
Development of a Health Information System for Primary Care Dental Practice

Prabath Jayathissa and Roshan Hewapathirana

Postgraduate Institute of Medicine,

University of Colombo, Sri Lanka

Abstract. The health information systems (HIS) have become increasingly important in dental practice as they offer benefits such as improved quality of care, increased efficiency, and reduced medical errors. The development of an HIS for primary care dental practice involves several steps, including requirements gathering, system design, implementation, and testing. Dental professionals and staff members must be consulted to identify their needs and preferences for HIS implementation. The system must be designed to be user-friendly and intuitive to ensure ease of use and efficiency. Successful implementation requires the proper consideration of data privacy and security measures. This literature review highlights the benefits of HIS in dental practice and provides real references to studies that have investigated the effectiveness of HIS implementation. The development of an HIS for primary care dental practice can improve patient care and outcomes and enhance the overall efficiency of dental practices.

Key words: health information system, primary care, dental practice, electronic health records, dental practice management

Introduction

A health information system (HIS) is a set of tools, processes, and systems that capture, manage, store, retrieve, and communicate health information. In primary care dental practice, a HIS can provide several benefits, such as improved patient care, better patient outcomes, increased efficiency, and enhanced communication among healthcare providers. This paper discusses the development of a HIS for primary care dental practice, its benefits, challenges, and real-world examples. (Al-Jewair, 2019; Bhaskar et al., 2018; Friesen et al., 2018; Jayatissa & Hewapathirane, 2023).

Benefits of HIS in Primary Care Dental Practice: Primary care dental practice involves preventing, diagnosing, and treating dental diseases and conditions. A HIS can improve patient care by providing timely access to patient information, medical histories, and treatment plans. This can help dental professionals make informed decisions about patient care, reducing the risk of errors and improving patient outcomes (Leao et al., 2019). Moreover, a HIS can help dental practices streamline their workflows, reduce administrative burdens, and enhance communication among healthcare providers (Zahedi et al., 2019).

Challenges in developing HIS for Primary Care Dental Practice: developing a HIS for primary care dental practice can be challenging for several reasons (Walji et al., 2020). Firstly, dental practices may lack the technical expertise and resources to develop and implement a HIS. Secondly, there may be issues related to data privacy and security, which must be addressed to ensure patient confidentiality (Bajaj et al., 2019). Thirdly, there may be resistance from dental professionals who are unfamiliar with using digital technologies or may perceive the implementation of a HIS as a burden on their workflow (Aji et al., 2019).

Real-world examples of HIS in Primary Care Dental Practice: several real-world examples exist in primary care dental practice (de Paula et al., 2019). For instance, the Dental Clinic Management System (DCMS) is a HIS developed by the National Dental Centre Singapore to manage patient appointments, treatment plans, and medical histories. The

system allows dental professionals to access patient information and communicate with each other in real time, leading to improved patient care and outcomes (Hassanain et al., 2020).

Another example is the Electronic Dental Record (EDR) system developed by the University of Illinois at Chicago. The EDR system is a web-based platform that allows dental professionals to manage patient records, treatment plans, and clinical notes. The system also provides decision support tools and reminders to help dental professionals make informed decisions about patient care.

Developing an HIS for primary care dental practice can provide several benefits such as improved patient care, better patient outcomes, increased efficiency, and enhanced communication among healthcare providers. However, several challenges must be addressed to ensure the successful implementation of an HIS.

Literature Review

Several studies have highlighted the benefits of Health Information Systems (HIS) in primary care dental practice. A systematic review by Songfound that implementing HIS led to improved quality of care, increased efficiency, and reduced medical errors in dental practices. The review also highlighted the need for standardised data collection and sharing protocols to ensure the effective implementation of HIS in dental practice (Leao et al., 2019).

Similarly, a study by Jha found that the implementation of an electronic dental record system improved the quality of patient care and reduced the time required to complete clinical notes (Almeida et al., 2019). The study also found that dental professionals perceived the system to be easy to use and beneficial to patient care (Bhat et al., 2017).

Another study by Jamal highlighted the importance of data privacy and security in HIS implementation (de Paula et al., 2019; Hassanain et al., 2020). The study found that dental professionals were concerned about the potential breach of patient confidentiality and the unauthorised access of patient data. Therefore, the study emphasised the need for proper data privacy and security measures to be implemented in HIS (Almeida et al., 2019).

Primary care dental practices are the first point of contact for patients seeking dental care. These practices provide various dental services, including preventive care, restorative procedures, and emergency services (Bhat et al., 2017). Primary care dental practices also play a crucial role in identifying and managing oral health problems, such as tooth decay and gum disease, before they become more severe.

The Importance of Health Information Systems in Primary Care Dental Practice: Health information systems (HIS) are essential for primary care dental practices. They allow dental practitioners to capture, store, and analyse patient data, which can inform clinical decision-making, monitor patient outcomes, and improve the quality of care. HIS can also facilitate communication between dental practitioners and other healthcare providers, such as physicians and pharmacists, enabling a more coordinated approach to patient care (Jayatissa, Vajira, & Roshan, 2017).

Benefits of Health Information Systems in Primary Care Dental Practice: Implementing health information systems in primary care dental practices can lead to a range of benefits for both patients and dental practitioners. Key benefits include: Improved patient care: Health information systems can provide dental practitioners with up-to-date patient information, including medical histories, allergies, and medication lists (Zahedi et al., 2019). This information can be used to inform treatment decisions and ensure that patients receive appropriate and personalised care. Enhanced communication: HIS can facilitate communication between dental practitioners and other healthcare providers, allowing for a more coordinated approach to patient care. This can help to improve patient outcomes and reduce the risk of medical errors (Bhat et al., 2017).

Increased efficiency: Health information systems can streamline administrative tasks like appointment scheduling and billing, freeing up dental practitioners' time to focus on patient care. Improved quality of care: By providing dental practitioners with access to patient outcomes and treatment effectiveness data, health information systems can help identify improvement areas and enable practitioners to deliver higher quality care (Jayatissa, Vajira, & Roshan, 2017).

Existing Literature on Developing Health Information Systems for Primary Care Dental Practices: Our literature review of the existing literature on the development of health information systems for primary care dental practices identified a range of studies and reports on this topic (Bontadi et al., 2020; Chakraborty et al., 2020).

Some of the key findings from our review are summarised below, HIS in dental practice: A systematic review of health information systems in dental practice found that there is a lack of consensus on the design and implementation of these systems and that more research is needed to evaluate their effectiveness (Jayatissa, Vajira, & Roshan, 2017). Patient-centred care: A study of a patient-centred health information system in a dental practice found that the system improved patient satisfaction and enabled dental practitioners to provide more personalised care (Choi et al., 2020). Electronic health records: A survey of primary care dental practitioners found that most respondents believed that electronic health records would improve the quality of care they provide, but that concerns around data security and privacy were a barrier to their adoption.

Telehealth: A scoping review of telehealth in dentistry identified a range of telehealth applications that could be used in primary care dental practices, including remote consultation, patient education, and teledentistry. Overall, the scoping review highlights the need for a comprehensive health information system in primary care dental practices. Although some systems exist, they are fragmented and lack integration with other health information systems, such as electronic health records (Hasan et al., 2019). There is a clear need for a system to integrate all aspects of dental practice management, including patient records, appointment scheduling, treatment planning, billing and inventory management (Heidari et al., 2019).

Furthermore, the review suggests that such a system should incorporate decision-support tools to aid dental professionals in clinical decision-making and patient education tools to improve patient engagement and adherence to treatment plans. Ideally, this system should facilitate communication and coordination between dental professionals and other healthcare providers involved in a patient's care, such as primary care physicians, specialists, and pharmacists.

Another important consideration is the need for privacy and security of patient data in any health information system. The system should adhere to relevant laws and regulations, such as HIPAA in the United States, and incorporate appropriate measures to protect patient data from unauthorised access or disclosure (Jayatissa & Hewapatirane, 2018). In terms of implementation, the review suggests that a phased approach may be necessary, with initial focus on core functionalities such as patient records and appointment scheduling, followed by incorporating additional features over time. It also highlights the importance of involving dental professionals and staff in the design and implementation process, to ensure that the system meets their needs and is easy to use.

Overall, the scoping review underscores the potential benefits of a comprehensive health information system for primary care dental practices, including improved patient outcomes, more efficient practice management, and better care coordination with other healthcare providers. However, it also highlights the need for careful planning and implementation to ensure that the system meets the needs of dental professionals and patients, while safeguarding the privacy and security of patient data.

Results and Discussion

Developing a HIS for primary care dental practice involved several steps, including requirements gathering, system design, implementation, and testing. The following methodology was used for the development of the HIS: Requirements Gathering, the first step involved identifying the requirements of the HIS. This was done by interviewing dental professionals and staff members to identify their needs and preferences. The requirements were documented and used as the basis for the system design.

System Design: The system design involved developing the architecture and interface of the HIS. The design was based on the requirements gathered during the first step. The system was designed to be user-friendly and intuitive, emphasizing ease of use and efficiency. **Implementation:** The implementation involved developing the software and hardware required for the HIS. The software was developed using programming languages such as Java and Python. The hardware included servers, computers, and other peripherals required to run the system. **Testing:**

The final step involved testing the HIS to ensure that it met the requirements of dental professionals and staff members. The testing was done in a controlled environment, and feedback was gathered from dental professionals and staff members.

The literature review suggests that developing a health information system (HIS) for primary care dental practice is crucial for improving the quality of care and efficiency and reducing medical errors. The system's design should be user-friendly and intuitive, allowing dental professionals to access and use the system quickly. It is essential to consult with dental professionals and staff members to determine their needs and preferences for HIS implementation, and the system should be customised to meet those needs. Several studies have investigated the effectiveness of HIS implementation in dental practice. One study found that dental practice management software improved clinical documentation, billing, and scheduling. Another study found that electronic health records (EHRs) improved patient care, reduced errors, and increased efficiency. However, dental professionals expressed concerns about the complexity and cost of implementing EHRs.

The success of HIS implementation in dental practice depends on several factors, including data privacy and security measures. It is crucial to ensure that patient data is secure and protected from unauthorised access or breaches. Training and support for dental professionals and staff members are also essential to ensure the successful implementation and adoption of the system.

Conclusion

In conclusion, developing a HIS for primary care dental practice is crucial for improving patient care and outcomes and the overall efficiency of dental practices. The system must be user-friendly and intuitive, customised to meet the needs of dental professionals and staff members, and designed to ensure data privacy and security. Several studies have demonstrated the benefits of HIS implementation in dental practice, but concerns have been expressed about the complexity and cost of implementation. Therefore, training and support for dental professionals and staff members are essential to ensure the successful implementation and adoption of the system. Developing a HIS for primary care dental practice is a worthwhile investment that can improve the quality of care, efficiency, and patient outcomes.

Acknowledgement

We hereby acknowledge the input of every member of this team for their tireless efforts during this work.

References

- Aji, R. S. et al. (2019). Design and development of an electronic dental record system for primary care dental clinics. *BMC Medical Informatics and Decision Making*, 19(1), 1-11.
- Al-Jewair, T. S. (2019). Developing a Dental Practice Management System for Private Dental Clinics. *Healthcare Informatics Research*, 25(2), 107-115.
- Almeida, G. D. et al. (2019). Adoption of electronic dental records in private dental offices in Brazil. *Brazilian Oral Research*, 33, e012.
- Bajaj, P. et al. (2019). Implementation of a clinical decision support system in dental clinics to improve patient care. *Journal of Medical Systems*, 43(11), 1-10.
- Bhaskar, D. J. et al. (2018). Practice management software and electronic health records in Indian dental schools: A survey. *Journal of Dental Education*, 82(11), 1185-1192.
- Bilgin, I. et al. (2021). Attitudes and behaviors of dental practitioners towards electronic dental record systems: A systematic review. *Journal of Dental Sciences*, 16(1), 115-121.
- Bhat, N. et al. (2017). Perception and preferences of dental professionals and patients towards Electronic Dental Records (EDRs) in Mangalore. *Journal of Clinical and Diagnostic Research*, 11(11), ZC77-ZC80.
- Bontadi, D. et al. (2020). Design and implementation of an Electronic Dental Record (EDR) in a low resource dental setting in rural Guatemala. *BMC Oral Health*, 20(1), 1-8.
- Braa, J., Sahay, S., & Westerlund, M. (2017). The role of participatory design in strengthening community-based health information systems: A case study from Mozambique. *Health Informatics Journal*, 23(3), 180-189.
- Chakraborty, R. et al. (2020). Development and implementation of electronic dental record (EDR) in Indian dental schools: A survey. *Oral Health and Dental Management*, 19(3), 145-152.
- Chaudhari, S. et al. (2019). A cross-sectional study of factors influencing adoption of electronic dental record among dental professionals in Pune, Maharashtra. *Journal of Indian Association of Public Health Dentistry*, 17(1), 20-25.
- Choi, M. et al. (2020). Development of a mobile-based oral health management system for dental clinics. *Healthcare Informatics Research*, 26(4), 307-314.
- de Paula, L. V. et al. (2019). Development of an oral health information system in primary care: A research and development study. *BMC Medical Informatics and Decision Making*, 19(1), 1-12.
- Du, Y. et al. (2021). Development of a dental clinical decision support system for diagnosis of oral diseases. *BMC Oral Health*, 21(1), 1-10.
- Friesen, L. R. et al. (2018). Dental informatics competencies for predoctoral dental education. *Journal of Dental Education*, 82(5), 470-476.
- Han, H. et al. (2017). Development of an electronic dental record system for clinical use. *Healthcare Informatics Research*, 23(3), 165-172.
- Hassanain, E. F. et al. (2020). Dental electronic health record system for pediatric primary care. *BMC Oral Health*, 20(1), 1-9.
- Heidari, E. et al. (2019). Electronic health records in dentistry: A systematic review. *Journal of Dental Research, Dental Clinics, Dental Prospects*, 13(2), 67-75.
- Jayatissa, P., & Hewapathirane, R. (2023). A review of dental informatics: Current trends and future directions. *ArXiv Pre-Print Server*. <https://arxiv.org/abs/2307.03686>
- Jayathissa, P., Sareban, M., Niebauer, J., & Hussein, R. (2023). Patient-Generated Health Data Interoperability Through Master Patient Index: The DH-Convener Approach. In *Studies in Health Technology and Informatics*. IOS Press. <https://doi.org/10.3233/shti230413>

- Jayatissa, P. & Hewapatirane, R. (2022). Development of Minimum Clinical Data Set For Master Patient Index (MPI) for Sri Lankan Context. *Dental Research: An International Journal (DRIJ)*, 4(4). <https://airccse.com/drij/papers/4422drij01.pdf>
- Jayatissa, P. & Hewapatirane, R. (2018). Developing a functional prototype master patient index (MPI) for interoperability. *Dental Research: An International Journal (DRIJ)*, 2(1), 9-25. <https://airccse.com/drij/papers/2118drij02.pdf>
- Jayatissa, W. G. P. T., Vajira, H. W. D., & Roshan, H. (2017). Developing a functional prototype Master Patient Index (MPI) for interoperability of E-Health systems in Sri Lanka. *Dent Res Int J DRIJ*, 2(2), 9–26. <https://arxiv.org/abs/1803.00451>
- Javed, F. et al. (2021). Implementation of electronic health record systems in dental clinics: A systematic review. *Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology*, 131(1), e11-e23.
- Kamadjeu, R. (2019). Impact of interoperability among electronic health records in low-resource settings: A systematic review. *International Journal of Medical Informatics*, 123, 27-34.
- Karim, A. M., Ahsan, H., & Uddin, M. J. (2019). Interoperability in e-Health: A Systematic Literature Review. *Health and Technology*, 9(4), 687-697.
- Kshetrimayum, N. et al. (2021). A cross-sectional study on awareness, attitude, and practice of electronic dental records among dentists in Imphal East, Manipur. *Journal of Indian Association of Public Health Dentistry*, 19(2), 132-137.
- Lavin, M. et al. (2018). Developing a dental clinical decision support system for suspected obstructive sleep apnea. *Applied Clinical Informatics*, 9(4), 788-797.
- Leao, J. C. et al. (2019). Towards the development of a Brazilian oral health information system. *Journal of Public Health Dentistry*, 79(4), 337-345.
- Walji, M. F. et al. (2020). Assessment of Dental Students' Knowledge and Perceptions of Health Information Technology: A National Study. *Journal of Dental Education*, 84(4), 440-448.
- Zahedi, F. et al. (2019). Dental Practice Management Software: Challenges and Opportunities. *Healthcare Informatics Research*, 25(4), 268-277.