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Smart Libraries for Smart Dentists: Conceptualising a Digital Future for the Central Library of Government Dental College Dibrugarh

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Abstract: The swift transition towards digital learning and evidence-based practices within health science education demands the evolution of traditional health-science academic libraries into intelligent, technology-enhanced knowledge centres. Inaugurated in 2023, the central library of Government Dental College Dibrugarh (GDCD) currently operates through manual systems with resources available only in print, which restricts its ability to meet the expanding academic and research demands of BDS students, interns, and faculty members. This paper conceptualises a smart library framework that is feasible and tailored to meet the unique requirements of dental education within the context of a state government-funded institution. Drawing from literature on smart libraries, health information behaviour, and the digitisation of libraries, the paper conducts an assessment identifying the deficiencies between the existing state of the GDCD library and the established attributes of smart health science libraries. Additionally, it reviews the pertinence of national health knowledge databases and repositories, alongside specialised dental learning platforms and biomedical information portals. Based on this analysis, the paper proposes a phased smart library framework that includes operational automation, digital connectivity, and the integration of a knowledge ecosystem. The framework details how the gradual introduction of a library management system, internet infrastructure, and supervised access to digital platforms can convert the GDCD library into a hub of knowledge access, thus supporting evidence-based learning, the development of clinical skills, and research activities. In conclusion, the paper asserts that the digital transformation of the GDCD library transcends a mere infrastructural enhancement and is a strategic imperative for nurturing competent, research-driven, and digitally proficient dental professionals in line with contemporary healthcare education.

Keywords: *Automation; Dental College; Digital Access; Research Support; Smart Library.*

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I. INTRODUCTION

Academic libraries within health sciences institutions are currently undergoing a notable transformation, moving away from traditional print-based collections towards digitally enhanced knowledge environments. This transition holds particular significance within the realm of dental education, where the emphasis on evidence-based practice, rapid scientific progress, and ongoing research necessitates prompt and seamless access to up-to-date scholarly information [1]. Notably, on a global scale, libraries are progressing towards becoming "smart libraries" that incorporate information and communication technologies (ICT), automated tools, digital catalogues, and networked resources to enhance accessibility, effectiveness, and user interaction [2,3]. A smart library can be defined as an intelligent and technology-driven ecosystem that facilitates learning and research through automation, digital resources, remote accessibility, and efficient information retrieval systems [4,5]. In institutions such as medical and dental colleges, these libraries play a vital role in granting students and faculty easy access to research databases, clinical guidelines, and scholarly journals necessary for academic success and patient care [6,7]. As a result, contemporary health-science academic libraries are now evaluated not just on the size of their physical collections but on their capability to provide digital access to knowledge.

In India, national medical consortium such as the NML–ERMED Consortium and the Medical Shodhganga repository [8,9,10] have emphasized collaborative access to high-quality electronic medical resources and the centralized archiving of postgraduate research across medical and dental institutions. These initiatives promote resource sharing, digital integration,

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and improved research visibility within the health sciences education ecosystem. Regulatory and academic quality frameworks increasingly recognize the importance of authenticated e-resource access, research preservation, and information literacy as essential components of academic infrastructure in medical institutions. These developments reflect the growing expectation that health sciences libraries must actively support digital learning, evidence-based practice, and research dissemination.

Within this evolving context, the central library of Government Dental College Dibrugarh (GDCD) represents a newly established academic library with significant potential for digital transformation. Government Dental College Dibrugarh was established in 2018 and recognized by the Dental Council of India in 2019 [11]. The GDCD library, inaugurated in 2023, currently functions through entirely manual processes with approximately 2,000 print books and 20 print journals serving BDS students, interns, and faculty across nine departments. There is no implementation yet of a library management system, barcode or RFID technology, digital cataloguing, e-journal subscriptions, Wi-Fi connectivity, computer terminals, remote access, or institutional digital repository.

Concurrently, there has been a steady rise in academic and research endeavours at the college, demonstrated by faculty members publishing research articles, participating in conferences and workshops, and being involved in patent-related projects [11]. This increase in research activities highlights a disparity with the outdated digital infrastructure of the library, underscoring the necessity to rethink its function in facilitating academic and research brilliance. Over-reliance on physical collections hampers access to up-to-date global research and hinders effective information retrieval, both crucial elements in evidence-based dental education, as noted by [1] and [3].

The concept of "smart libraries for smart dentists" arises from the disparity between current limitations and future educational requirements. A smart library goes beyond just technological advancements, serving as a strategic facilitator that integrates library services with the digital progression of dental education and research. Viewing this evolution for the GDCD library offers an opportunity to establish a practical, gradual route towards automation, digital accessibility, and improved knowledge services while operating within the constraints of government-backed infrastructure. This paper therefore aims to lay the conceptual foundation for transforming the GDCD library from a manual setup into a smart, digitally empowered library tailored to the needs of dental education. The following sections will examine the rationale, scope, objectives, methodology, and a proposed framework for achieving this transformation.

II. LITERATURE REVIEW

The transformation of academic libraries from traditional print repositories to digitally integrated knowledge environments has been extensively explored in library and information science literature. Researchers underscore that contemporary libraries must serve as proactive partners in education, learning, and research rather than merely functioning as static storage spaces [2]. The notion of the "smart library" has arisen from this evolution, characterised by automation, digital catalogues, interconnected resources, and user-focused information services, all facilitated by information and communication technologies [3]. In the realm of health sciences education, libraries play an especially pivotal role, as students and faculty require up-to-date, evidence-based information for both academic study and clinical practice. Research into the information-seeking behaviour of healthcare professionals reveals a significant reliance on prompt access to peer-reviewed journals, databases, and online resources [7]. Reference [1] additionally observed that the ease of digital access greatly impacts the frequency with which academic professionals read and utilise scholarly articles. This underscores the critical importance of digital infrastructure in libraries that support medical and dental education.

Research indicates that automating library systems and enhancing digital services significantly boosts user satisfaction, streamlines information retrieval processes, and enhances overall research productivity [5]. Reference [12] observe that academic libraries are playing an ever-increasing role in supporting research by offering digital repositories, bibliometric services, and data management support. These services are particularly crucial in professional colleges where the volume of research output is on the rise. In the Indian context, various national initiatives are strengthening the incorporation of health science academic libraries into digital knowledge networks. Platforms like SAKSHAM (LMIS) [13], the NML-ERMED (National Medical Library e-Resources in Medicine) Consortium [9], the National Medical College Network (NMCN) [14], and the NHA digital academy [15] facilitate access to e-learning materials and medical e-resources, which can be effectively leveraged through digitally equipped libraries. Repositories such as Medical Shodhganga (ICMR) [8] provide access to theses and dissertations pertinent to health sciences research.

In the realm of dental education, modern teaching and learning methods are increasingly embracing digital platforms for clinical training and online knowledge repositories. Platforms such as Spear Education [16], DentalXP [17], Digital Smile Design (DSD) Online [18], OHI-S [19], and Institute of Digital Dentistry (iDD) [20] exemplify the heightened reliance on digital resources for the enhancement of clinical skills and lifelong learning. Access to biomedical databases like PubMed/MEDLINE [21] is crucial for pursuing evidence-based dental education resources. Consequently, the literature underscores three pivotal insights: firstly, that smart libraries boost academic and research efficiency; secondly, that education in the health sciences is heavily reliant on digital information access; and thirdly, that while national and field-specific digital platforms are accessible, their efficacious utilisation necessitates integration into institutional library systems. These conclusions lay the academic groundwork for developing a smart library framework that is tailored to meet the requirements of the central library, Government Dental College Dibrugarh.

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III. RATIONALE

The necessity for smart libraries within professional education emerges from the increasing reliance on timely and evidence-based scholarly resources. In the field of dentistry, where education, clinical decision-making, and research are driven by the latest scientific literature, traditional library systems and solely print-based collections limit the efficient acquisition of knowledge [7,1]. The implementation of library automation, digital cataloguing, and networked information services has been demonstrated to significantly improve the performance of academic libraries and enhance user satisfaction [2,3].

In the Indian context, national knowledge initiatives such as the SAKSHAM LMIS, National Medical College Network and the NHA Digital Academy offer access to extensive digital collections supporting medical and dental education. Repositories such as medical shodhganga further facilitate the accessibility of theses and dissertations pertinent to research in health sciences. The integration of these platforms is increasingly regarded as vital for academic libraries in health science institutions. The central library of Government Dental College Dibrugarh functions solely through manual operations, lacking any form of automation, internet connectivity, or digital resources. Meanwhile, there is a consistent rise in faculty research activities, publications, and academic participation. This situation results in a disparity between the users' information requirements and the current library infrastructure.

Therefore, the purpose of this paper is to address this disparity by outlining how the GDCD library can make the transition to a smart library model through a gradual process of automation and integration with national digital knowledge networks. Such a transformation is anticipated to enhance support for teaching, learning, and research in the field of dental education within the institution.

➢ *Scope*

This paper primarily aims to conceptualise a viable pathway for transforming the central library of Government Dental College Dibrugarh (GDCD) from a completely manual system into an advanced, digitally equipped academic library tailored for dental education. The focus is confined to exploring how automation, digital cataloguing, internet access, and e-resources can enhance library services for BDS students, interns, and academic staff. The paper specifically considers the integration with national knowledge platforms to facilitate improved access to scholarly literature pertinent to dental sciences. The scope encompasses proposing a staged framework for library automation, digital accessibility, and resource integration that is feasible within the limitations of a state government-funded institution. It also addresses how such transformation can support teaching, learning, and research activities in the college. Nonetheless, the paper does not engage in international comparisons, cost assessments, architectural redesign of the library premises, or analysis of user behaviour through surveys, as its focus remains on the conceptual planning for digital transformation.

➢ *Objectives*

The objectives of the paper are as follows:

- To assess the existing structural and functional status of the central library of Government Dental College Dibrugarh in relation to contemporary standards of health science academic libraries.
- To identify the infrastructural, technological, and digital gaps in the present manual library systems of GDCD.
- To formulate a practical, scalable smart library framework tailored to the academic and research needs of GDCD.
- To propose a phased implementation strategy for the digital transformation of the GDCD library within a state government-funded setup.
- To recommend institutional measures for strengthening teaching, learning, and research support services through library modernisation.

IV. METHODOLOGY

This paper follows a conceptual, descriptive research methodology aimed at designing a feasible smart library framework for the central library of Government Dental College Dibrugarh (GDCD). The methodology is grounded in scholarly literature on smart libraries and health sciences information behaviour, contextual analysis of the current GDCD library status, and mapping of realistic digital solutions through national and dental-specific knowledge platforms. The approach does not involve surveys or experimental data but relies on systematic interpretation of existing conditions and established models of digital library transformation.

➢ *Research Approach*

The research adopts a qualitative, concept-oriented approach based on three components:

- Review of scholarly literature on smart libraries, automation, and digital services in academic and health science libraries.
- Understanding information-seeking patterns in medical and dental education, and
- Examination of relevant digital knowledge ecosystems.

National health and academic platforms such as SAKSHAM (LMIS), the National Medical Library e-Resources in Medicine Consortium, the National Medical College Network, the NHA Digital Academy, and repositories like Medical Shodhganga (ICMR) are examined for their applicability to GDCD. In addition, domain-specific dental learning platforms such as Spear Education, DentalXP, Digital Smile Design (DSD) Online, OHI-S Dental, Institute of Digital Dentistry (iDD), and biomedical databases such as PubMed/MEDLINE are considered as essential components of a smart dental library environment.

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➢ *Data Sources*

Table 1 Data Source Categories

Source Category	Details
Institutional context	Present manual status of GDCD library, collection size, user base, and facilities as documented in Pragya [11]
Scholarly literature	Peer-reviewed works on smart libraries, digital transformation, and health sciences information use
National platforms	SAKSHAM, NML-ERMED, NMCN, NHA digital academy, medical shodhganga (ICMR)
Dental knowledge platforms	Spear education, DentalXP, DSD Online, OHI-S, iDD
Biomedical database	PubMed/MEDLINE for evidence-based learning needs

As can be seen in Table 1, the paper utilises both contextual institutional data and secondary scholarly sources.

➢ *Analytical Framework*

A gap analysis framework is applied to compare:

- Existing manual practices at the GDCD library.
- Documented characteristics of smart and automated academic health science libraries.

The gaps identified in automation, access, infrastructure, and digital integration inform the development of a context-specific smart library framework and a phased implementation plan suited to a government-funded dental college.

➢ *Methodological Flow*

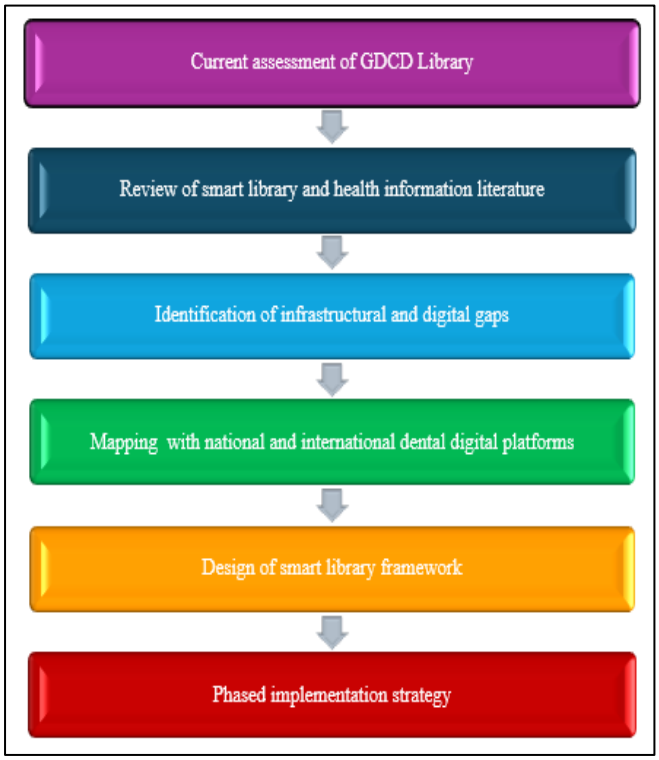

Fig 1 Methodological Flow of the Paper

This structured methodological progression ensures that the proposed smart library model is grounded in both theoretical and practical realities of GDCD.

V. ANALYSIS

The analysis focuses on a comparative assessment of the existing manual operations of the central library at Government Dental College Dibrugarh (GDCD) against the documented characteristics of modern, digitally enhanced health science libraries. This discrepancy is further highlighted when considered in relation to the college's expanding academic and research initiatives and the presence of digital knowledge ecosystems relevant to medical and dental fields, both national and international.

➢ *Present Functional Status of GDCD Library*

The GDCD library currently operates through manual procedures without:

- Library management system (LMS)
- Digital catalogue or OPAC
- Barcode/ RFID-based circulation
- Internet connectivity or wi-fi
- Computer terminals for users
- Access to e-journals, databases, or digital repositories

The collection consists of approximately 2,000 print books and 20 print journals serving BDS students, interns, and faculty across nine departments.

➢ *Characteristics of Smart Health-Science Libraries (from Literature Review)*

The literature review identifies the following essential components of smart academic libraries in health sciences:

- Automated cataloguing and circulation
- Digital access to journals and databases
- Integration with national and global knowledge networks
- Support for research visibility and information literacy
- Access to domain-specific digital learning platforms

➢ *Gap Table*

Table 2 presents the observed gaps highlighting the deficiencies between the components of a smart library standard and the current operational status of the GDCD library, followed by Figure 2 illustrating the gap's nature.

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Table 2 Gaps— Smart Library Standard vs. GDCD Library's Current Standing

Component	Smart library standard	GDCD library's current status	Observed gap
Cataloguing	LMS with OPAC	Manual registers	No digital discovery
Circulation	Barcode/RFID	Manual issue-return	Inefficient tracking
Access	e-journals, databases, wi-fi	Print resources only	No real-time information access
Research support	Repositories, database access	None	Limited research facilitation
Learning support	Digital learning platforms	None	No support for modern dental learning
Networking	Integration with national platforms	None	Isolation from knowledge networks

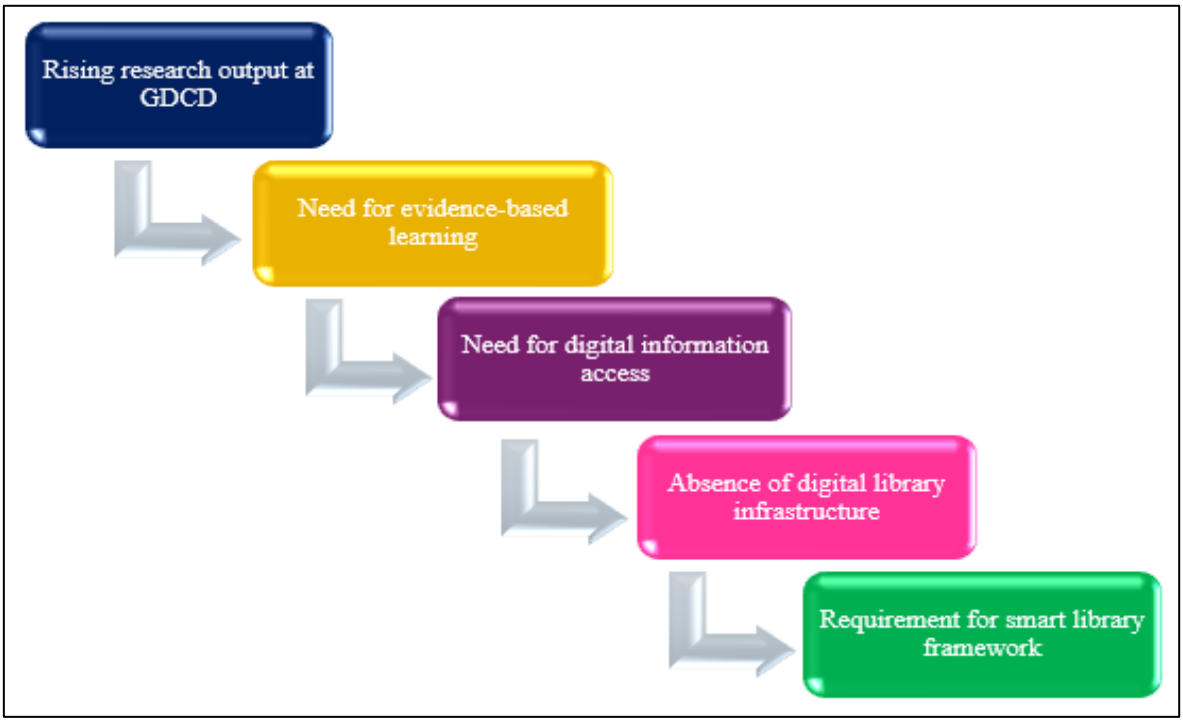

Fig 2 Nature of the Gap

➢ *Relevance of National Health Knowledge Platforms*

Platforms such as SAKSHAM (LMIS), National Medical College Network (NMCN), NHA Digital Academy, and Medical Shodhganga (ICMR) provide structured medical education resources, tele-education, training modules, and access to theses. These can significantly enhance academic engagement if accessible through a digitally enabled library environment.

➢ *Relevance of Dental Digital Learning Platforms*

Modern dental education relies heavily on platforms such as Spear Education, DentalXP, Digital Smile Design (DSD) Online, OHI-S, and Institute of Digital Dentistry (iDD), along with biomedical databases like PubMed. The absence of digital access at GDCD prevents students and faculty from engaging with these globally accepted learning resources.

Table 3 shows various knowledge platforms pertaining to health-science and dental education (both national and international) and their accessibility at the central library of Government Dental College Dibrugarh.

Table 3 Knowledge Systems Available and their Accessibility at GDCD Library

Sl. No.	Available health-science and dental knowledge platforms (national and international)	Accessible through GDCD library?
1	SAKSHAM (LMIS)	No
2	National Medical College Network (NMCN)	No
3	NHA digital academy	No
4	Medical shodhganga (ICMR)	No
5	Spear education	No
6	DentalXP	No
7	Digital Smile Design (DSD) online	No
8	OHI-S	No

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9	Institute of Digital Dentistry (iDD)	No
10	PubMed/MEDLINE database	No
11	NML-ERMED consortium	No

➢ *Analytical Insight*

The analysis clearly indicates that the limitation at GDCD is not lack of academic demand, but lack of digital infrastructure to connect users with available knowledge ecosystems. The gap is infrastructural and technological rather than academic. This creates a strong foundation for proposing a phased smart library framework that integrates automation, connectivity, and resource access aligned with dental education needs.

VI. PROPOSED SMART LIBRARY FRAMEWORK FOR GDCD

The proposed smart library framework for the central library of Government Dental College Dibrugarh (GDCD) is designed as a layered, phased, and need-based transformation model that aligns library modernisation with the academic and research demands of dental education. The framework does not view automation as a standalone upgrade but as a progressive integration of technology, connectivity, and knowledge ecosystems.

➢ *Conceptual Foundation of the Framework*

The framework is built on three interdependent pillars:

- Operational automation- to streamline internal library functions.
- Digital access infrastructure- to connect users with information resources.
- Knowledge ecosystem integration- to link GDCD's library with national and international health-science and dental specific learning platforms.

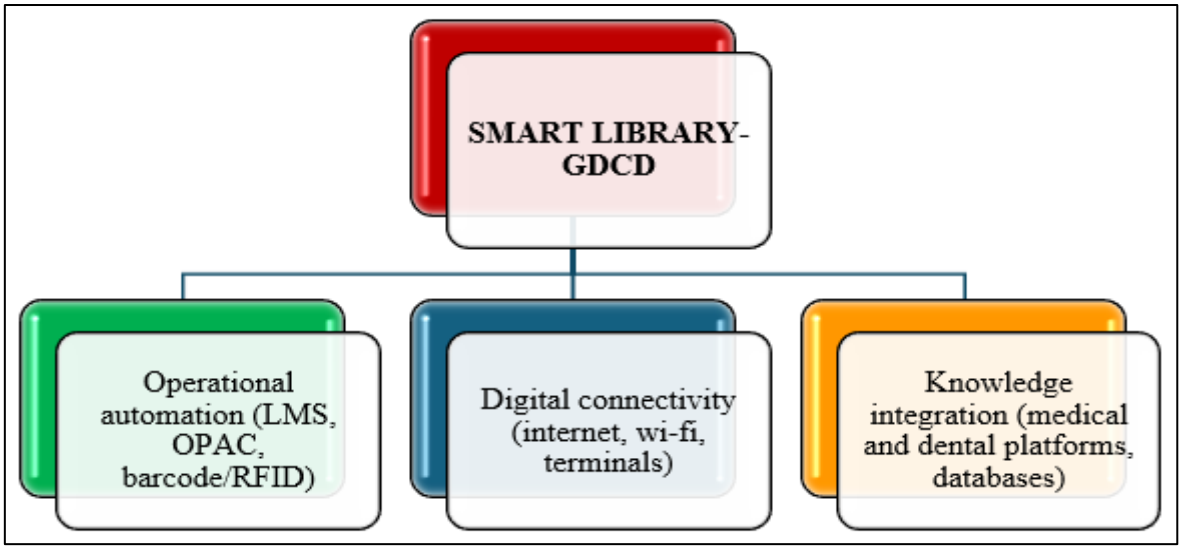

Fig 3 Core Architecture of the Smart Library Framework

➢ *Pillar 1— Operational Automation*

This first step focuses on introducing a Library Management System (LMS) with OPAC and barcode/RFID-based circulation. The existing print collection of approx. 2,000 books and 20 journals will be digitally catalogued. Automation reduces manual workload, improves accuracy in circulation, and enables quick resource discovery. The implementation of operational automation through a Library Management System, complemented by barcode or RFID-based circulation, is anticipated to yield several functional advantages for the GDCD library. A digitally catalogued collection, accessible through the Online Public Access Catalogue (OPAC), will enable students and faculty to effortlessly search for and locate resources, thereby eliminating dependence on manual registers. Automated processes for issuing and returning will ensure precise and efficient tracking of library materials, thereby minimising errors and reducing administrative burdens. Furthermore, the system will produce usage data and analytics, allowing the library to gain insights into user behaviour, resource demand, and the efficacy of services, which can guide future planning and resource development.

➢ *Pillar 2— Digital Access Infrastructure*

Automation alone is inadequate without sufficient digital connectivity. This pillar emphasises the importance of ensuring reliable internet access and wi-fi capabilities within the GDCD library, in addition to providing dedicated computer terminals for both students and faculty. Such measures will establish access points to e-resources, online databases, and training platforms that are vital for contemporary dental education. By facilitating uninterrupted connectivity, this element serves as an essential conduit linking the GDCD library with external medical and dental knowledge systems of both national and international level, thus enabling users to take advantage of a broad spectrum of digital learning and research platforms.

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➢ *Pillar 3— Knowledge Ecosystem Integration*

Upon establishing operational automation and digital connectivity, the central library of GDCD can serve as an entryway into expansive knowledge ecosystems critical for dental education and research. By integrating with national health and academic platforms like SAKSHAM (LMIS), the National Medical Library e-Resources in Medicine (NML-ERMED) consortium, the National Medical College Network (NMCN), the NHA digital academy, and medical shodhganga (ICMR), students and faculty can gain access to structured e-learning modules, tele-education services, medical e-resources, and repositories of postgraduate theses relevant to health sciences. These platforms collectively foster capacity building, academic training, and enhance research visibility across medical institutions in India. Concurrently, the library can provide access to specialised dental learning and clinical skill enhancement platforms such as Spear Education, DentalXP, Digital Smile Design (DSD) Online, OHI-S, and the Institute of Digital Dentistry (iDD), which are widely acclaimed for advancing clinical knowledge and continuing dental education. Furthermore, access to biomedical databases like PubMed/MEDLINE is indispensable for advancing evidence-based learning and research amongst students, interns, and faculty. With this integration, the GDCD library transitions from being merely a physical space to a digitally connected hub of knowledge access, aligning its users with national health education initiatives and global dental learning resources, thereby directly supporting academic excellence and clinical proficiency.

Figure 4 shows the functional workflow of the proposed smart GDCD library, illustrating how students and faculty interact with the system. Users begin with an OPAC search to identify required resources, which may lead to either physical books or digital materials. Through digital connectivity, they can further access national health platforms and dental learning systems, ultimately supporting evidence-based learning, research activities, and clinical skill development.

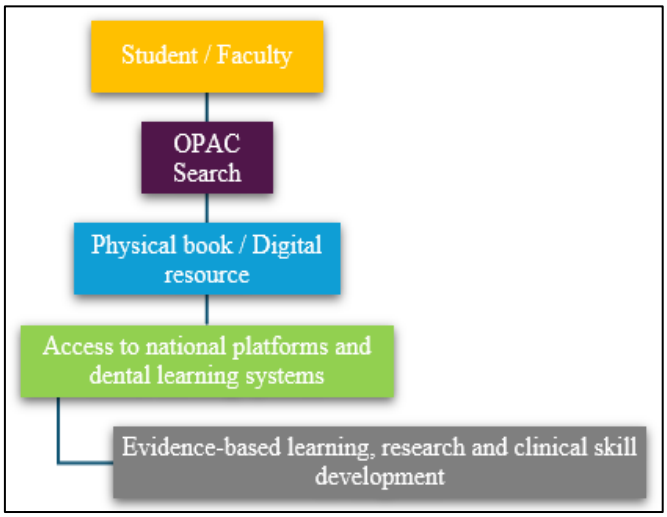

Fig 4 Functional Flow within the Smart GDCD Library

➢ *Phased Implementation Strategy*

Table 4 outlines the phased implementation strategy for transforming the GDCD library into a smart library through a logical sequence of interventions. The progression begins with automation of core library functions, followed by establishing digital connectivity, then integrating health-science and dental knowledge platforms, and finally developing research-oriented digital services. This phased approach ensures gradual, manageable development aligned with institutional capacity while steadily enhancing learning and research support.

Table 4 Phased Implementation Strategy for Transitioning the GDCD Library from Manual Operations to a Smart, Digitally Enabled Library System.

Phase	Intervention	Purpose	Outcome
Phase 1	LMS + Cataloguing + Barcode	Automate core functions	Digital discovery and tracking
Phase 2	Internet + wi-fi + terminals	Enable connectivity	Access to e-platforms
Phase 3	Integration with health-science and dental platforms	Knowledge expansion	Research and learning support
Phase 4	Digital repository and research services	Academic strengthening	Increased research visibility

➢ *Functional Impact on GDCD Library's Stakeholders*

As can be seen below, Table 5 demonstrates how the proposed smart library framework directly benefits different stakeholders of GDCD. By aligning digital access, automation, and knowledge integration with user needs, the smart library supports evidence-based learning for students, clinical skill enhancement for interns, research facilitation for faculty, and overall academic advancement for the institution.

Table 5 Functional Impact of the Proposed Smart Library Framework on GDCD Stakeholders

Stakeholder	Benefit from smart library
BDS students	Access to evidence-based learning resources and dental training platforms
Interns	Clinical skill enhancement through digital platforms
Faculty	Easier research access, publication support, thesis repository access
Institution	Alignment with modern academic and accreditation expectations

The framework demonstrates that the transformation of the central library of GDCD from manual to smart can be accomplished through methodical, cost-effective, and gradual measures. Instead of requiring substantial immediate financial outlay, the model advocates for a gradual integration, which directly fosters dental education, enhances the expansion of research, and aligns with national digital health objectives.

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VII. RECOMMENDATIONS

Based on the analysis and the proposed framework, the following recommendations are suggested for the phased transformation of the central library of Government Dental College Dibrugarh (GDCD) into a smart library system.

- The college administration should formally recognize library automation and digital access as an academic priority aligned with dental education and research growth. Inclusion of smart library development in institutional planning and budget proposals to the Directorate of Medical Education (DME) / Medical Education and Research Department (MERD)— Government of Assam, will be essential for systematic implementation.

- Immediate steps should be taken to adopt a suitable library management system with OPAC and barcode / RFID facilities to digitise the existing collection and automate circulation processes.

- Provision of reliable internet connectivity, wi-fi, and user computer terminals within the library should be prioritised to enable access to digital platforms and databases.

- The GDCD library should orient users to access and utilise platforms such as NHA Digital Academy, SAKSHAM (LMIS), National Medical College Network, etc., through basic awareness sessions and guided access once digital connectivity is established.

- Students, interns, and faculty members should be encouraged to use dental learning platforms such as Spear Education, DentalXP, etc., along with training in literature search using PubMed, as part of routine academic support by the library.

- In the later phase, the library should initiate steps toward setting up a small institutional digital repository for dissertations and faculty publications and provide basic research support services such as reference management guidance and literature search assistance.

- Regular orientation sessions for students and faculty on using OPAC, digital databases, and dental science education platforms should be organised to ensure effective utilisation of the smart library infrastructure.

VIII. CONCLUSION

The evolution of health-science academic libraries into advanced, digitally-capable knowledge hubs is crucial for facilitating modern clinical science education. In the field of dentistry, where access to up-to-date information is vital for evidence-based learning, research participation, and the development of clinical competencies, traditional library systems are becoming increasingly inadequate. A review of literature on smart libraries underscores the significance of automation, connectivity, and integration with digital knowledge networks in enhancing academic productivity. The central library of Government Dental College Dibrugarh, which was recently established and is presently functioning through manual processes, represents a significant opportunity for carefully planned digital transformation. The assessment within this paper reveals that the core limitation is not a lack of academic demand, but the lack of digital infrastructure capable of linking users to existing national and international dental science platforms and contemporary dental educational resources.

By proposing a phased framework for a smart library that focuses on operational automation, digital access infrastructure, and integration with a knowledge ecosystem, the paper delineates a feasible pathway for modernisation within a state government-funded context. Such a transformation would directly benefit BDS students, interns, and faculty by providing access to evidence-based resources, clinical learning platforms, and research support systems. Thus, envisioning a smart library for GDCD is not simply an infrastructural enhancement, but a strategic initiative towards cultivating competent, research-focused, and digitally adept dentists, well-prepared for the contemporary healthcare landscape.

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