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RESEARCH ARTICLE

Smart Odontogram on Preventive Dentistry: A Managerial and Policy Review at Nala Husada Dental Hospital Surabaya

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ABSTRACT

Background: *Digital transformation in dental healthcare has brought forward Smart Odontogram systems that offer structured, electronic, and real-time documentation of dental conditions. This tool is particularly valuable for early detection, monitoring, and prevention of oral diseases. However, its success relies heavily on management readiness and policy.* ***Objective:*** *This study aimed to review the implementation of the Smart Odontogram application from a managerial and policy perspective in supporting preventive dentistry.* ***Methods:*** *This study used a mixed-methods approach. The sample consisted of 12 selected individuals using purposive sampling. Inclusion criterion was involvement in Smart Odontogram implementation for at least six months. Primary data were obtained from interviews and questionnaires, focusing on organizational readiness, human resource competency and training, and managerial challenges and policies.* ***Results:*** *The hospital management has implemented both the hardware and software of Smart Odontogram, but not much (33.3%) integrated with Electronic Medical Record (EMR) system. Only one participant reported a lack of mentoring (8,3%), and only a few received basic training on Smart Odontogram (16,7%). Only one experienced an oversight of data input (8,3%), and a few reported about the lack of quality of data system control (16,7%). Most participants considered Smart Odontogram to be a significant support of preventive dentistry, particularly in the early identification of caries and periodontal diseases (83,3%).* ***Conclusion:*** *The implementation of Smart Odontogram, supported by sound managerial strategies and policies, significantly enhanced preventive dentistry at Nala Husada Dental Hospital.*

Keywords: *Hospital management, preventive dentistry, smart odontogram*

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INTRODUCTION

The development of digital technology has shifted the paradigm of dental medical record-keeping from manual to digital systems. Electronic Health Record (EHR) systems facilitate efficient data management, real-time access to patient histories, and improved collaboration among dental professionals. The adoption of EHR in dentistry has demonstrated significant improvements in patient outcomes by minimizing medical errors, optimizing treatment planning, and enabling better coordination among healthcare providers. Research indicates that digital records improve diagnostic accuracy and procedural efficiency, leading to enhanced patient satisfaction and reduced appointment duration. Furthermore, EHR systems support the integration of decision-support tools that provide evidence-based recommendations for treatment planning.[1]

One of the newest approaches is the Smart Odontogram application, which provides graphical, real-time, integrated recording of dental conditions within an electronic medical record system. Brahmanta et al. (2022), revealed that the inclusion of Artificial Intelligence (AI) elements in this application enables identification of dental conditions through an intraoral camera and deep learning, thereby reducing human error that often occurs in manual recording.[2] The Smart Odontogram application combines automatic detection of dental conditions using an intraoral camera and deep learning algorithms. This study of 15 dentists yielded very positive results; the majority of users reported the system as efficient, effective, and satisfactory in facilitating digital dental status recording. With high accuracy and intuitive operation, this system supports preventive practices such as early caries identification and treatment evaluation from one visit to the next by improving recording consistency and minimizing human error.

Integration of Smart Odontogram into an AI-based Electronic Medical Record (EMR) system in the Journal of Personalized Medicine. This study demonstrated that the digital data structure added to the odontogram improved recording accuracy and supported the Clinical Decision Support System (CDSS). With structured longitudinal data, this system effectively standardizes diagnoses and streamlines preventive planning processes, such as fluoride varnish scheduling and caries prevention. This implementation has demonstrated significant potential for promoting data-driven, preventative dental practices.[3]

Furthermore, integrating Smart Odontogram into a health information system provides several operational benefits. Smart Odontograms were shown to improve time efficiency, recording accuracy, and clinical user satisfaction. They also facilitate clinical team communication and patient education regarding dental status in a visual and objective manner, as implemented at the Ninsaúde Clinic.[4]

Electronic dental medical record system that complies with the standards of the Indonesian Ministry of Health. One of its modules includes a digital odontogram designed in a format that complies with national regulations and supports educational and preventive functions in dental clinical practice. The development of this system strengthens the potential of Smart Odontogram in systematically identifying dental caries and supporting preventive interventions based on patient needs.[5]

The success of Smart Odontogram implementation is heavily influenced by managerial readiness, including strategic planning, staff training, resource allocation, and support for internal hospital policy. Hensley (2020) stated that implementing complex digital systems requires cross-departmental involvement and effective coordination between Information Technology (IT) units, clinics, and quality management.[6] This emphasizes the critical importance of managerial aspects in implementing digital health technology. Challenges such as information system

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adaptation, training, and record quality assurance are key concerns in the Smart Odontogram implementation process.

The development of digital technology through the implementation of Smart Odontograms brings significant opportunities for improving preventive dentistry recording and services at Nala Husada Dental Hospital. However, its utilization is still not optimal, its implementation is not maximal as documentation of odontogram recording improves data accuracy in medical records. It has not become a strategic tool in preventive dentistry practices that rely on long-term documentation, recording, and early management of dental caries; therefore, it has not assisted in technology-based patient education. This is because there are still several obstacles that need to be followed up, especially related to digital infrastructure readiness, system integration, human resource competency, and internal policy support. Based on these conditions, it is important to conduct research that explores managerial factors and internal policies so that this system is fully and effectively implemented.

MATERIALS AND METHODS

This study used a mixed methods approach to determine and understand the implementation of the Smart Odontogram system in supporting dental disease prevention at Nala Husada Dental Hospital from a managerial policy perspective. This study used purposive sampling methods. This technique was used because the study required informants with competence and direct experience in implementing Smart Odontogram. The sample consisted of 12 respondents selected because they had direct involvement in the use or implementation of Smart Odontogram for at least six months (inclusion criteria). Respondents included elements of management, Information Technology (IT) staff, dentists, and clinical supervisors. This technique was chosen to ensure that the data obtained came from individuals who had relevant experience and could provide in-depth information regarding the operation and implementation of Smart Odontogram.

The data in this study were primary data obtained from questionnaires and interviews. Data collection was conducted through in-depth interviews using semi-structured guidelines. Focus group discussions were conducted to determine perceptions of use, barriers, and benefits. Direct observation of the use of the Smart Odontogram system in clinical practice and patient data input was conducted. When completing the questionnaire, there were four indicators asked: organizational readiness, human resource competency and training, managerial challenges and policies, and contributions to preventive dentistry. Each indicator had three questions. This study will be conducted over a three-month period, from April to June 2025. Data Analysis Techniques: Analysis was conducted using a questionnaire in the following stages: (1) data collection, (2) identification, (3) data analysis, and (4) managerial and policy interpretation of the data. Data analysis in this study used two approaches: quantitative data from questionnaire results with a frequency distribution of respondent characteristics (age, position, length of system use), perception scores, benefits, ease of use, barriers, and the percentage of users who stated Smart Odontogram was easy to use. Qualitative data analysis was conducted through interviews, Focus Group Discussions (FGDs), observations of Smart Odontogram use, and document audits (SOPs, policies, and digital system evaluations). Before distribution, the questionnaire underwent validity and reliability tests. Validity was determined if: r count >r table ($p<0.05$), while reliability was tested using Cronbach's Alpha. The questionnaire instrument was considered valid if Cronbach's Alpha ≥0.70. After the quantitative and qualitative analyses were completed, the data were combined to generate a comprehensive understanding of user

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perceptions (quantitative), causes, barriers, and implementation context (qualitative) through FGDs.

RESULTS

This study selected four indicator approaches: Organizational Readiness, Human Resource Competency and Training, Managerial and Policy Challenges, an Contribution to Preventive Dentistry. The research findings are as follows:

Table 1. Organizational Readiness

Aspects	Yes	%	No	%
Hardware availability	12	100	0	0
Software availability	12	100	0	0
Integrated with EMR	4	33.3	8	66.7

The survey results, most respondents stated that management had provided hardware and software to support Smart Odontogram, but it had not been fully integrated with the hospital's electronic medical records system. The majority of respondents (100%) stated that Smart Odontogram hardware and software were available and functional, but only about a third (33.3%) reported partial integration with the electronic medical records system. This means that technical readiness is quite high, but system readiness and integration policies still need to be strengthened by the hospital management and IT team.

Interview results with IT staff Nala Husada Dental Hospital showed that Smart Odontogram system can be used well in the service unit, but it is not yet fully connected to the patient's electronic medical record, and also have to open two separate systems to view clinical data and odontograms. From a technical perspective, full integration is not yet possible because there are no technical guidelines for database integration. The network infrastructure also still needs to be upgraded so that the system can synchronize in real time. This indicates that there is still a gap between infrastructure readiness, managerial system readiness, and data integration policies. The organization is technically ready, but it needs to strengthen integration policies and cross-unit collaboration (IT team, service, and quality) so that the implementation of Smart Odontogram can optimally support preventive dentistry.

Table 2. Human Resources Competence and Training

Aspects	Yes	%	No	%
Basic Training	8	66.7	4	33.3
Mentoring	1	8.3	11	91.7
Never received training	2	16.7	10	83.3

Table 2 shows that some dentists and clinic staff have not received adequate and ongoing training regarding the use of the Smart Odontogram system. Training was only provided at the initial implementation stage, and no periodic updates. Survey results showed that the majority of dentists and clinical staff at Nala Husada Dental Hospital (66.7%) had received basic training at the initial implementation of the Smart Odontogram system. However, only a small proportion (8.3%) received regular mentoring or competency updates, while 16.7% of respondents had never received any training at all. This indicates that user training is still basic and not sustainable, potentially reducing the effectiveness of digital information system implementation in the long term.

In line with the interview results, the Smart Odontogram system can be used well in the service unit, but it is not yet fully connected to the patient's electronic medical record, and two separate systems must be opened to view clinical data and odontograms. The IT staff stated that, from a technical perspective, full integration was not yet possible because there were no technical guidelines for database

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integration. The network infrastructure also still needs to be upgraded so that the system can synchronize in real time. This indicates that there is still a gap between infrastructure readiness, managerial system readiness, and data integration policies. The organization is technically ready, but it needs to strengthen integration policies and cross-unit collaboration (IT, service, and quality) so that the implementation of Smart Odontogram can optimally support preventive dentistry.

Respondents lacked confidence in using Smart integrative features of Smart Odontogram due to a lack of technical assistance. They only learned about Smart Odontogram during practice, and there is no official module yet. Furthermore, there is a gap in user competency regarding the technology. The IT team is often asked to assist users because not everyone understands how to input complex data. Digital skills vary across medical personnel groups. There is no ongoing policy for improving competency through training.

Several policies have not yet supported the use of Smart Odontograms as a preventive tool. This indicator is related to a. Smart odontogram usage policy b. Data input checking c. Data quality control systems. This survey results as shown in Table 3.

Tabel 3. Managerial and Policy Challenges

Aspects	Yes	%	No	%
Smart odontogram usage policy	5	41.7	7	58.3
Data input checking	1	8.3	11	91.7
Data quality control system	2	16.7	10	83.3

According Table 3 shows that there are no officers who check the completeness and accuracy of data input. Supportive policies (41.7%) indicated that less than half of the organizations felt that institutional policies explicitly supported Smart Odontogram as a preventive support tool. This means that many policies have not been formulated or implemented concretely. Respondents feel there is no clear picture of the condition of the policy/supervision. Data input checking officers (8.3%) indicated that specific tasks for data verification and validation are not yet routine or not all units have such officers. The optimal quality control of data input (16.7%) was very low, indicating that the data Quality Assurance (QA) system was not yet running effectively. Input errors, incomplete data, or inconsistencies may still occur frequently.

In-depth interviews with several key informants, including medical records officers and IT officers, revealed that institutional policy support for the implementation of Smart Odontogram was suboptimal. Informants stated that there were no specific regulations governing the system's use, staff responsibilities, or data evaluation mechanisms. Interviews with the staff of the Medical Records Unit showed that the policy regarding Smart Odontogram does exist, but it has not been outlined in an Standart Operational Procedure or binding regulations. Therefore, its implementation still depends on the initiative of each unit. Interviews with the IT team revealed that there was no dedicated officer to double-check the inputted data. There is no dedicated officer was assigned to verify the completeness and accuracy of the data. The checking process remains manual and unstructured. In terms of quality assurance, interviews indicated that the QA system for Smart Odontogram data was not yet effective. Overall, the results of in-depth interviews confirmed that the root of the problem lies in weak policy support, minimal supervisory structure, and the suboptimal role of supporting human resources.

Despite the challenges, clinicians agree that Smart Odontogram can support promotive and preventive efforts through systematic early identification of caries and periodontal status and visual-based patient education. The results are shown in Table 4.

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Tabel 4. Contribution to Preventive Dentistry

Aspects	Yes	%	No	%
Early identification of caries/periodontal disease	10	83.3	2	16.7
Visual based patient education	9	75.0	3	25.0
Improved compliance with follow up visit	8	66.7	4	33.3

Table 4 shows that the implementation of Smart Odontogram plays a significant role in supporting promotive and preventive activities in dental health services: 83.3% of respondents stated that this system helps systematically identify caries and periodontal disease early. 75% of respondents considered smart odontogram effective in visual-based patient education, improving their understanding of dental conditions. 66,6% of respondents stated that there was an increase in patient control compliance due to clearer and easier-to-understand visualization of dental status. Smart Odontograms have proven to be a clinical documentation tool that supports promotive and preventive strategies through systematic early caries/periodontal detection, interactive visual education, and increased patient compliance with follow-up care. It can be concluded that this system will function optimally when integrated with data quality control and training of digital medical record officers.

When asked about the role of Smart Odontograms in supporting early detection of dental disease, most dentists considered Smart Odontograms effective in systematically identifying early caries and periodontal disease, allowing for faster preventive measures.

The following interview results indicate that Smart Odontograms are very helpful, especially for identifying areas of caries or gum recession that might have been missed with manual records. This system visually displays the dental status, allowing us to immediately focus on problem areas. Similarly, when asked about education, the following responses were obtained: Patients understand more easily when they are shown the condition of their teeth directly on the screen. The colors and symbols on the system help them identify which teeth have cavities and which have been treated. This helps make doctor-patient communication more effective. Regarding changes in patient behavior reated to compliance, patients were more willing to come for checkups because they could see the progress of their dental condition on the recording. They want to see whether their teeth are improving or not. This interview emphasized the importance of data quality monitoring and improving human resource competency so that the benefits of Smart Odontograms in improving patient compliance can be optimal and sustainable.

DISCUSSION

Infrastructure readiness is a key factor influencing smooth implementation. Wang et al. (2022), stated that system interoperability is crucial in implementing odontogram-based digital medical records.[3] Smart Odontogram without system integration risks becoming a silo of data rather than a tool for comprehensive patient management.

Table 1 shows that Smart Odontogram hardware and software are available and functional at Nala Husada Dental Hospital, but the system is only partially integrated with electronic medical records. This indicates that system integration and supporting policies still need to be strengthened by management and IT teams.

The software to record electronic medical records must meet certain standards and the Indonesian constitution. To increase the legality of dental medical records and communication to each health provider in Indonesia, the Ministry of Health Indonesia created this guidebook. Writing excellent medical records requires meeting

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specific standards. The guidebook is on how to write and compose dental medical records in a good and precise form, including using symbols in odontogram. Thus, we have the same symbol based on the guidebook from the Ministry of health.[7]

An analysis of dentists' behavior in completing odontograms shows that, in terms of performance expectations, the use of odontograms in electronic medical records is perceived as simplifying the recording process, thus speeding up the work. In terms of business expectations, the odontogram filling system in EMR is considered easy for users to understand and operate. Meanwhile, in terms of social influence on the implementation of electronic medical records, a supportive work environment and supportive leadership have been shown to positively encourage the use of EMR systems.[8]

Despite the evident benefits, several barriers to the widespread adoption of EHRs in dentistry were identified: Financial Costs: Initial setup costs for EHR software and hardware are high, leading to reluctance among solo practitioners. User Training and Technical Issues: Lack of formal training programs results in low digital literacy among older dental professionals. Resistance to Change: Dentists accustomed to paper-based records often express reluctance to transition to digital systems.[9]

Smart Odontogram user training remains elementary and discontinuous. While most staff members receive initial training, some do not. Only a small number receive regular support. This lack of ongoing training could potentially reduce the long-term effectiveness of digital system implementation (Table 2).

The importance of human resource training is crucial, who emphasized that the successful implementation of a digital health information system depends heavily on competency-based training and regular updates for users, enabling them to adapt to evolving system features and procedures. In a managerial context, this indicates the need for a strategy to continuously strengthen human resource capacity through institutional policies that regulate regular training, digital competency certification, and mechanisms for evaluating training effectiveness. This ensures the sustainability of Smart Odontogram implementation and supports the hospital's long-term goal of strengthening IT-based preventive dentistry services.[10]

The main challenges facing human resources, including healthcare and non-healthcare workers, include high workloads, potential human error, lack of technical training, and suboptimal EMR systems. Therefore, strategies are needed to improve the accuracy of EMR data through structured, ongoing, and relevant training, which is consistent with system development. Practice-based training and mentoring for doctors, nurses, and medical records officers should be implemented to strengthen user competencies. Furthermore, continuous evaluation and refinement of the EMR system, including strengthening integration between service units, must ensure faster and more accurate access to medical data and support the continuity of healthcare services.[11]

Medical record training is crucial to the successful implementation of health information technology. According to Piper et al. (2021), comprehensive training improves staff knowledge and skills in managing medical records. This increased competency not only reduces recording errors but also improves the accessibility and security of patient data.[12] The use of electronic medical records also benefits doctors and healthcare workers by simplifying information access and aiding clinical decision-making. Electronic medical records also facilitate patient data maintenance, making them more effective because if a medical record is damaged or lost, a backup of the data is stored within the medical record application.[13]

The success of healthcare system digitalization is greatly influenced by the sustainability and digital literacy training of medical personnel. Without continued training,

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users are less likely to adapt to system updates. Furthermore, the WHO (2021), in its Global Strategy on Digital Health, recommends that every healthcare institution adopt a continuous capacity-building approach, including technical, managerial, and clinical training, to ensure optimal long-term digital system functionality. A training schedule for Smart Odontogram users, including refresher courses on new features, should be incorporated into work programs, education, and training agendas. Develop competency-based training modules integrated with the academic system for clinical students. Implement an internal mentoring system (senior and junior doctors) to maintain competency in system use.[14]

The research results from the managerial and policy aspects (Table 3) indicate that the monitoring mechanisms and supporting policies for Smart Odontogram remain weak. There are no dedicated staff members who routinely check data completeness and accuracy, while institutional policies supporting this system are still perceived as minimal. Only a small number of units have data verification staff, and the quality of data input control is very low. This indicates that the data quality assurance system is not yet effective, resulting in a high risk of input errors and incomplete data.

Legal and ethical issues are also significant. Privacy regulations vary between jurisdictions, creating uncertainty regarding the lawful collection, storage, and sharing of health records. Moreover, the inclusion of dental data may increase the risk of re-identification, as certain dental features are highly distinctive, which is why dental records are commonly used in forensics. This raises important questions about who should be entitled to access complete patient records and how secondary use of such data should be governed. Patients may be reluctant to consent to data sharing if the risks are not clearly communicated, and clinicians may hesitate to participate if the legal frameworks remain ambiguous. Security breaches further intensify these concerns, potentially undermining public trust and jeopardizing the widespread adoption of EHR systems.[15]

The success of a digital system is highly dependent on policy support and governance of data quality. This is in line with research that states that the absence of supervision leads to low quality and consistency of data in electronic systems.[16] System and data quality affect the level of satisfaction and success of EMR users. Hospitals with strong data training and supervision policies have higher implementation success rates. These results indicate that policy support and user training have begun to take shape, but data quality oversight remains a weak point in the implementation of digital systems at Nala Husada Dental Hospital's long-term history of preventive care.[17]

Therefore, Nala Husada Dental Hospital needs to create policies to strengthen formal policies regarding the integration of Smart Odontogram into the hospital's quality system and electronic medical records, and to create ongoing and competency-based training programs for all system users. Data quality assurance supervision and periodic audit mechanisms were used to ensure that the quality of odontogram data remained valid and could be used in preventive dental analysis.

Smart Odontograms have been proven to be not only a clinical documentation tool but also support promotive and preventive strategies through systematic early detection of caries/periodontal disease, interactive visual education, and increased patient compliance with follow-up care. This system will function optimally when integrated with data quality control and training of digital medical record staff. Artificial Inteligen (AI) assisted caries detection tools show potential for clinical applications, with high overall accuracy and specificity. However, its sensitivity varies greatly depending on tooth position and caries type; more advanced AI can improve the performance of AI-assisted caries detection in clinical practice.[18]

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Intraoral photo images play an important role in early screening and clinical diagnosis of oral diseases, detecting dental caries, dental calculus, and gingivitis, based on the overall characteristics of the tooth surface and gingival margin.[19] The use of information technology in dental health has several roles. First, it supports clinical decisions in the context of oral health. Second, websites, mobile applications, and other information technology resources can be used to promote better oral health. Third, information technology helps individuals access information about oral disease symptoms and preventative measures that help them maintain their oral health.[20]

The evaluation of the quality of dental records, including the charting process and overall clinical documentation, indicates that the quality of medical records and the accuracy of data entry play crucial roles in providing high-quality dental health services. Accurate and complete records not only assist dentists in determining the correct diagnosis and treatment plan but also enable ongoing monitoring of the patient's condition. Therefore, good charting quality contributes directly to the effectiveness of care management, including early identification of changes in dental conditions, allowing for faster, more precise, and more structured preventive measures against oral diseases. This makes good medical records a key component in supporting the practice of preventive dentistry and maintaining overall clinical service standards.[21]

Based on the findings of this study, several recommendations can be made to integrate Smart Odontogram with the electronic medical records system and hospital management dashboard comprehensively to support interoperability and data-driven decision-making. Human resource training and capacity building must be conducted regular training and mentoring for dentists and dental nurses regarding the use of Smart Odontogram. Internal regulations and standard operating procedures must be developed, and internal policies that require the use of Smart Odontogram in all clinical procedures must be strengthened. Quality indicators for recording must be established as part of the performance evaluation of healthcare workers. Data audit and monitoring conduct regular audits of the completeness and accuracy of data in Smart Odontogram as part of the hospital's quality management system. Encourage the use of data from Smart Odontogram for the development of patient education programs, early screening for caries or periodontal disease, and annual preventive management reports to increase utilization for promotion and prevention. Developing advanced research based on digital data from Smart Odontogram to generate scientific evidence regarding the effectiveness of Preventive.

CONCLUSION

The Smart Odontogram has strong potential to support preventive dentistry at Nala Husada Dental Hospital; however, its implementation remains constrained by managerial and policy challenges. Adequate digital infrastructure, system integration, continuous staff training, and internal regulatory support are essential to ensure its effectiveness. The system can improve systematic dental records, enhance patient visual education, and support data-driven preventive intervention. However, without strong policies and oversight, its role may be limited to documentation rather than functioning as a strategic preventive tool.

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