachdev R, et. al [24]	Assessment of dental fluorosis and dental caries among 8–16-year-old schoolchildren in Kanpur rural region, Uttar Pradesh	2021
19.	Nithya K, et. al [25]	Caries prevalence and associated risk factors in school children at Kannur in Kerala, India: A cross-sectional study	2021
20.	Gadhiraju T, et. al [26]	Prevalence of Dental Caries and Periodontal Disease among Transgenders in Belagavi District, Karnataka, India: A Cross-sectional Study	2022
21.	Doley S, et. al [27]	Association between oral hygiene status and dental caries among 13–14 years old children of Kamrup District, Assam	2022
22.	Kotha SB, et. al [28]	Association between Body Mass Index (BMI) and Dental Caries among 6–12-Year-Old School Children. Children	2022

Table 2 represents some Oral health status Epidemiological studies in India by the private sector.

TABLE 3: ORAL EPIDEMIOLOGICAL STUDY DATA CAN BE COLLECTED FROM

ORAL EPIDEMIOLOGICAL STUDY DATA SOURCE IN INDIA		
GOVERNMENTAL		**NON- GOVERNMENTAL**
1	Dental Council of India	Private Educational Institutions
2	National Institute of Epidemiology	
3	Indian Council for Medical Research	
4	Ministry of Health and Family Welfare	

Table 3 represents the source of Oral Epidemiological data in India.

TABLE 4: OFFICIALS WHO SHOULD ACCESS DENTAL DATA RECORDS

S. No	OFFICIALS WHO ACCESS DENTAL RECORDS	PURPOSE
1.	General Practitioners	Uploading Data
2.	Public Health Dentist	• Interpret data • For epidemiological studies • To evolve futuristic treatment plans • Legislations on oral health
3.	Forensic Odontologist	To solve medico-legal cases

Table 4 represents officials who should access dental data records.

TABLE 5: ARTICLES REGARDING MAINTENANCE PERCENTAGE OF DENTAL DATA RECORDS IN INDIA BY PRIVATE SECTOR

S. No	AUTHOR	ARTICLES SHOWING AWARENESS REGARDING DENTAL RECORD MAINTENANCE IN INDIA	YEAR	RECORD MAINTENANCE PERCENTAGE
1.	Astekar M, et. al [29]	Maintaining dental records: Are we ready for forensic needs?	2011	38%
2.	Gupta A, et. al [30]	Forensic revolution need maintenance of dental records of patients by the dentists: A descriptive study	2016	22%
3.	Wadhwani S, et. al [31]	Maintenance of antemortem dental records in private dental clinics: Knowledge, attitude, and practice among the practitioners of Mangalore and surrounding areas	2018	31%
4.	Agrawal A, et. al [32]	Importance and Maintenance of Dental Records - Are Dentists Aware? A Survey Among Private Dental Practitioners	2020	66.6%
5.	Tomar U, et. al [33]	A vigilance alert for forensic odontology: Preservation and maintenance of dental records in Central India	2020	43%
6.	Sharma SR, et. al [34]	Awareness towards forensic dentistry - A questionnaire-based cross-sectional study	2021	13.4%
7.	Dineshkumar T, et. al [35]	Assessment of knowledge and awareness of forensic odontology among dentists in Tamil Nadu – A systematic review	2022	15%
				MEAN = 32.7%

Table 5 represents the articles regarding the maintenance percentage of dental data records in India. On average only 32.7% of dentists maintain proper dental records.

TABLE 6: ARTICLES REGARDING DATA COLLECTION USING ELECTRONIC RECORD SYSTEMS IN DENTISTRY IN VARIOUS COUNTRIES BY THE PRIVATE SECTOR

S. No	AUTHOR	YEAR	DATA COLLECTION USING VARIOUS ELECTRONIC HEALTH RECORDING SYSTEMS	COUNTRY
1.	Chadwick et al., [36]	2002	Validation of undergraduate clinical data by electronic capture (barcode)	• UK
2.	Thyvalikakath et al., [37]	2008	Assessment of interface usability in 4 commercial dental computer-based patient record systems	• USA
3.	Irwin et al., [38]	2009	Methodology to develop and evaluate a semantic representation for NLP	• USA
4.	Hippmann et al., [39]	2010	Voice-supported electronic health record for temporomandibular joint disorders	• Czechia
5.	Hill et al., [40]	2010	Assessment of the impact of integrating health information technology systems into chair-side patient care on dental school users	• USA
6.	Fedja Masic [41]	2012	Information Systems in Dentistry	• Austria
7.	Walji et al., [42]	2013	Detection and characterization of usability problems in structured data entry interfaces in dentistry	• USA
8.	Noureldin et al., [43]	2014	Quality assessment of care data documentation in an EDR in primary health care units of Alexandria, Egypt	• Egypt
9.	Walji et al., [44]	2014	Evaluation of the effectiveness of 3 different methods for the detection of usability problems in an EDR: user testing, semi-structured interviews, and surveys	• USA
10.	Thyvalikakath et al., [45]	2014	Assessment of dentist workflow during a typical patient examination to help design a novel EDR interface	• USA
11.	Tokede et al., [46]	2016	Assessment of data entered in an EDR and of the frequency of update of each clinical entry (Delphi	• USA

			process)	
12.	Schwei et al., [47]	2016	Assessment of EDR workflow using time and motion methodology to identify breakdowns and opportunities for process improvement	• USA
13.	Thierer et al., [48]	2017	Assessment of the improvement of progress note documentation by dental students after an educational intervention	• USA
14.	Sidek et al. [49]	2017	Identification of the perceived critical success factors of EDR system implementation in a dental clinic	• UK
15.	Asgari I [50]	2018	Development an Electronic Oral Health Record application for educational dental setting.	• Iran
16.	Taylor HL, et. al. [51]	2020	Health information exchange use during dental visits	• USA
17.	Virdee J [52]	2022	Going electronic: an Epic move	•
15.	Irene Li et al., [53]	2022	Neural Natural Language Processing for unstructured data in electronic health records: A review	• USA

Table 6 represents articles regarding data collection using electronic record systems in dentistry in various countries.

TABLE 7: YEAR- WISE AVAILABLE ARTICLES ON RECORD MANAGEMENT IN FORENSIC ODONTOLOGY, ORAL HEALTH STATUS IN INDIA, RECORD MANAGEMENT SYSTEMS IN DENTISTRY IN VARIOUS NATIONS, DENTAL MANPOWER IN INDIA BY PRIVATE AND PUBLIC ORGANIZATIONS

S. No	TITLE	1999-2005		2006-2010		2011- 2015		2016- 2020		2021- 2022	
		PRIVATE SECTOR	PUBLIC SECTOR	PRIVATE SECTOR	PUBLIC SECTOR	PRIVATE SECTOR	PUBLIC SECTOR	PRIVATE SECTOR	PUBLIC SECTOR	PRIVATE SECTOR	PUBLIC SECTOR
1.	Record Management in Forensic Odontology	1	0	1	0	3	0	11	0	4	0
2.	Oral Health Status in India	1	2	2	0	2	0	12	0	6	0
3.	Record Management in Dentistry in India	1	0	4	0	5	0	6	0	2	0
4.	Dental Manpower in India	0	1	0	0	1	0	7	0	2	0
5.	Previous oral health programs in India	0	3	0	0	0	0	0	0	0	0
6.	EHR in Dentistry in various countries	1	0	4	0	5	0	6	2	2	0

Table 7 represents the year-wise available articles on record management in Forensic Odontology, Oral Health status in India, Record management in dentistry in India, Dental Manpower in India, Previous oral health programs in India, and Record management in dentistry in various nations in private and Government sectors.

DISCUSSION

CENTRALIZED EPIDEMIOLOGICAL DATA ON DENTISTRY AMONG VARIOUS COUNTRIES BY THE PUBLIC SECTOR

CDC's Division of Oral Health and the Association of State and Territorial Dental Directors (ASTDD) collaborateswith the National Oral Health Surveillance System (NOHSS) in the USA. On a national and state level, NOHSS monitors the burden of oral disease, the use of oral health care services, and the fluoridation of community water. NOHSS is intended to track oral health care use, the prevalence of oral disease, and the state and national status of community water fluoridation. [54] The Australian Digital Health Agency has recently introduced 'My Health Record' - an online summary of individual medical information that can help to compile all health-related information of an individual in one place that can be accessed, monitored, and updated by each individual and relevant health professional. Several other countries do not have a centralized database for dental health operated by the government. In India, more than 300 public hospitals have adopted QR code-based quick OPD registration as part of the Ayushman Bharat Digital Mission, cutting waiting time. [55] Similarly, oral health data can be accessed with a QR code from the Centralized database when constructed and implemented. The medical field has gradually embraced technology in an effort to enhance patient care, expedite processes, and upend established approaches to data management. [56] A brand new comprehensive oral health survey should be conducted in India by the Government of India, taking all the aspects of dental disease burden (dental caries, periodontal status, malocclusion status, oral mucosal lesions, oral cancer, prosthetic status, Number of teeth present, oral hygiene practices, etc). Since individuals of different ages and sexes were to be examined or interviewed (for oral health problems), it was necessary that dentists should be involved in the data collection teams. Therefore, the Departments of Community Dentistry should be involved in quality data collection work. This comprehensive survey should be conducted with a well-calibrated dental examiner team along with trained dental nurses and statisticians. The gathered data should be incorporated as a QR code for each participant and, eventually, transferred to the centralized database constructed for Indian oral health records.

The World Health Organisation (WHO) created the Global Oral Health Data Bank in 1967 and is still making consistent efforts to maintain oral health surveillance [57, 58]. Regional epidemiology data that follow a consistent approach are important to enable cross-national comparison. The World Health Organisation recommends performing clinical oral health surveys in the same community or environment every five to six years. Following standards, such as using basic instruments and record forms for documenting clinical situations, are advised to ensure data's high validity and reliability. The priorities of the survey methodology include oral health statuses such as oral mucosal lesions, oral precancer or cancer, dental caries, and treatment needs, dentition status, prosthesis status and needs, and developmental anomalies of teeth. [5] World Health Organization (WHO) has a CAPP database (Country/Area Profile Programme Information System), where centralized data from India can be linked to a global platform.

There is a definite need to maintain a dental health databank in a centralized database in India, which can be used in forensic odontology to solve medico-legal cases, to gain knowledge about oral epidemiology and the status of dental manpower, which may ultimately open doors to commence changes in oral health policy and implement appropriate measures to improve oral health in the country. However, the majority of dentists in India do not keep accurate dental records.

USES OF RECORD MAINTENANCE IN FORENSIC DENTISTRY

Charangowda BK [2] reported that in forensics, identification plays a crucial role in investigating and solving medico-legal cases. Forensic odontology, on the other hand, can help in the easy identification of the deceased person if proper dental records are maintained. Dental records, i.e., patient's personal history, medical history, and treatment history, are maintained in a database. Denture labeling using numbers or barcodes helps in after-death identification, even in cases of burns or blasts that involve high temperatures, as dental ceramics can withstand up to 2135 degrees Celsius. [59] Thus, forensic odontology helps in the easy identification of the deceased person rather than the use of complex procedures like DNA analysis. So, a centralized database that contains all the dental records of individual, governmental, and institutional practices should be employed.

EPIDEMIOLOGICAL RECORD MAINTENANCE NEEDS IN DENTISTRY

In India, oral health is a neglected public health concern that receives little governmental attention. Chronic, non-communicable diseases of the mouth impact a wide population, have a substantial impact on general health, and place a heavy socioeconomic burden on the affected individuals. The Global Burden of Diseases- 2016 study reported that globally, 3.9 billion people have any form of oral disease. According to data from the Institute of Health Metrics and Evaluation, the annual rate of oral disorders in India is rising by 0.83%. [6]. Planning programs are made more difficult by the inability to determine the burden of oral disease without a current oral health survey. People and policymakers believe that dental health is not as essential as other health issues despite its high rate of prevalence.

Veiga N et al. [60] reported the importance of epidemiological research in dentistry. Epidemiological research has paved the pathway for determining the cause of many oral diseases and formulating preventive measures. The majority of epidemiological research in dentistry has been done by postgraduate educational institutions, public health organizations, and the government. Collectively, the epidemiological dental data from all these organizations should be fed into a centralized database to establish specific treatment strategies with precise data and time consumption.

Dental record maintenance is a complicated procedure to be undertaken single-handedly. Individual dentists, dental educational institutes, and the government should collaborate in their work to make this mission a success. Arora KS et al. [61] reported that private and government dental institutions and individual practicing dentists in India should maintain electronic dental records that are up to date and transfer them to the centralized database from time to time.

RECOMMENDATIONS

A national research center to plan appropriate programs should be set up and should train and calibrate investigators for collecting and maintaining the country's oral health data bank. The implementation of QR Codes in the dental record databank will serve as a powerful solution in improving communication, transparency, and information between healthcare providers, caregivers, and care recipients, which eventually helps in the precise collection of patients dental health records (personal information, dental health status, dental treatment records), data on epidemiological studies and dental manpower in India.

LIMITATIONS

It is very difficult for a nation like India, with a huge population, to integrate dental records into QR codes. Maintaining dental records of patients with healthy oral cavities is also a challenge. It requires a significant investment of time and energy to complete this procedure.

CONCLUSION

Oral health is an integral part of overall health. A new oral health policy should be implemented by the Government of India together with the Dental Council of India from a brand-new Oral health survey. Creating, maintaining, and sharing clear and accurate patient records is an integral part of a dentist's professional responsibilities. All these procedures are time-consuming, but the success of this task will assist dentists when forensic claims are made, help police and legal staff to correctly identify individuals, and create a strong epidemiological database. Thus, a centralized dental data architecture in India would be just the beginning of further initiatives for proper treatment plans, solving medico-legal cases, and managing dental manpower for the benefit of the citizens of India.

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