Arab American University
Faculty of Graduate Studies

Assessing oral healthcare delivery process for proposing a framework to establish a dental electronic registry at Arab American University - Palestine

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This thesis was submitted in partial fulfillment of the requirements for the Master's degree in Health Informatics
02 / 2026

Thesis Approval

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Declaration

I declare that, except where explicit reference is made to the contribution of others, this thesis is substantially my own work and has not been submitted for any other degree at the Arab American University or any other institution.

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Dedication

I deeply dedicate my thesis to my family, who have been my inspiration source and who have given me power when I thought of giving up and who typically provide their emotional and spiritual support, and without them by my side, I wouldn’t be where I am today, and I will be eternally grateful. They lent their support and stood with me at all times. Their wisdom and belief in lifelong learning inspired my journey.

Acknowledgments

This thesis is the culmination of many years of work, during which I have received the support and help of many.

I would like to begin by thanking Dr. Shahnaz Najjar for all her help and kindness, along with for imparting her health informatics expertise. Her every class and assignment gave me the motivation to focus my efforts in this direction. Through her knowledge and kindness, she inspires me to believe in myself, works me harder, and pushes me on, wanting to know more. I appreciate you seeing the researcher in me from our first meeting. Your keen observations on the scientific research have been instructive and guided the inquiry into the methods and data analysis of the study. I could not have completed this research without your insightful comments.

I also appreciate the insightful comments of Dr. Rami Hodrob and his offer of his expertise on dental registry research and health informatics. Dr. Hadrob's assistance and valuable advice are much appreciated. Specifically, his advice facilitated administrative and dissertation-writing procedures.

My loving wife Israa and my lovely family, no words can adequately explain how grateful I am for your unwavering affection, support, and understanding. Thank you for sticking with me through thick and thin and believing in me. Your love and, at times, distraction helped me refine my thesis. Thank you, my lovely wife, for your unending love and support.

Lastly, but certainly not least, I want to extend my deep appreciation to every one of my friends and colleagues who helped by lending their time, energy, and support to the fulfillment of this work.

Abstract

The oral healthcare delivery within university dental teaching clinics depends on timely access to complete and accurate patient information. Yet in many low and middle-income settings, documentation is primarily in paper-based form. This impacts continuity of care, auditability and educational supervision that is driven by data. The objective of this thesis was to assess the current oral healthcare delivery and documentation workflow at the Faculty of Dentistry, Arab American University–Palestine (AAUP) in order to generate evidence to inform the design of a feasible, user centred electronic dental registry and phased implementation roadmap. A mixed-method cross-sectional design, a combination of a quantitative survey, and qualitative inquiry. Between February and July 2023, quantitative data were collected from undergraduate dental students (n = 319) and clinical instructors (n = 75). These were done through a structured questionnaire that examined patient management and administrative processes, record keeping, educational & clinical training instruments (Logbooks and feedback), internal system integration and organisational performance. Organized interviews were conducted with the management of dental schools to obtain qualitative data in regard to contextual challenges, facilitators, and strategic priorities.

The quantitative data was analyzed using descriptive statistics (means, SDs, percentages, frequencies) while the qualitative data was analyzed thematically. Qualitative findings were integrated with survey results to develop an evidence-based framework. The findings indicated that paper-based medical records are heavily relied on as a central element of clinical workflow. This resulted in variations in ease of retrieval, fragmentation of information across departments, limitations in longitudinal follow-up, as well as institutional reporting. Although these barriers identified in the literature to the adoption of health information systems (i.e. infrastructure readiness, training capacity, cost) were a concern, both students and instructors were highly ready for digitisation. Both groups were confident that electronic systems would improve documentation quality, workflow efficiency, and patient care. Participants believed that the electronic logbook was a tangible tool to start the digitalisation journey. The ease of data entry was highlighted, as was the opportunity to receive quick feedback that is trackable and educational. Based on evidence collected through

mixed methods, the thesis proposes a three-phase user-centred framework for an electronic dental registry for the AAUP.

The phases included planning and design for standardisation and participation, implementation and training according to the clinic and academic settings, and monitoring and sustainability for continual evaluation, governance and adaptiveness. The suggested framework for the registry contains a contextually relevant pathway designed for institutional digital transformation as it relates to Palestinian dental education and provides a basis for future interoperability with national IT systems for health, quality improvement initiatives and oral health policies.

Keywords: electronic dental registry; dental education; mixed-methods; paper-based medical records; e-logbook; workflow; interoperability; Palestine.

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Chapter One: Introduction

1.1 Background

A registry can be conceptualized as an organized system for the structured collection of standardized information on individuals for a defined purpose (Drolet & Johnson, 2008). In the healthcare setting, it is most often used specifically to refer to "patient registries" in order to differentiate health data collections from other types of document collections. A "patient registry" doesn't have a specific definition that one can use internationally. It is taken to mean "a file of documents with comparable information on individual persons, brought together systematically and comprehensively, for a particular reason" (Brooke, 1974). Newer comprehensive definition highlights them as "an organized system for the collection, storage, retrieval, analysis, and dissemination of information on individual persons who have either a particular disease, a condition that predisposes to the occurrence of a health-related event, or prior exposure to known substances or circumstances suspected to cause adverse health effects" (Gliklich et al., 2020). Patient registries are valuable tools that can be used for monitoring disease progression, understanding differences in treatment and outcome, exploring issues affecting quality of life and prognosis, studying patterns of care (including appropriateness and inequities), evaluating effectiveness, monitoring safety and harm, and rating quality of care (Gliklich, 2020). Modern registries are being increasingly used to derive deeper insights, enrich data, and inform regulatory decision-making, as they are strong sources of real-world data and real-world evidence. This is because modern registries have access to advanced analytics and AI. (Saran, et al 2023). A registry can support epidemiological surveillance and disease characterization, and it is also used to evaluate quality of care, patient safety/harms, and cost or value of healthcare delivery

(Gliklich et al., 2020; Evans et al., 2017) At the end, registries are likely to help improve patient care and various other health care indices like cost, benefit to society, and quality of life. Often, registries can be classified into the triad of disease or condition registries; these registries define the typical manifestations, phenotypic diversities, and clinical improvement of the condition in the patient group with a specific illness. Product registries assess the safety or hazard of different types of substances or products (Eirik et al., 2021). In conclusion, health

service registries, which are the subject of this study, “measure the extent to which health services to individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge” (Kurk et al., 2018).

Based on standard classification, disease/condition registries account for the majority (65%), followed by service registries (26%), with product-based registries being the least common (10%), as illustrated in Figure 1.

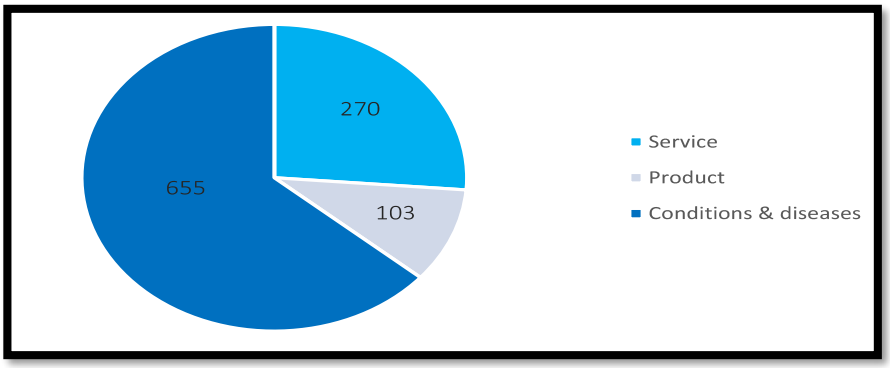

Figure 1: Breakdown of all registries based on their category

When we analyze further, we notice that many subgroups of registries are based on organ systems or clinical fields. Among these, the maximum number of registries fall into the vascular subcategory. Currently, the dental sector has the smallest number of registries (Kurk et al., 2018), as shown in Figure 2 and Table 1. This gap motivated us to go for probably the least studied health informatics area in the dental sector.

Over the years, registries have changed from handwritten, manually classified records to modern computerized registries (Weddell, 1973); however, the basic terms in the definitions of "registry" have not changed very much. At the same time, the number of registry projects has been growing to a remarkable extent, always growing in registry considered at any regional level (Parker R. 2010). In the world of medical registries, there are currently 1028 registers in use with capacity for more (Zaletel J. 2015). This makes the lack of dental registries even more surprising.

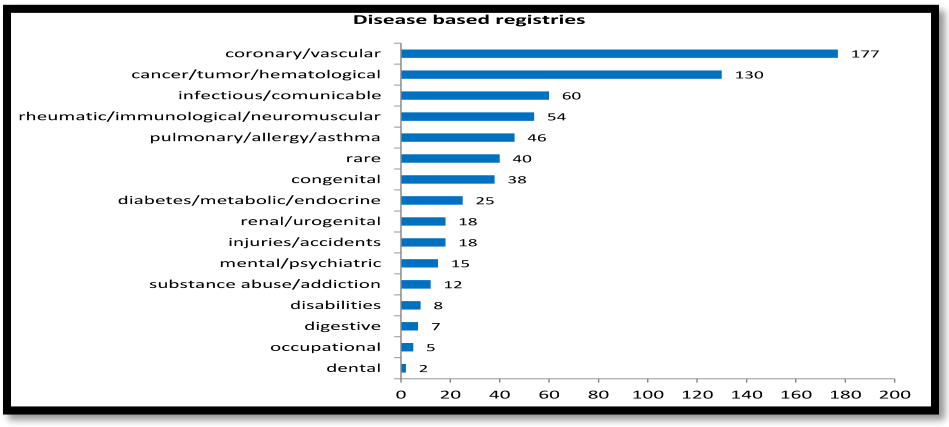

Figure 2: Disease-Based Registries

The goal of a dental registry is to capture comprehensive patient information from electronic dental records (e.g., demographics, dental status/diagnoses, risk assessments, and care provided) in a structured manner so that, after validation, these data can be efficiently extracted and reused for quality improvement and research purposes (von Bültzingslöwen et al., 2019; Wanyonyi et al., 2019)

A dental registry is a dental healthcare field registry of a defined cohort of people with a specific oral disease, infection, condition, exposure, and/or service related to dental health care to collect, analyze, interpret, and disseminate data and other information (Gliklich et al., 2020). The systematic approach will ensure that services are scientifically and clinically pre-planned to achieve desired public health goals. The growing use of artificial intelligence (AI) is increasingly impacting every aspect of dentistry, including diagnostics, treatment planning, and patient management. There is a need for structured high-quality data that the dental registry can provide. AI techniques analyze patient data like clinical records and X-rays. They provide more efficient and accurate diagnoses.

Modern registries and digital clinical data sources are increasingly used to generate real-world insights and support decision-making; however, extracting value—especially for personalized planning—depends on robust data acquisition, data quality, and advanced analytics/AI capabilities (Alghauli et al., 2025).

Table 1: Distribution of identified registries (Zaletel J. 2015)

Country	N	Country	N
Spain	191	Latvia	17
UK	139	Estonia	16
France	82	Slovenia	15
Portugal	66	Netherlands	14
Ireland	65	Multi-country	13
Germany	41	Czech Republic	11
Hungary	40	Switzerland	10
Austria	38	Malta	9
Italy	38	Cyprus	8
Finland	32	Greece	7
Sweden	29	Romania	6
Croatia	28	Lithuania	4
Poland	24	Serbia	2
Norway	23	Albania	1
Belgium	19	Bulgaria	1
Denmark	19	Georgia	1
Slovakia	18	Turkey	1
		Total	**1028**

1.2 Problem Statement

Organizing clinical dental data and information has always been considered a challenging area. There are health information systems for registries being implemented in Palestine. The Palestinian National Institute of Public Health, along with the Ministry of Health (MoH) has initiated improvement for the cancer registry. Furthermore, a maternal and child health electronic registry has also been established, and after some initial difficulties, it has contributed to a gradual improvement in maternal and child health outcomes for the last 10 years (Isbeih et al., 2019).

Recently, the Ministry of Health in Palestine initiated the unification of maternal, child, and family health data into a national information system, DHIS2. The completed initiative by 2026 aims to introduce a dental registry in 14 districts to track oral health services (DHIS2. 2025). Though this is an important step towards digital health and public health surveillance in Palestine, it is essential to clarify its scope. A registry with a public health focus collects aggregate data for reporting and epidemiology. However, there has not yet been created a well-designed, clinically relevant electronic dental registry for managing in-depth patient

data quality improvement and research at a university dental faculty institution like Arab American University – Palestine (AAUP). Dental patients' data must continually be organized such that they are available to all dental care providers in the dental faculty departments at all future visits to the AAUP. The collected information must be processed so as to provide valuable data for upcoming dental health care professionals to make the right treatment decision and also greatly help in research. The absence of accurate, complete, and analyzed information systems in a clinical educational setting can result in lost valuable data, potentially leading to suboptimal outcomes for dental patients and hindering academic and research pursuits. This critical need for a detailed clinical dental registry is observed globally and locally in Palestine.

Up to the present day, there has been no research conducted in Palestine that documents the whole process of oral healthcare delivery on dental patients, which begins from the time of diagnosis and ends when the treatment is completed, followed by proposing a scientific framework for an electronic registry that serves to decongest the process. In Palestine for the first time at AAUP, it will provide a scientific framework for outlining and functionally featuring a dental electronic registry. The primary purpose of this framework is to empower dental health care providers with enhanced knowledge and appreciation of data systems. This will pave the way for delivering more accurate and quality dental services and deriving research from more precise and readily available data.

1.3 Significance of the Study

By focusing on the documentation of the oral healthcare delivery process to a dental patient, this study attempts to propose a framework to establish an electronic dental registry. Further, this process must start from diagnosis and stop at completing the treatment of dental patients. In addition, a robust outline and functional feature of a dental electronic registry will be able to screen the full range of dental patient data (relevant to conditions, diagnosis, treatment procedures, and outcomes) in electronic dental records. The electronic registry method can allow for regularly updated data and on-demand reports (Ovretveit J et al., 2016). The dental registry will also positively impact the AAUP's competency for dental research efforts and improve the patient care quality. The information gathered from various departments can be used on a clinical level to pinpoint areas that need to be improved when it comes to patient

dental healthcare (Nelson et al. 2016). Recent literature strongly supports the role of registries, which might be able to bridge health, research, education, and innovation. Furthermore, registries evaluate diagnostics, assess treatment results, discover differences, and produce a 'research culture' (Nelson et al., 2016).

Most Palestinians struggle greatly with the effectiveness and accessibility of the oral healthcare delivery system. In addition, additional challenges are insufficient incorporation of competent professional dentists in public institutions providing more health and social services, limited choices and flexibility in personnel, insufficient association of dental and other healthcare professions hindering equitable access to oral health care, and the unavailability of national oral health care standards to guarantee assured access to a determined quality of oral health care for all citizens, irrespective of their conditions. Lower- and middle-income countries often face these barriers, emphasizing the need for robust organizational support, training, and consideration of user acceptance (Akhlaqet al., 2016).

The AAUP delivers oral healthcare to a geographically selected population. Furthermore, the demand is high for an improved delivery system that can highlight oral health needs of particular population groups. Also identify strengths and weaknesses of the existing delivery system. Recommend manpower innovations to deal with access issues. Finally, present policy considerations for improving the delivery system. The existing oral healthcare delivery system's evaluation and solutions proposed in the study may provide additional knowledge that may be considered an essential aspect to increase the healthcare framework of improvement and digital world transformation.

This current study is the first to evaluate systematically the existing workflow for delivering oral healthcare services at AAUP and to propose a novel design for a comprehensive dental electronic registry within this specific context. The anticipated results will contribute to an integrated and dynamic approach to providing individuals with the highest quality of oral healthcare services.

1.4 Main Objective

This thesis's primary aim is to assess the oral healthcare delivery process for proposing a framework to establish a dental electronic registry at Arab American University – Palestine. To achieve this main objective, we have established the following sub-objectives:

- To evaluate the current oral healthcare delivery process and its data workflow of dental patients' records in the faculty dental clinics from the perspectives of both students and instructors.
- To identify the challenges and facilitators to improving the oral healthcare delivery process within the faculty dental clinics, particularly concerning data management and the potential for electronic registry adoption.
- To propose a scientific framework for establishing a comprehensive dental electronic registry at Arab American University – Palestine.

1.5 Research Questions

The principal research question of this thesis is, how can the current oral healthcare delivery process be assessed to propose a framework for establishing a dental electronic registry at Arab American University—Palestine? To answer this main question, we also seek to answer the following sub-questions:

- What is the current oral healthcare delivery process and its data workflow of dental patients' records in the faculty dental clinics from both students' and instructors' points of view?
- What are the expected challenges and facilitators influencing the improvement of the oral healthcare delivery process and the adoption of an electronic dental registry within the faculty dental clinics?
- What recommendations are proposed to establish a comprehensive and effective dental electronic registry at Arab American University – Palestine?

Chapter Two: Literature Review

2.1 Oral Health

Maintaining oral health is crucial for one's overall health and well-being. According to the World Health Organization, oral health includes being free of tooth loss, periodontal disease, oral cancer, oral infections, and other conditions. Additionally, these cause pain when speaking, biting, chewing, and engaging in psychosocial activities (Peres et al., 2019). This comprehensive definition emerged from a need to encompass the full spectrum of health and well-being, moving beyond a mere absence of disease to include the values, perceptions, and expectations of an individual. Recent evidence about oral health indicates, the difficult relationships between illness, medical condition state, and physiological and psychosocial functions. In the same way, the World Dental Federation believes that oral health is a multisided phenomenon that includes speaking, smiling, tasting, touching, chewing, swallowing and expressing oneself in the absence of pain or discomfort (Glick et al., 2016). Oral healthcare is essential from a medical point of view. It helps prevent and treat infections in the orofacial area. In addition to this, it aids in alleviating pain. Next, it helps to restore the form and function of teeth. Lastly, it helps to correct craniofacial deformities or dysfunctions (American Academy of Pediatric Dentistry, 2024).

Poor oral health can have a big impact on your general health. Poor mouth care in particular can make the mouth a reservoir for excessive amounts of microorganisms, which may lead to respiratory tract infection diseases such as aspiration pneumonia and also may increase atherosclerosis (Desvarieux et al., 2003; El-Rabbany et al., 2015; Sjögren et al., 2008). Moreover, teeth or dentures that are unstable in chewing function may eventually lead to loss of weight and malnutrition (Saarela et al., 2014). Exposure to pain due to dental problems is often associated with lower quality of life and appearance of the teeth (Porter et al., 2015). The domains of nutrition and dental hygiene practices, awareness, attitudes, and behavior affect oral health. Gingivitis and tooth decay could occur if deficiencies are found in any of these aspects. It is important to maintain good oral hygiene in order to prevent these common oral diseases (Chapple et al., 2009).

However, the role of digital health literacy, patient engagement, and personalized prevention in improving oral health outcomes is increasing. The evolving trend of event monitoring signals to populations and governments that high-quality communication is always valuable. The dental electronic registry justifies the understanding of the multidimensional nature of oral health. Such a registry will make available relevant, standardized, and easily accessible data, which is needed to monitor disease incidence, quality of care, and for evidence-based decision-making in an academic dental setting such as AAUP.

2.1.1 Dental Caries

Dental caries is a condition that affects the surfaces of a tooth. It is a dynamic process that is mainly caused by an imbalance in the bacteria within the oral biofilm (Pitts et al., 2017). The beginning is when a decrease in the pH of salivary levels occurs below a certain level. The process of tooth decay. When the pH goes up, there can be remineralization, and the oral environment is in equilibrium. The sugar we eat leads to tooth decay because it feeds bacteria that make acid. These acids lead to a dangerous drop in pH (Pitts et al., 2017). A growing concern is that children and adolescents globally have increased their intake of sugar-sweetened beverages—a major source of added/free sugars—over recent decades (Lara-Castor et al., 2024). Dental decay frequently causes discomfort and distress. Kids with the pain and severe effects of dental caries may find difficulties in communication, chewing, and sleeping. It can make it hard for kids to focus on school, which can affect their education (Ruff et al., 2019). According to the recent study, dietary interventions and early preventive measures can help in reducing the global burden of dental caries (Moynihan et al., 2016)

To be functionally useful in a university teaching clinic, a dental electronic registry must consist of systematic caries-related indicators, like lesion classification, risk assessment of the patient, delivered preventive measures, and follow-up outcomes. This data will help us identify those who are at risk and will evaluate our prevention programs and monitor how well we treat. This data is currently not available with AAUP’s paper-based or unstandardized documentation. Using organized caries data in a registry system directly facilitates enhanced patient care, education for students, and public health planning.

2.1.2 Gingivitis

Gingivitis refers to inflammation of the gingiva, clinically characterized by redness, swelling, and a tendency to bleed on gentle provocation (Chapple et al., 2015). Microbes on the gingival margin for a long time are the main cause of gingivitis. People may experience gum disease at any age. If gum disease is not recognized and treated, it can lead to periodontal infection. This is an infection of the tissue that surrounds and supports the teeth. This can ultimately lead to tooth disease or tooth loss. (Kwon et al., 2021) demonstrated that gingivitis is also associated with other systemic conditions, such as diabetes and coronary heart disease. Having good plaque control that maintains overall and dental health is very important. New studies are researching personalized ways to prevent and manage gingivitis, often using digital tools to educate and monitor patients (Buck, 2024). Recent strategies shed light on personalized prevention and digital monitoring. Digital health tools and patient engagement platforms are being investigated to augment plaque control and self-care behaviors while aiding in the early detection of periodontal changes. There is an increased trend for preventive dentistry to depend on data. The electronic dental registry must include standardized periodontal indicators (bleeding score, plaque index, pocket depth, and risk profiles) because gingivitis is highly prevalent and highly preventable. By adopting these approaches inside AAUP's clinical workflow, trends in gingival health can be monitored as routine, the effectiveness of student-delivered care can be evaluated, and patients needing prevention can be identified. Data in a structured way with periodontology information will assist in enhancing quality of care and promote evidence-based teaching to undergraduate dental students.

2.1.3 Identifying Elements

There are many factors that contribute to dental disorders. Certain risk factors, if present, either environmental, behavioral or biological, largely increase the risk of oral disease. Dentists can find patients at high risk to set up personalized preventative programs. Evaluating these factors will be critical to best address prevention and managing dental care (Featherstone et al., 2021). Age plays a significant role in oral health as many attitudes and behaviours are established in childhood. As a result, people who practice good oral-care from an early age make better decisions during adulthood. Most importantly, oral health

knowledge, education level, income, and social status are other significant determinants. In addition, raising awareness is important for individuals and families to choose a healthier diet and hygiene as well as use of dental facilities (Williams et al. 2013). Adequate knowledge is essential for the upkeep of oral health in parents as well as children. According to Alzahrani et al. (2024), having enough knowledge allows individuals to make appropriate decisions. Alternatively, less knowledge or perceived unimportance of oral health may heighten risk due to non-engagement in proper oral hygiene behavior.

Our thoughts and knowledge directly influence our behavior. Nevertheless, being aware of something, in this case, that brushing teeth is beneficial doesn't necessarily mean that people will do it. This explains how behavior directly impacts dental health. An individual's perception of the situation, motivation, skills, and social situation determine behavior. Attitude is another crucial aspect of dental health. People's attitudes are largely a function of their environment. They are developed early through lessons learned through experiences. Emotional and rational (cognitive) represent attitude classification. Changing behavior can change attitude, and it is no easy feat (Albarracín, 2018). In order to change a behavior, a person must have the adequate information, but he must also be ready, able, and motivated to change it. Effective patient-dentist communication helps in bringing about a change in the personality of a person. A successful form of communication with the oral healthcare practitioner is the patient's trust, as a new attitude to a new activity must feel voluntary so that the patient can adopt it in daily life (Albarracín, 2018). Improvements in digital health literacy are increasingly seen as a vital component of engagement where the patient takes part in the oral health (Hakeem et al., 2023).

An electronic registry for dental public health must contain structured fields to capture these determinants that define clinical data and contextualize it for more comprehensive risk assessment. By factoring in demographic, behavioral, and socioeconomic variables, AAUP can enhance understanding of its patient populations, tailor preventive programs accordingly and evaluate patterns of care delivery in the teaching-clinic environment. Keeping track of determinants of health consistently in the health registry strengthens the analytical value of the registry itself. It also supports clinical decision-making and public-health planning.

2.1.4 Oral Health in Saudi Arabia

According to a national survey carried out in the Kingdom of Saudi Arabia in 2013, more than 1.4 million Saudi citizens had regular dental visits, while over 6.4 million required oral health care services (El Bcheraoui et al., 2016). Later studies reveal that these statistics have increased lately, indicating that the demand for oral health care in the Kingdom is increasing (Quadri et al., 2018). As a result, MoH's dentist-to-population ratio has increased from 4.5 per 10 000 people in 2016 to 5.7 per 10 000 people in 2020 (Ministry of Health- Saudi Arabia, 2020). The Kingdom of Saudi Arabia has announced the Vision 2030 strategy across several sectors, like healthcare, in response to this growing demand and expenditure on healthcare. The goal of this vision is to improve the standards of healthcare services in the Kingdom as cost-effective (Alharbi, 2025). Developments in digital health and artificial intelligence (AI) are impacting health care in the region and reaffirming the importance of a strong data infrastructure. Moreover, they are changing the oral and maxillofacial surgery (Al-Kahtani et al., 2022).

The socio-economic profile of Saudi Arabia and Palestine are not the same, but the rapid adaption of digital health and well-structured oral-health data systems could be a regional marker. The measures taken in Saudi Arabia demonstrate that a national strategy, common information platform, and investment in digital infrastructure can strengthen the delivery of oral health services and support data-driven policies. According to AAUP, a comparison shows that standardization of electronic data (starting with an electronic dental registry) is important for monitoring quality, research, and other health information initiatives. The differences in what Saudi Arabia is doing and the divided systems of Palestine reveal the importance of a framework that would work with a university dental clinic.

2.1.5 Oral Health in Palestinian Territories

The Palestinian territories have been under occupation for decades, which made life very difficult there. As a result, the economic and social conditions in the West Bank and Gaza Strip have sharply declined. Chronic diseases and infectious diseases are therefore common diseases. Despite the fact that the Ministry of Health and UNRWA provide certain health care services, major constraints on funding prevent them from adequately addressing the growing needs of the population. (Giacaman et al. 2007). Established in 1994, UNO School Dental Health Programme is one of the oldest oral health programmes in the region. The

program provides dental screening, oral health education, and basic treatment to children attending UNRWA and public schools. Despite its expansion over the years, the program does not function as a national registry and remains electronically unlinked to the Ministry of Health systems (Abuhaloob & Petersen, 2021).

According to the WHO, the poor cannot access dental treatment, and this is affecting vulnerable groups. Consequently, in 2007, the World Health Assembly adopted an action plan on oral health that stresses on the promotion of primary health care for the underserved . According to (World Health Organization, 2018), educational oral health interventions are especially important for children, as they reach large groups at a young age and during important stages of development. Oral diseases have a great effect on a child's academic performance, food intake, growth, and quality of life. In collaboration with the Palestinian Ministry of Health, UNRWA is carrying out the Palestinian School Dental Health Program, which is part of the National Primary Health Care System to promote the dental health of Palestinian children and adolescents. A program implemented in 1994, which aims to deliver dental care to the dental students of public UNRWA-run refugee schools and private schools in the Palestinian Territories (West Bank and Gaza Strip), gradually expands coverage to ever more children and teenagers (Abuhaloob & Petersen, 2021). In conclusion, it is clear from existing data that the burden of dental caries among Palestinian adolescents clearly increases with age. To resolve these issues, it is essential to enhance the digital health system and data utilization of the Palestinian health system in order to implement complete oral health programs.

2.2 Registries

The patient registries have evolved over more than 150 years, tracing their inception to the National Leprosy Registry of Norway in 1856. Subsequently, in Germany, Alexander von initiated the collection of cancer cases a decade later. By 1926, the city of Hamburg established Germany's first epidemiologic cancer registry. The World Health Organization (WHO) provided a comprehensive review on the utilization of registries in epidemiological and clinical research in 1974. However, after that time registries expanded into health services research to describe and evaluate routine healthcare practice. Many modern registries focus on assessing quality of care across provider types, geographic regions, and

patient groups, and some—particularly in the Nordic countries—achieve near-complete national population coverage (Jervelund & de Montgomery, 2020).

Patient registries, designed for individuals sharing common characteristics (e.g., diagnostic features, implanted devices, specific treatments, or risk of developing an illness), have become a substantial source of data for evaluating clinical efficacy, conducting health technology assessments, or examining the long-term effects of policy decisions at state, national, and global levels (Gliklich et al., 2020; European Medicines Agency, 2021; Allen et al., 2022).

These registries range widely, from simple paper-based spreadsheets in a doctor's clinic to global initiatives for rare diseases that integrate clinical and genetic information with biobanks. The possibility to substantially alter how informed decisions are made for both individual patients and large populations has emerged over the past fifteen years, driven by advancements in information technology. Among other things, this has been made possible because physicians can now effortlessly collect, share, compare, and evaluate large sets of patient data. The arrival of artificial intelligence and machine learning to health registries is now further enhancing their capacity to extract complex insights and predict outcomes (James et al., 2023). There are usually registries for disease monitoring, treatment efficacy, adverse event monitoring, quality improvement, and care evaluation. The registry, whatever type, must have a defined population, standardized data elements, a standard and systematic data-collection approach, and data quality, governance, and interoperability systems. Dentistry is not well represented in registries that are well established in medicine and public health research worldwide. (Gliklich et al., 2020; Berge et al., 2025). Understanding the history of registries as well as their structure and purpose is key to creating a framework. A framework shall be proposed that will help to capture, standardize, and use oral-health data that is generated as part of the AAUP clinical activities. This part will also engage with different types of registries (disease, service, product) and their features, which should be targeted when designing a registry for dental diseases.

2.2.1 Patient Category Registries

The development and assessment of a registry should be guided by its intended goals, particularly in terms of the patient outcomes it aims to track. Establishing and maintaining a patient registry serves a variety of important general purposes, including public health

surveillance and disease control, determining clinical and/or financial efficiency, assessing safety or hazards, measuring the quality of healthcare provided, and describing the natural history of a disease. In essence, patient registries ought to provide for improving patient services and planning for healthcare, along with impacting social, economic, and individual quality of life factors (e.g., healthcare access, health condition, funding of healthcare). (Nelson et al., 2016).

While the premise of documenting patient improvement over time and the factors contributing to outcomes applies to various registry types, there are clear distinctions between them. Eligibility, for example, is defined differently by a diagnostic feature versus by an intervention. Patients can be observed for short-, medium-, and long-term results if they are followed systematically over time and location. It is vital to clearly distinguish between the many types, subtypes, and primary/secondary functions of every patient registry. For instance, a diabetes registry and a surgical operation registry may share several data points, but they serve very different primary goals. The huge majority of patient registries can be categorized into one of three main types, each with potential subcategories and combinations: observational studies where the patient has a certain illness or condition, has been exposed to a service or product, or has experienced different combinations of these characteristics. Recent trends emphasize the integration of real-world data (RWD) from various sources into patient registries to provide more comprehensive understanding of disease advancement and therapeutic efficacy (Marra, 2025).

Patient category registries differ fundamentally in the eligibility criteria, which may be based on diagnosis characteristics, receipt of particular interventions, and exposure to specified risk. New developments show more real-world data (RWD) from electronic health records, claims data, and patient-reported outcomes being used. Integrating real-world data into registries increases analytical capacity and permits broader evaluations of the natural history of diseases, therapeutic effectiveness, and service use.

The proposed dental electronic registry at AAUP can benefit from patient category registries as a model since the university clinic manages various patient categories whose conditions and outcomes need to be followed up on a long-term basis. However, the best model for a registry regarding changes in oral-health status, disease outcomes (e.g., caries or periodontal progression), preventive interventions, and treatment success. Additionally, using real-world

data from actual care delivered by students day-to-day would aid in quality improvement, clinical research, and the generation of findings for educational and service delivery purposes. Accordingly, patient category registries could play an important role in the development of a structured, well-defined oral health registry for AAUP.

2.2.2 Registries of Diseases and Other Conditions

The existence of a particular illness or disorder is typically the most important factor considered when selecting patients for inclusion in disease or condition registries. This condition can be temporary or permanent (e.g., a rare disease like cystic fibrosis, a chronic condition like disability, or short-term infectious conditions). Disease registries can be established within hospitals and clinics, or they might focus on the general population. The former method is utilized for a certain ailment regardless of the geographical location of the case.

The primary goals of disease or condition registries are almost always descriptive. These objectives include determining the usual phenotypic traits of individuals with an illness and observing alterations in phenotypic and clinical manifestations of the disease over time (i.e., the natural course of the disease). The ability of illness registries to offer historically comparable data and long-term review is leading to a greater understanding of their utility. Disease and condition registries identify and track individuals whose illness, disorder, or health condition is included in the registry. The registries may deal with an infectious disease, a chronic disease lasting longer than six months, and a rare disease requiring special management. The main uses of disease registries are descriptive, tracking the natural history, characterizing clinical presentation, and monitoring disease over time. These longitudinal designs allow for datasets to be compared over time, enabling trend analysis as well as evidence-based clinical and policy making (Vittozzi et al., 2013). The interoperability of disease registries with electronic health records (EHRs) is growing Disease registries often complement randomized clinical trials to provide outcomes data from a wider applicability and more diverse population. It turns out that registries may represent the only source of epidemiological and clinical information for rare or highly specialized conditions. For this reason, they can be a valuable resource for researchers, clinicians and regulators. Interoperability between disease registries and electronic health records is a hot topic in registry science that allows stored data to be accessed quickly, accurately and relatively easy

to analyze. Working with EHR systems likewise lessens clinician stress and allows for almost instantaneous control of health conditions (Ebbers et al., 2024).

At AAUP, a dental electronic registry can be developed based on a strong conceptual foundation provided by disease registries. This includes a registry for dental caries and periodontal disease, among other common oral conditions. By using consistent diagnostic criteria as well as follow-up measures, the AAUP can track disease severity, treatment impact and the appearance of oral-health trends in the particular population. Creating disease-specific modules within the AAUP dental registries would further aid research, improve teaching quality, and set the stage for future connection to national health-information systems like DHIS2. In the Palestinian context, where no national oral-health registry exists, adopting disease-registry principles at AAUP is crucial for oral-health surveillance.

2.2.2.1 European Best Information through Regional Outcome in Diabetes (EUBIROD) Registry

EUBIROD, which stands for "European Best Information through Regional Outcomes in Diabetes," is an example of a registry project that tries to formulate disease registries better in terms of definition, legal context, semantics of the data, and technical operation. This initiative aims to disseminate information on therapy, prevention, and patient management in diabetes. Knowledge on diabetes in Europe is not being put to use, despite the presence of a lot of fragmented information. So EUBIROD aims to improve accessibility for the general community and develop appropriate strategies, policies, and actions to effectively coordinate health information, data collection, comparability challenges, and data sharing (within and between Member States) in the long term. It involves the ongoing construction of databases, analysis, and greater dissemination of information, as well as enhancing the caliber of information given to the public. Additionally, the main goal of the project is to create a long-term sustainable solution for a standardized online exchange of information and knowledge in every EU member state. The generation of information is mostly made possible by a shared dataset. This can be done with further datasets and refer to findings that can further be standardized to give global indicators. The initiative EUBIROD has been undertaken in order to provide comparable data on diabetes in Europe. It will evaluate and standardize Europe's output on diabetes and use of diabetes equipment, including glucose meters and insulin pens. EUBIROD is a tool created to deal with disparate and incompatible data sets. It fosters the

comparability, reliability, and accessibility of health data. The project develops harmonized definitions, standardized datasets, and interoperable data structures to allow cross-border exchange. Strategies to facilitate an ongoing evolvement of the database, to define standards and practices for referential data quality, and to disseminate findings to assist in public-health planning. So, EUBIROD supports health systems to monitor outcome and benchmark through comparable metrics and interoperable systems (Carinci, F., et al 2025).

The e-registry framework at the AAUP although EUBIROD has to do with diabetes not dentistry. Oral health data systems benefit from standardized data sets, standardized data definitions and other important principles. Standardising the data would make the data from the clinics comparable and allow the students to document things in a standardised manner.

Furthermore, this will allow for future integration with the national platforms, for example, DHIS2. The registry method applied in EUBIROD shows that structures and the use of indicators can combine registry purposes aimed at enhancing patient care with those aimed at improving monitoring of health more broadly. These lessons are very relevant for Palestine, which lacks a unified oral-health dataset and where cross-sector interoperability is weak.

2.2.2.2 European Academy of Allergy and Clinical Immunology (EAACI) Registry

The EAACI, or European Academy of Allergy and Clinical Immunology, is another organization making substantial efforts concerning disease registries (Asllani et al., 2023). EAACI is an organization of well doctors, scientists, nurses, and other healthcare providers that want to improve the health of people who suffer from allergies. Apart from the objectives, the project aimed to help standardize data related to allergic diseases, diagnosis, and therapy (Kappen et al., 2023). In doing so, it will help to improve the management of allergic diseases and allergen exposure.

The European Academy of Allergy and Clinical Immunology (EAACI) has developed registration initiatives to standardize data-collection for allergic diseases in Europe. Methods that merge documentation of diagnosis, treatment and outcome as well as being a tool for clinical improvement and cross-border research. The EAACI model enables the generation of comparable and good quality data sets from centres (Spielman 2024a) through the use of standard uniform data elements, common software tooling, and harmonised analytical procedures. The deployment of the project will take place in phases, starting with registries for anaphylaxis and drug allergy. This will be followed by other conditions. This method,

along with a strong commitment to ethical standards, data protection, and unified operational procedures, can boost sustainability and stakeholder trust. The project of the EAACI registry gives many relevant ideas for the design of a dental electronic registry at AAUP. It demonstrates that aligning data definitions, collection processes and software platforms across centers enhances the comparability and utility of clinical data. If AAUP were to adopt similar principles there would be better communication between students and supervisors and consequently more continuity of care, as well as better assessment of oral-health trends in clinic populations. The EAACI model is useful that start with caries or periodontal disease modules prior to widening to a wider multi-condition oral-health registry. In addition, the attention that will be given to ethical and standardized governance will assist in the establishment of a trusted and interoperable registry connected to the national health information systems of Palestine.

2.2.2.3 The Swedish Quality Registry for Caries and Periodontal Disease (SKaPa)

The Swedish Quality Registry for Caries and Periodontal Disease (SKaPa) is recognized as one of the most advanced and comprehensive dental registries worldwide. SKaPa is an automatic system that allows the daily transfer of information from EDRs (electronic dental records) to ensure the continuous, uniform, and real-time collection of data.

(Von Bültzingslöwen et al., 2019). The registry captures a wide range of information, including demographic characteristics, diagnostic data, periodontal risk assessments, clinical findings, and dental treatments. All diagnostic and procedural data are coded using Sweden's nationally standardized coding systems, which are consistently applied across all dental care providers (Field, OECD/European(OECD/European Observatory on Health Systems and Policies, 2023). SKaPa does not yet encompass the respective characteristics of implant devices. However, its solid architecture effectively supports epidemiological studies, quality monitoring, and the longitudinal assessment of oral health outcomes at the individual and population level. Besides, the registry exemplified how automated EHR/EDR interoperability can reduce clinician workload while increasing data completeness and quality. Thanks to these strengths, SKaPa has significantly contributed to health policy planning, academic research, and service evaluation. SKaPa is an international model of a dental registry (OECD/European Observatory on Health Systems and Policies 2023). Also, through the capacity for long-term monitoring of disease progression, as well as treatment

outcomes, SKaPa presents AAUP with a great opportunity to evaluate the quality of patient care and student clinical performance. Also, demonstrating interoperability shows that once national oral health indicators are defined, a similar AAUP system could be used with MOH platforms or the DHIS2 system.

A registry with a focus on the principles of SKaPa will be more than just a system for standard clinical activity. It would help develop structured data for evidence-informed research and health policy; and help identify trends and gaps in clinical training In the end, this strategy will reinforce and strengthen AAUP's academic mission. At present, there is no national oral health registry in Palestine. Thus, if the AAUP adopts the SKaPa framework, this would make it the first institution in Palestine to systematically collect and analyze structured data on dental problems. Through this program, quality monitoring of dental services may be improved, which can lay the groundwork for future inclusion in national eHealth programs.

2.2.3 Registries for Products

Once a medicine or device receives regulatory authority approval for usage (based on the laws of the respective state), the consumer population becomes considerably broader and more diversified than during the clinical trial phase, where the sample group is typically highly specific and less representative of the whole population (European Medicines Agency [EMA], 2021). The utilization of various registries should be taken into consideration as a tool to address the requirement for quality assessment that arises during the crucial post-approval phase. When developing a registry that aims to assess the risk or safety level associated with the use of a range of products (drugs or devices), it is highly recommended that the registry sponsor consults with the relevant local public health authority regarding their intentions for adverse event collection and processing, as they have to predict and evaluate the necessity for adverse event detection, processing, and reporting.

It's important to highlight the significant differences between the way adverse events (AEs) and product outcomes manifest in medical devices and pharmaceutical drugs, why these occur, the legislation that govern definitions and reporting of these and request upon approval studies and more. When one compares device technologies to pharmacological ones the rate of change is much faster and the timeframes are shorter. Hence device registries must be adapted accordingly in the right way. Furthermore, various healthcare practitioners may differ in skill with the technology, which can influence patient outcomes; especially in the

case of dental implants. Medical device registries should essentially assign a unique status identifier to each individual component of a device for recipient. When establishing a device registry, all the specialized characteristics of medical equipment should be taken into account (Mauch et al., 2021).

Gadget registries can indeed be created with a number of goals in mind, including tracking the effects of variables like oral surgical method, oral surgeon, hospital, and patient characteristics, as well as offering useful information on the long-term usefulness and safety of devices. One of the goals in creating registries for dental and medical equipment is to collect data on how well and safely they perform over time. In many circumstances, crucial information for medical professionals, patients, and decision-makers can be gleaned from properly conducted analyses of data from medical device registries, which take into account and correct for the most relevant confounding variables. Following approval, there is still a great deal of uncertainty regarding the safety of medical devices and pharmaceuticals, necessitating post-marketing surveillance; spontaneous adverse event reporting is a tried-and-true path for addressing this need that is also legally binding. Safety and harm registries offer a number of benefits compared to spontaneous reporting of AEs. Two primary qualities of these registers are of utmost significance today: first, the understanding from research conducted in other areas of science is that any clinician-chosen data architecture requiring active and non-systematic efforts to record a negative report is inferior to a systematic follow-up of such occurrences, regardless of the reporting quality. Second, and connected to the first point, when adverse events are reported in a manner that is not systematic, the exposed individuals are typically not identified, and as a result, it is unable to provide any epidemiological measurements of disease occurrence. We are able to compute the incidence of adverse events within a structured safety/harm registry that has a specified population, and these registers are appearing increasingly frequently in the market for medical supplies and equipment.

Consequently, depending on whether post-marketing compliance is required, it is also advisable to take into account the disease and product registries that have been suggested as resources. Furthermore, registries may have the advantage of monitoring a large and varied patient population because of their observational approach and open structure. Registry populations, as opposed to those used in clinical research, more accurately represent those

who actually use a product or even have surgery. Among the numerous advantages provided by such registry characteristics are the following: the collection of data may lead to insights on the prescribing practices of providers, and any follow-up duration may require a substantial period of time in order to determine the effects of long-term use. The integration of AI and machine learning is increasingly enhancing product registries by enabling predictive analytics for adverse events and identifying subtle safety signals in vast datasets (Nagar et al., 2025).

AAUP's first-ever dental electronic registry will primarily focus on oral health conditions and service provision. Nonetheless, certain principles from product registries are also relevant. There are departments like prosthodontics, oral surgery, implantology, etc., where dental device tracking can be highly useful. Thus, to make it easier for patients and doctors, a satellite is created. With designated fields for implant systems, restorative materials, batch numbers, and device-related complications, the registry will facilitate the AAUP's tracking of long-term clinical outcomes and will be a rich data source for future national surveillance. Furthermore, integrating product-registry concepts into the AAUP dental e-registry would align the institution with international best practices in medical device traceability and post-market surveillance. At present, Palestine lacks a national dental-specific medical device reporting system. Thus, the AAUP registry could be the prototype for the establishment of one such system in the future.

2.2.4 Registry for Health Service

Exposure to a healthcare service is yet another way that can be used to characterize patient registry exposure (Agency for Healthcare Research and Quality [AHRQ], 2020). The provision of information that can be utilized in the administration of healthcare is the primary objective of registries that are related to those services. These are based on data created by the service itself and collected from various health facilities and interactions between patients and providers. It is possible to designate which clinical interactions, such as clinic visits or hospital stays, treatment procedures, or full therapy episodes, should be included in a register. Healthcare service registries are sometimes used to assess and improve the level of therapy, defined as "the extent to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge".The data pertaining to hospital discharges are a subset of the data that pertain to

health service registries. They are easily accessible and can be of great use when evaluating the standard of medical care provided. This domain eventually comprises individual files that record different features of interaction that occur between the individual and the healthcare services, such as cost measurement or payment, basic statistics of procedures and diagnosis, and so on. Statistics on hospital discharges have been used in research on healthcare quality, and more recently, they have been a component of evaluations of effective coverage. (Jannati et al., 2018). As a consequence of this, it is recommended to conduct regular assessments of the quality of the data pertaining to health service providers and to assist in ensuring some degree of fundamental standardization. To the greatest degree practicable, basic standards should be implemented to improve the service of both domestic and local concerns. Regular system monitoring can also lead to a better understanding of a healthcare system's total capacity of care delivery.

The purpose of quality improvement (QI) registries is to control and enhance the standards of healthcare on either a local, regional, or national level while also disseminating clinical research. QI registries collect data in a methodical manner and make use of additional methods. Generally speaking, QI registries are divided into two different categories: registries of clients who received particular medical services (such as a hospitalization register or a surgery registry) within a reasonably short time frame (also known as an "event"); and registries of individuals with a disease or condition who were followed over time by several health providers.

Quality improvement registries can be used for many purposes, including monitoring rising or falling rates of specific treatments, analyzing healthcare utilization patterns, checking for provider compliance with safety regulations and best practice recommendations, keeping an eye on the results of public health awareness drives and preventative measures, and polling doctors and nurses on the standard of treatment they're providing their patients. These registries may be able to uncover inequalities in the availability of care, identify and evaluate practices and procedures that are less than optimal, and highlight potential prospects for reform. The requirement to explain medical intervention and plans using precise costs and benefits calculations and by demonstrating the effects of treatments on pertinent outcomes is driven by the rising costs of healthcare (annual health spending for OECD nations increased at a rate of about 5% on average between 2000 and 2009). If an institution does not have a

reliable means for tracking results internally, management will have difficulty knowing how their services actually compare to those elsewhere or to predefined quality criteria. Because registries can continually record data, they have the ability to uncover unnecessary or inappropriate differences in healthcare quality and inspire improvements by offering results that can identify regions of low quality. Also, longitudinal data provide the necessary information to serve as an early warning system in the event that the quality of a product deteriorates. The future of health service registries is increasingly tied to interoperability with electronic health records (EHRs) and the application of advanced analytics, including AI, to drive real-time quality improvement cycles and support a true learning health system (Nicholson et al., 2025).

Health-service registries classify patients based on their exposure to healthcare services rather than by diagnosis or treatment type. The aim of the health care quality reports is to generate information that can assist in managing, evaluating and improving the quality of medical care. These registers are based on the data from normal clinical encounters like outpatient visits as well as hospitalizations, treatment procedures or whole episodes of care. Such data sheds light on the pattern of service use, adherence to best practice guidelines and quality and efficiency of care over time. Health Service Registries make a significant contribution to quality improvement (QI) through a well-structured collection of clinical activities, outcomes and performance of providers. One must look at the trends – including rates of procedures – examine compliance with clinical protocols, and highlight care variations that may imply inefficiencies, inequity and more. Registry data are collected continuously, allowing these data to serve as early warning systems for deteriorating quality or emerging safety issues. Data from registries usually include cost, diagnosis, and procedural information, which can assist with resource planning and health-policy.

In the face of ever-increasing global health costs, the ability to measure outcomes against the use of resources is essential for optimizing service delivery (Mbau et al.,2022). The value of health-service registries will depend on the quality, completeness, and standardization of collected data. Periodic evaluation of registry data ensures its credibility, allows for benchmarking between institutions, and enables analysis at national or regional health-system levels. The capacity for electronic health records integration further boosts the

accuracy of registries, decreases the documentation burden, and strengthens the analysis of the registries.

Services registries related to health, aid in the development of a dental electronic registry, at AAUP. University teaching clinics operate in complicated service-delivery environments that generate substantial quantities of encounter-level data. Making use of health-service registry principles will allow AAUP to systematically document patient visits, procedures performed by students, treatment plans, follow-up outcomes, and key quality indicators. This systematic collection of data allows for a holistic evaluation of the quality of care in student clinics, compliance with evidence-based practices and service delivery across prosthodontics, operative dentistry, orthodontics departments, etc. It also helps find out the workflow inefficiencies that impact the patient movement and supervision of the students and institution or university benchmarking of the student performance which is an essential part of academic dental education. In addition, a health-service registry framework would allow AAUP to be aligned with future national eHealth systems, given that these registries are often the working basis for national reporting systems. A significant step towards setting up a systematic oral-health information infrastructure will be the establishment of a service-oriented dental registry (SDR) at AAUP. No existing SDR in the Palestinian context currently exists. A national oral health registry does not exist. Similarly, oral-health data systems are fragmented in the Palestinian context. This initiative would empower the AAUP to become a national leader capable of providing structured service data for reporting to the Ministry of Health or DHIS2 once national dental datasets are in place.

2.3 Digital Health and Dental Information Systems

Digital health is at the core of most modern healthcare delivery processes, with the value it produces in data management, clinical decision-making, and service coordination. In many high-resource settings, electronic dental records (EDRs), digital radiography, and advanced imaging have significantly transformed clinical workflows. Dental technology has not advanced along the same lines as medicine on the global level (Schwendicke et al., 2025). Often, dental documentation is fragmented, resulting in data silos and limited opportunities for large-scale analysis. Many dental clinics in different settings, including low- and middle-income countries, still use either paper-based records or stand-alone software applications or

commercial EDR systems without standardization. In addition, dental information systems are often not compatible with national health information systems. It hence becomes difficult to survey oral health, monitor quality indicators, and execute preventive strategies. The lack of standardized diagnostic and procedure coding systems in the area of dentistry exacerbates the problem of limited comparability of data between facilities and inhibits the incorporation of dental data into national eHealth initiatives. (Ballester Benoit et al., 2022).

In Palestine, digital health development has been mainly around maternal health, child health, and communicable disease programs, while not much is done on oral health services (Venkateswaran et al., 2022). Despite the fact that the Ministry of Health has a policy for its employees to report every district utilizing the same DHIS2 system, information about oral health is neither standardized nor reported onto this system. Consequently, a large volume of most of the dental records at public dental clinic,s the clinics of UNRWA or UN agencies, and many private practices are still paper records. AAUP and other university dental centers typically rely on a combination of paper files, spreadsheets, and generalist software. When databases are constructed separately, the data is created in an unstructured manner. This makes it impossible for organizations to take necessary actions like trend analysis, benchmarking, and quality monitoring (Schwendicke et al., 2025) .

The absence of a national digital infrastructure to systematically collect, manage, and analyze oral health data limits monitoring caries prevalence, periodontal disease trends, service utilization and treatment outcomes. The analysis of this gap severely restricts national health planning and institutional quality appraisals. In light of the foregoing, It is vital to have electronic dental registry at AAUP for bridging these limitations of digital health. A registry like this would allow routine patient encounters to generate useful data for improving patient care, evaluating education, and planning public health, by permitting standardized data collection, structured documentation, and longitudinal follow-up.

Moreover, the AAUP model can be a prototype for future national systems and design for interface with Service Platforms DHIS2, as well as for the absence of a national oral health registry in Palestine.

2.4 Conclusion and Identification gaps

The literature shows that oral diseases such as caries and gingival diseases remain highly prevalent and are strongly linked to behaviour, socioeconomic and environmental risk factors. In Palestine, the limited availability of dental services, inconsistent exposure to fluoride, and inadequate preventive programs further exacerbate these challenges. Moreover, there is no national oral health registry in the country, reporting datasets are not standardized, and existing digital health systems don't integrate dental information. International examples, and here we mean EUBIROD, EAACI, and the Swedish SKaPa registry, show how standardized, interoperable, and automated data systems can improve our understanding of disease evolution, quality assessment of services as well as research and policies. Medical specialties in high-income countries have had registry-based systems as part of standard care for a long time now. In contrast, dentistry and university-based dental education remain badly underdeveloped in this respect. In low-resource settings, structured registry frameworks are missing and this gap is more deeply pronounced.

The data of the evidence reveals there is a need for better access to comprehensive data from oral health to enhance outcomes, training, and surveillance as well as planning.

2.4.1 Identification of Gaps

This Chapter highlighted the burden of oral diseases, key determinants of oral health outcomes and the particular challenges surrounding oral healthcare in Palestine. Palestine currently lacks a national oral health registry, standardized data collection tools and interoperable digital systems to help support surveillance or quality improvement initiatives despite sizeable needs. International registry models in medicine and dentistry, such as EUBIROD, EAACI, or SKaPa demonstrate that the key components of a successful registry are standardized dataset(s), interoperability, automated data collection, governance, and sustainability. So far, none of the Palestinian dental institutions implemented or adapted these models.

The key gaps identified include:

- Absence of a national oral health registry and a standardized oral health dataset in Palestine.

- Fragmented documentation systems across the Ministry of Health, UNRWA, private, and university dental clinics.
- Lack of interoperable digital infrastructure linking dental services with national eHealth platforms such as DHIS2.
- No registry frameworks tailored to university dental teaching environments.
- Limited data availability to support quality improvement, student assessment, and service planning at AAUP and similar institutions.

Although oral health registries hold significant potential, the current dental data landscape in Palestine remains underdeveloped. The reviewed literature provides a strong conceptual, technical, and operational foundation for the establishment of a dental electronic registry. Addressing the identified gaps, this study proposes a framework to organize data collection, integration, and analysis within the AAUP dental teaching clinic, with the potential for future national scale-up.

Chapter Three: Conceptual Framework

3.1 Introduction

This chapter of the present study is dedicated to the analysis of the major elements relating to the proposed conceptual framework along with their effects on the oral healthcare delivery process. A review of literature suggests that electronic registries are able to improve patient care outcomes, improve data accessibility, and enhance health delivery processes. It is important to assess these items in the clinical practice in order to improve the oral health care outcomes (Richesson et al., 2021, Atchison et al., 2020). However, for a healthcare workflow to undergo digital transformation, one needs to know what makes it up. According to experts, to diagnose inefficiencies and design redesign, assessment and evaluation of the process in detail are needed (Mohammadi et al., 2023). The following methods are included:

- **Cognitive Task Analysis (CTA):** This approach involves recognizing what expert doctors do when they make clinical decisions. It goes beyond their visible behavior, and it makes explicit the so-called "tacit knowledge." For example, the CTA may be used to learn how a well-trained dentist made use of one feature in a new electronic registry and the shortcuts/formulae he uses that could be built into the registry for everyone to use (Swaby et al., 2022).
- **Heuristic Evaluation:** A usability inspection technique in which evaluators examine a system's interface according to a predefined set of usability principles (heuristics). This method is employed to detect any usability issues, such as ambiguous navigation or insufficient feedback, which might be crucial for accepting a new electronic health record system (Tremoulet, 2021).
- **Clinical Workflow Mapping:** This involves producing visual representations like flowcharts of a healthcare process, which helps in the identification of redundancies, bottlenecks, and information flow. The first phase of redesigning is to visualize the "as-is" state and plan a more efficient "to-be" procedure with new electronics (Antonacci et al., 2021).
- **Systems Engineering Initiative for Patient Safety (SEIPS):** A comprehensive socio-technical model that views healthcare as a system of interacting components: people, tasks, tools, technology**,** organization, and environment. Using this

framework, a failure to document patient data would not simply be attributed to a student's error but would trigger an investigation into the entire system, including the clarity of the software, the available training, and the clinic's environment (Holden et al., 2013). From the various methods explored, the Systems Engineering Initiative for Patient Safety (SEIPS) framework is the most suitable to describe the current study's approach. This is because this study exceeds a simple evaluation of a tool or a process and takes a holistic view of the entire oral healthcare delivery system.

Here are the key reasons why SEIPS is the best fit for this research:

- **Holistic, Socio-Technical Perspective:** The current study evaluates a range of related elements, which concern people (students, instructors), tasks (scheduling appointments, documentation), and the organization (strategic developments and integration). Essentially, SEIPS doesn't look at parts in themselves but instead in relation to each other. It assumes a system is a whole. Outcome is influenced by workflow, people, tasks, and environment.
- **Methodological Versatility:** SEIPS might not collect the data but advocates for using a range of strategies to enable full data collection. The quantitative structured questionnaire was an efficient way of collecting attitudes and practices from a large group of people, while the qualitative group interviews would seek to obtain in-depth information from key stakeholders.

- **Focus on Improvement:** The ultimate goal of this study is to use data collected to propose a new digital dental registry. SEIPS is specifically designed for this purpose: to identify weaknesses in a system and provide a robust, data-driven foundation for a redesign that addresses the root causes of problems, rather than just treating symptoms.

The evaluation of the oral healthcare delivery process and the expected improvement suggestions of intervention compatibility within clinical settings were guided by three key aspects. Firstly, it required identifying essential intervention items during the oral healthcare delivery process. Secondly, outline the expected mediating factors that highlight the expected challenges and facilitators influencing the improvement of the oral healthcare delivery

process and the adoption of an electronic dental registry within the faculty dental clinics. Finally, outline the expected dependent variables that may help to propose a structure to establish a comprehensive and practical dental electronic registry at Arab American University – Palestine.

3.2 Identifying the Various Items of a Workflow

The initial stage in developing a conceptual framework is the identification of variable items within the healthcare delivery process that necessitate measurement. Due to the numerous duties that take place during oral healthcare delivery, it is crucial to establish a clear outline of the activities that need to be evaluated in order to guarantee consistent collection and documentation of each action (Wang et al., 2023). Tracked actions can be classified into various independent variables, including:

3.2.1 Patient Management and Administrative Processes

1. **Scheduling Patient Appointments:** The procedure of allocating time and/or healthcare resources to individual patients and/or patients' activities. Optimized scheduling can reduce patient waiting times, increase adherence to treatment plans, and maximize resource utilization (Ali Ala & Feng Chen, 2022; Gupta et al., 2021).
2. **Medical Documentation:** Recording the treatment plan, patient treatment procedures, and treatment outcomes. Comprehensive documentation is essential for patient safety, continuity of care, and preventing medical errors from miscommunication (Moghadam, 2023).
3. **Medical Record Preservation and Accessibility:** This refers to the permanent storage of records in a secure, safe, organized, and accessible manner. A secure storage place protects the right of privacy; the facility to get the complete medical history fast helps the dental staff to make fast, correct decisions (Pavlenko et al., 2020).

3.2.2 Educational and Clinical Training Tools

1. **Monitoring Student's Logbooks:** The logbook is a systematic way to set learning objectives, track student progress, and assess performance. It can aid in self-evaluation and constructive criticism and improves the performance of the students a lot (Shahzad Mehranfard et al., 2022; Licari et al., 2018).
2. **Feedback**: Getting systematic feedback on how evaluations are done now is relevant. There may be identification of gaps, inefficiencies, and improvement needs in evaluation processes. Students, faculty, and administrative staff are the stakeholders who offer their opinions about the existing evaluation procedures, documentation, workflow, and system usability in order to help the design and implementation of a better electronic registry system (Wilson et al, 2022; Wong et al, 2022).

3.2.3 Systemic and Organizational Performance

1. **Internal System Integration:** The integration of different departments to ensure a seamless and secure flow of information. Integrated systems reduce administrative duplication, minimize medical errors, and enhance collaboration (Mihaylova & Pavlov, 2023; Khan et al., 2019).
2. **Strategic Planning:** Gathering and analyzing viewpoints and visions of stakeholders for improvement of organization and system. It is essential to understand how stakeholders perceive the electronic dental registry framework and what their expectations are about performance metrics such as patient satisfaction and productivity. There is international evidence showing the effectiveness of stakeholder visioning exercises to develop a shared vision for planning and subsequent healthcare service development (Gameiro et al., 2018). The effective strategic plan involves these diverse perspectives to build consensus and ownership (Via Healthcare Consulting, 2024). According to Esposito, stakeholder analyses facilitate health innovation planning and strategic actions (Esposito et al., 2020). Thus, the framework development of the electronic dental registry will be positioned through stakeholder input and future planning.

3.2.4 Personal Demographics

Demographic Variables (e.g., gender, student academic level, etc.): These variables are powerful predictors of healthcare needs and outcomes. Understanding demographics can reveal disparities in oral health and inform educational interventions to address the specific needs of different student populations.

3.3 Mediating factors in the conceptual framework

Facilitators and/or challenges (i.e., mediating factors) differ considerably from some of the independent variables (i.e., organizational performance, patient management) that are considered predictors of Electronic Dental Registry (EDR) implementation success. Facilitators such as educational alignment (Thyvalikakath et al., 2014) can enhance adoption, while barriers to adoption include resistance to change (Holden & Karsh, 2010). Highly recognized in health IT literature as input/output determinants of system success, intervention of these factors will facilitate the bridge between patient management, such as timely appointments (input), and outcome, such as better patient care (output). For instance, user-friendly design (the facilitator) minimizes workflow inefficiencies (the challenge)—consistent with Schleyer et al.'s (2013) findings about the usability of a dental EHR.

3.3.1 Potential Challenges

1. **Persistent Reliance on Paper-Based Systems**

   Earlier research in dental settings (Schleyer et al., 2013) noted important inertia in going from paper. For instance, Kalenderian et al. (2011) found that 68% of dental practices were operating hybrids—paper and digital—long after EHR adoption. Implementing an EDR using this dual system may result in fragmentation of data and workflow inefficiencies.

2. **Workflow Integration Difficulties**

   The use of health IT is often resisted when it interferes with clinician workflow (Holden & Karsh, 2010). As proposed by Spallek et al. (2015), an EHR system can

often mean a complete remaking of clinical workflow and losing productivity at the same time during a dental education project.

3. **Data Standardization Issues**

   Electronic dental record systems suffer disproportionately from interoperability issues. Data flow between clinical and educational systems in dental schools under study by Kataria and Ravindran (2018) achieved only 23%. This indicates that the present study may face standardization problems.

4. **Resource Constraints**

   Dental schools often face distinct financial and technical constraints (Spallek et al., 2015). The proposed EDR may encounter limits with IT support staffing and hardware and continuous maintenance budgeting challenges like those already seen in similar LMIC academic health centers (AbuKhousa et al., 2022).

3.3.2 Potential Facilitators

1. **Stakeholder Readiness for Change and Support**

   The Gagnon et al. (2012) article indicated that positive stakeholder attitudes most strongly predicted successful health IT adoption. Schleyer et al. (2013) found that in a dental education setting, 82% of students and faculty would use the digital system if trained. According to Kruse et al. (2018), the commitment of institutional leadership is the most important success factor. Dental school management may proactively participate in overcoming the impending technical and cultural barriers.

2. **Educational Alignment**

   Electronic dental record systems can enhance clinical education when aligned with curriculum objectives (Thyvalikakath et al., 2014). Through curricular design and development, the existing value proposition can inform the education component of the electronic dental record.

3. **Perceived Benefits to Patient Care**

   As dental electronic health record adoption increased, care continuity similarly increased by 32% (Thyvalikakath et al., 2013). Clinicians may be keen to engage with the proposed system, as it benefits their patients.

3.4 Expected Dependent Variables (Outcomes)

1. Improved Efficiency in Patient Management

This dependent variable corresponds to operational improvements that result from better patient management or administration. If scheduling systems are optimized, clinics will observe a decrease in patient waiting times and enhanced allocation of resources, according to Ali Ala and Feng Chen (2022), who developed scheduling models for the healthcare sector. Furthermore, according to Moghadam (2023), structured medical documentation leads to reduced clinical errors and improved continuity of care, which improves patient safety outcomes. Medical records that are secure and accessible enhance decision-making more efficiently (Ngoako Marutha, 2021). You can measure these improvements by the average length of the appointment, the errors in documentation, and the date and time a record was retrieved.

2. Enhanced Clinical Learning and Performance

By including organized logbooks, the students' skills and the capability to recall what they have been taught will be enhanced. Shahzad Mehranfard et al. (2022) suggest that logbook make tracking therapy progress easier and facilitate independent learning. Wilson et al. (2022), on the other hand, indicate brief, pointed feedback strengthens students' processes and improves their judgement of their own work. These enhancements will assist dental students in improving their performance and being prepared for work in a clinical setting.

3. Optimized Healthcare System Performance

According to Schwendicke (2025), if a well-integrated EDR is developed, it should provide easier reproduction of clinical, administrative, and educational systems, which in turn will reduce errors and redundant work. An effective EDR should enhance coordination among providers and accelerate processes within institutions.

4. Personalized and Equitable Oral Healthcare Delivery

The utilization of healthcare will depend on student academic level and gender (WHO, 2025). By analyzing these characteristics, the EDR can showcase gaps in treatment access and educational performance, as well as address them. Demographic-sensitive training methods emphasize equity in clinical education.

3.5 Independent vs. expected dependent variables

The anticipated connections between the independent variables and their corresponding expected dependent variables are as hypothesized concepts in the conceptual framework of the electronic dental registry. The impact of each input factor on the oral healthcare delivery system at Arab American University-Palestine is projected using this table. The table links the expected outcomes with supporting literature to show the evidence base for the framework; we can expect these outcomes to be true. The dependent variables represent the critical success and effectiveness performance items to adjudge the electronic dental registry system across patient management, educational enhancement, organizational optimization, and healthcare equity.

Table 2 :Independent & Expected dependent Variables

Independent Variable	Expected Dependent Variable	Key Supporting Literature
Patient Management & Admin Processes	Improved Efficiency in Patient Management	Ali Ala & Chen (2022), Marutha (2021)
Educational & Training Tools	Enhanced Clinical Learning and Performance	Mehranfard et al. (2022), Wilson et al. (2022)
Systemic & Organizational Performance	Optimized Healthcare System Performance	Mihaylova & Pavlov (2023), Scarbecz (2020)
Personal Demographics	Personalized and Equitable Oral Healthcare Delivery	WHO (2025)

3.6 Operational Definitions

It is necessary to create operational definitions prior to the start of data collecting. Every person using the system must share a consistent concept and adhere to the same procedure while gathering data. While it is usually assumed that those collecting data know what to do

and how to finalize the task, individuals involved may hold differing views and interpretations of the same concept, which can influence data consistency. The best way to ensure data consistency is by means of comprehensive operational definitions of terms (Vandenbos, G. R., 2015).

The following will be the operational definitions used in this study:

Table 3 :Operational Definitions

Operational Factors	Definition
Scheduling patient appointments	The procedure of allocating time and/or healthcare resources to individual patients and/or patients' activities.
Medical documentation	The process of documenting the treatment plan, the needs of the patient, the actions that the healthcare professional has to take, and the assessment of the patient's outcome.
Record preservation	The process of maintaining medical records in a secured and properly classified way, with access controlled and obtained only with the necessary authorization and/or rights.
Medical record accessibility	The ease with which health records are reached in terms of time, availability of trained staff, and physical access. An effective and high-quality healthcare system must be accessible.
Monitoring Student's Logbooks	The process of identifying areas of weakness, promoting more patient problems and in-depth study on certain academic subjects, and enhancing students' documenting abilities.
Internal system integration	Collaboration among different dental health services and departments and other care providers typically focused on the formation of multidisciplinary teams or care networks to support a particular population.
Feedback	Constructive feedback or critique provided by an individual to suggest enhancements for performance, products, etc.

3.7 Theoretical and Conceptual Framework

3.7.1 Theoretical Framework

According to Holden et al. (2013), the SEIPS model is a robust socio-technical systems model that looks at how the interaction of people, tasks, technology, organization, and environment affects outputs or outcomes in healthcare systems. The SEIPS conceptual model offers a comprehensive perspective to assess the process of delivering oral healthcare. It reflects the focus of this study on the workflow, patient management and other administrative processes, educational and clinical training tools, systemic and organizational performances, and personal demographics.

The independent factors are summarized as follows:

1. Patient Management and Administrative Processes:

- Scheduling Patient Appointments.
- Medical Documentation.
- Medical Record Preservation and Accessibility.

2. Educational and Clinical Training Tools

- Using Logbooks to Enhance Students' Learning.
- Feedback.

3. Systemic and Organizational Performance

- Internal System Integration.
- Strategic Planning Indicators.

4. Personal Demographics

- Demographic Variables (e.g., gender, student academic level, etc.)

3.7.2 Conceptual Framework

The study's conceptual framework is depicted in Figure 3.1 and contains the following variables:

Independent variables

1. Patient Management and Administrative Processes:

⊗ Scheduling Patient Appointments.
⊗ Medical Documentation.
⊗ Medical Record Preservation and Accessibility.

2. Educational and Clinical Training Tools

⊗ Monitoring Students' Logbooks.
⊗ Feedback.

3. Systemic and Organizational Performance

⊗ Internal System Integration.
⊗ Strategic Planning Indicators.

4. Personal Demographics

⊗ Demographic Variables (e.g., gender, student academic level, etc.)

Mediating Factors
Potential Challenges

⊗ Persistent Reliance on Paper-Based Systems
⊗ Workflow Integration Difficulties
⊗ Data Standardization Issues
⊗ Resource Constraints

Potential Facilitators

⊗ Stakeholder Readiness for Change and Support
⊗ Educational Alignment
⊗ Perceived Benefits to Patient Care

Expected Dependent Variables (Outcomes)

⊗ Improved Efficiency in Patient Management

- ⊗ Enhanced Clinical Learning and Performance
- ⊗ Optimized Healthcare System Performance
- ⊗ Personalized and Equitable Oral Healthcare Delivery

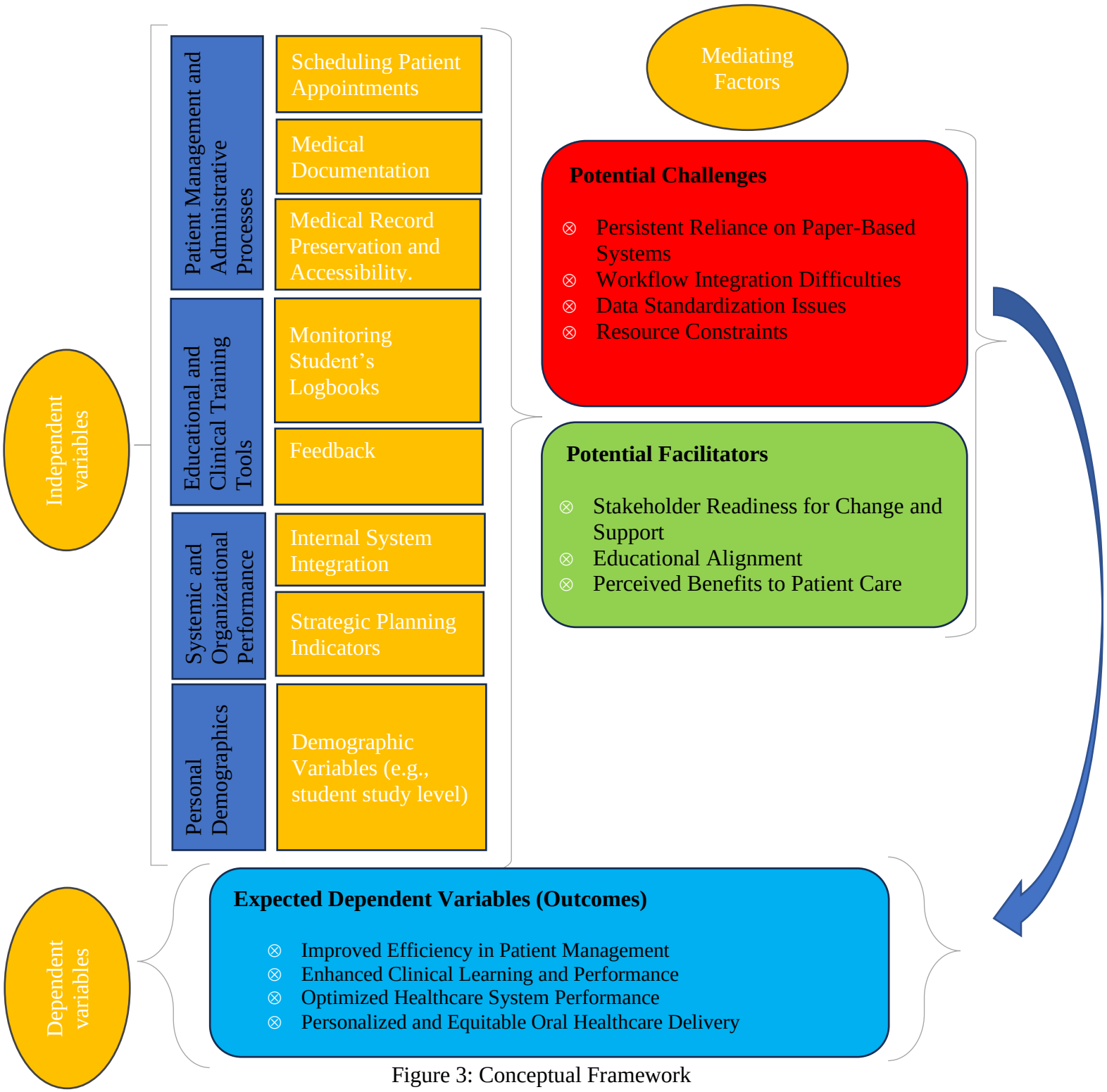

Figure 3: Conceptual Framework

Rectangles, ovals, and squares refer to groups of items; arrows regard expected causal outputs, impact, and the outcome. This visual representation shows the hypothesized relationship between the identified items and the desired outcomes of the electronic dental registry. The framework is designed to guide the investigation into how these factors interact to facilitate or hinder the efficiency of proposing a framework and establishing such a registry (Creswell & Poth, 2018).

3.8 Summary

The chapter sets the conceptual framework of our study based on the Systems Engineering Initiative for Patient Safety (SEIPS) concept. In terms of healthcare delivery, the health system consists of four main influences: patient management and administrative methods, educational training tools, organizational performance, and demography. The effectiveness of the implementation is influenced by barriers (like reliance on paper-based systems and workflow issues), as well as facilitators (i.e., stakeholder readiness and management support). This means an improvement in how patients are managed or treated. Students learn better, the system works efficiently and fairly, and so on. This holistic framework presents a roadmap for digital transformation in dentistry education that tackles the challenges inherent in the interrelationships between people, technology, and organization.

Chapter Four: Methodology

4.1 Introduction

This chapter outlines a mixed-method study design employed to achieve the research objectives and address the research questions. The study process involved an initial evaluation of the existing oral health care delivery process items to identify their capabilities and deficiencies, then a subsequent interview with dental management staff to identify further challenges and facilitators to establish goals for the framework of the electronic registry structure, and finally proposing a framework and formulating recommendations for establishing a dental electronic registry at Arab American University – Palestine (AAUP). The following sections describe the study design and setting as well as the subjects and data collection instruments needed to achieve the research objectives. The research started by evaluating existing oral health delivery processes using structured questionnaires and personal interviews to identify both potential challenges and facilitators. The assessment process resulted in formulating recommendations that will guide the development of the proposed electronic dental registry framework.

4.2 Study Design Overview

The research applied a mixed-method study design, combining quantitative and qualitative methods to offer a thorough insight into the existing oral healthcare delivery process. This design is comprised of

- **Structured questionnaires** were distributed to students and instructors to gather quantitative data on various aspects of the oral healthcare delivery process.
- **Personal interviews** were conducted with dental school management staff to explore in-depth qualitative insights into challenges, facilitators, and strategic considerations.

This sequential mixed-method study design allowed for triangulation of findings, enhancing the robustness and validity of the results. The study sequentially pursued three primary aspects:

- Assessment of the existing oral health delivery process to identify its capabilities and deficiencies.
- Identification of potential challenges and facilitators.
- Proposing a framework and formulating a recommendation leading to the proposed framework for an electronic dental registry.

4.3 Study Area/Setting

The study was held at the Faculty of Dentistry at the Arab American University – Palestine (AAUP), Jenin, West Bank. The researcher selected the setting for the study because of its direct relevance to the research objective goals. The setting of this study has easy access to dental students and faculty members. Also, the setting provides access to important stakeholders who are also involved in training and patient care.

4.4 Study Subjects

The research participants were drawn from an appropriate population group to meet the aims of the study for both quantitative and qualitative research studies. In the following sub-sections, we elaborated more on the subjects who participated in each study design.

4.4.1 Quantitative participating subjects

The study participant population consisted of 550 dental students in their 4^{th} and 5^{th} years, who were actively participating in clinical training, as well as teaching staff, who were 90 clinical supervisors who supervised clinical training and had more than one year of experience at the Faculty of Dentistry in the academic year 2022/2023.The quantitative part of the study involved participating subjects using the following inclusion criteria:

- Dental students in their 4^{th} and 5^{th} years actively participated in clinical training during the 2^{nd} semester of the academic year 2022/2023.
- Teaching staff supervising clinical training with more than one year of experience within the Faculty of Dentistry.

The quantitative part of the study excluded any subjects that fall under the following criteria:

- Dental students were not involved in clinical training during the study period.
- Teaching staff who do not supervise clinical training
- Teaching staff who do have less than one year of supervising experience.

4.4.2 Qualitative participating subjects

The qualitative study included 5 key stakeholders from the dental school's management, who were the dean, vice dean, and departmental heads. The selection of these participants was important for the study because they are directly involved in clinical training and patient care.

4.5 Data Collection Instruments

Data were collected between February and July 2023 from participants meeting the inclusion criteria. The study utilized structured questionnaires for quantitative data and personal interviews for qualitative data. (Appendix I, II, III)

4.5.1 Quantitative Data Collection

A structured questionnaire was developed following a comprehensive review of relevant literature on healthcare workflow, documentation, and electronic health systems (Rule A, 2020; Mohammadi, T., Saadat, S., & Rahimi, B. 2023). Two distinct versions of the structured questionnaires were designed: one for dental students and another for instructors (including academic staff and school management). Both structured questionnaires utilized closed-ended and Likert-type items with a 5-point scale (Always / Often / Sometimes / Rarely / Never) 5-1, respectively, to capture opinions and frequencies of practices.

The student-structured questionnaires explored opinions on four key domains: (1) Patient Management and Administrative Processes; that cover scheduling patient appointments and medical documentation, medical record preservation and medical record accessibility (2) Educational and Clinical Training Tools; that covers monitoring student’s logbook and feedback (3) Systemic and Organizational Performance; that covers internal system integration and (4) Personal Demographics that covers student personal information. Additionally, the instructor-structured questionnaires explored opinions on four key domains: (1) Patient Management and Administrative Processes; that cover scheduling patient

appointments and medical documentation, medical record preservation and medical record accessibility (2) Educational and Clinical Training Tools; feedback (3) Systemic and Organizational Performance; that covers internal system integration and (4) Personal Demographics that covers instructor personal information. Moreover, the dental school management questionnaire included questions regarding the systemic and organizational performance domain that covers the strategic planning fields and three open-ended questions aiming to identify indicators relevant for strategic decisions and daily operational improvements.

A small convenience sample of ten students and five instructors was used to conduct the pilot study to pretest the questionnaires for clarity, content validity, and reliability. Based on feedback from pilot participants, some small changes were made to the final questionnaire forms, which are not included in the main study data. Also, an academia board analyzed the questionnaire so that it became consistent and suitable for the Palestinian context. So, modifications were also done.

To address reliability, the Cronbach's Alpha method was employed. The reliability was computed, and the results are displayed in table (4) as follows:

Table 4 :Cronbach's Coefficient Alpha

Variable	Number of items	Cronbach's Alpha value (Student)	Cronbach's Alpha value (Instructor)
Patient Management and Administrative Processes	4	0.812	0.883
Educational and Clinical Training Tools	2	0.902	0.921
Systemic and Organizational Performance	2	0.873	0.902

The data presented in table (4) shows that the value of Cronbach's Alpha of key variables—patient management and administrative processes, educational and clinical training tools, and systemic and organizational performance—are all above 0.70 for both student and instructor samples. This indicates that the entire questionnaire has a high degree of reliability.

4.5.2 Qualitative Data Collection

To gain detailed, rich qualitative insight, structured personal interviews were conducted with the faculty and management staff. The interview focused on the current oral healthcare delivery process and its challenges, strengths, weaknesses, and recommendations. I provided prompts and hints as necessary to encourage detail. The interview guide was made up based on study objectives and the conceptual framework. The open-ended probes employed in the current study were aimed at obtaining an in-depth understanding of the oral healthcare delivery processes of the dental colleges. To ease their participation, which would optimize enrollment, interviews were scheduled at times and locations convenient to them. During this interview, the interviewer asked three open-ended questions regarding the requirement of the study.

The first question asked how the participants would describe the dental school's oral health care delivery process. This corresponds to frameworks that describe systematic activities in oral health service delivery, such as patient registration, patient assessment, treatment planning, supervised care, and follow-up (Hummel, Phillips, Holt & Hayes, 2015, Cabrera, Bedi & Lomazzi, 2024). These models show that structured workflows with connections to a larger health system are essential for effectively delivering oral healthcare. This supports the inclusion of this subject to examine similar practices in oral health education.

The second question of the research, which was related to the major changes in the delivery process since the establishment of a school, is corroborated by contemporary research citing that there are continuous renewals of curriculum. Digital and evidence-based practices are being integrated into dental education (Salmerón-Martínez, García-Sanz, Pérez-Torres, & Navarro-Serrano, 2024; Frontiers in Oral Health, 2024). Research studies on oral healthcare systems are dynamic, so there is a need to study the evolution and adaptation of the institution.

The third question, concerning perceived strengths and weaknesses, is based on research that highlights factors affecting the dental training environment, such as quality of supervision and availability of resources and feedback (Hendricson & Flaitz, 2007; Al-Bitar, Al-Qudah, & Hamdan, 2024). The extensive open-ended questions used in the present inquiry are closely related to the constructs specified in the literature-based development of the previous study. The aforementioned constructs were found to have empirical support. The matching of open-ended questions with the constructs has strong content validity. Hence, the open-

ended questions in this study are likely to closely capture experiences and perspectives of participants on the effectiveness, evolution, and quality of oral healthcare delivery at their institutions.

4.6 Research process

The research started by identifying the main items within the oral healthcare delivery process that can be measured, and there are many ways to evaluate them, such as through direct observations, medical staff reports, staff interviews, patient interviews, survey distributions, sensor-based studies, and job task diaries (Wang et al., 2023). This study focused on structured questionnaire distributions and interviewing members of the research sample because this method offers benefits over others, such as providing a more in-depth look at complex interactions and clinical workarounds, as well as offering the opportunity to get clinical staff more involved (Goldberg & Kuzel, 2019). The study then employed method triangulation, which is frequently used to add credibility and robustness to qualitative research findings (Creswell & Poth, 2018). This study involved combining survey data with interview responses to validate workflow assessments. The following figure presents the research process adopted in this study. First, the main oral health care delivery process items were identified and grouped into major domains. Then, appropriate data collection instruments were used to measure these items using structured questionnaires and personal interviews. Lastly, the study triangulated the data by integrating them from multiple sources to produce a more robust assessment of the workflow and its requirements.

4.7 Study Population and Sampling

The target population of the study consisted of 550 dental students involved in clinical training at the dental college of AAUP, along with approximately 90 instructors supervising the clinical training at that time. With a desired confidence level of 95%, a 5% margin of error and an assumed proportion of 0.50, the minimum required samples were 227 students and 74 instructors, respectively (Krejcie & Morgan, 1970). A convenience sampling technique was applied to select participants. A convenience sampling technique was applied for the study to select participants. A total of 75 instructors and 319 students who were

accessible and actively engaged in clinical training were chosen for the study, with response rates of 83% and 58%, respectively.

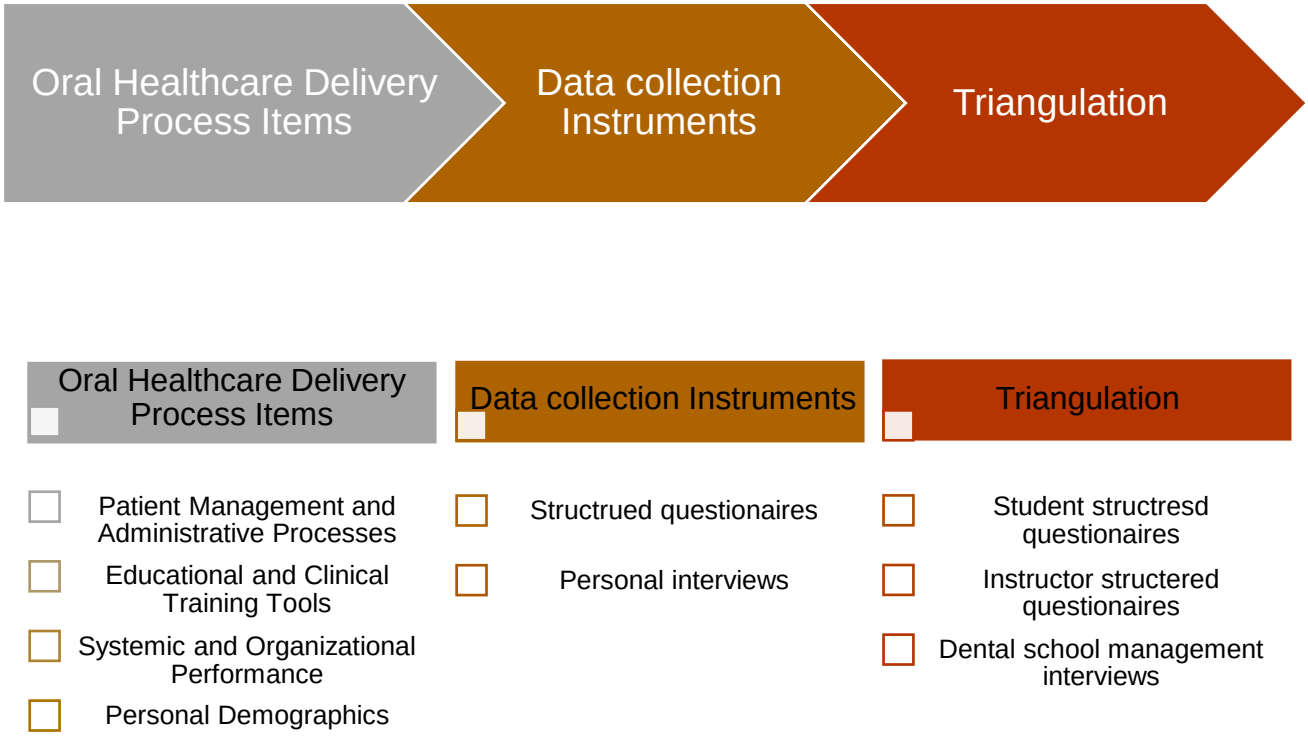

Figure 4: Research Process

4.8 Data Management & Analysis

4.8.1 Quantitative Data Analysis

The quantitative data obtained from the electronic surveys were securely transmitted to Excel sheets for organization and processed and analyzed using the Statistical Package for the Social Sciences (SPSS 28.0). Descriptive statistics were primarily used to analyze the data, including frequency, mean, standard deviation, and percentage, for all items. The study used a 5-point Likert scale to evaluate these variables, where 5 indicated “Always” and 1 represented “Never.” The study sample mean scores underwent transformation into three response levels (1 to 3, which correspond to high, medium, and low categories) through the following formula:

Class Interval = (Upper Limit - Lower Limit) / Number of Levels

The scale shows three response levels starting from 1 to 2.33, which indicates low agreement; 2.34 to 3.66 represents moderate agreement; and 3.67 to 5 indicates strong agreement. The classification system enables researchers to evaluate both the frequency and strength of responses through a standardized method for result interpretation. (Iriqat, R. A. 2019).

4.8.2 Qualitative Data Analysis

Qualitative data obtained from the personal interviews were transcribed. The transcribed data were then subjected to thematic analysis, a widely recognized method for identifying, analyzing, and reporting patterns (themes) within qualitative data (Braun, V., & Clarke, V. 2021). The analysis involved an iterative process of familiarization with the data, initial coding, searching for themes, reviewing themes, defining and naming themes, and producing the report.

In addition to thematic analysis, a quantitative approach was applied to the qualitative data to assess the level of agreement and disagreement among the five management participants. This involved comparing their replies to the three open-ended questions and calculating the percentage of overlap in the identified themes and key points. This quantification of qualitative data added a further dimension of dependability to the qualitative results, enhancing the comprehensive descriptive insights. The PEEL approach (Point, Evidence, Explanation, Link) was employed to organize and articulate the thematic analysis for each interview question, offering a clear and thorough overview of participant viewpoints as outlined in Chapter Five.

4.9 Framework Development

The integrated findings from both the quantitative and qualitative analyses were used to construct the proposed framework and recommendation for a dental electronic registry. The objective of this framework is to enable the practical application of enhanced oral health data administration in three critical domains: health and social care policy, enhanced service delivery, and advancements in research and dental education. The e-registry framework for

oral health establishes a theoretical foundation for the development of a comprehensive policy agenda and the development of an action plan for the implementation of innovative service systems that are based on the research evidence (Freeman, R., et al. 2020).

4.10 Ethical Considerations

Research participants signed the consent form. No personal information, such as participants' names, IDs, or other identifiers, was gathered or maintained during thesis writing. Except as required by law, all data will be kept confidential and used only for scientific research.

4.11 Summary

A mixed-method study design was adopted for this study as described in this chapter. The study area, inclusion and exclusion criteria of the participants, development and pretesting of the quantitative questionnaire tools, and conduct of qualitative interviews have been defined. The chapter provides a clear description of the quantitative data analysis by descriptive statistics and qualitative data analysis by theme analysis, including the quantifying of inter-participant agreement. In the end, it discussed how the proposed electronic dental registry system would be constructed and the ethical principles that governed the entire research activity. The methodological operations enabled collection of extensive and reliable data to achieve the aims of the research and the establishment of an effective dental electronic registry architecture at AAUP.

Chapter Five: Results

5.1 Introduction

This chapter presents the findings of the study, derived from the quantitative and qualitative data collected. The results are organized into descriptive statistics and thematic analyses to address the research objectives and answer research questions.

5.2 Results of the Pilot Study

To ensure the reliability and validity of the research tool, a pilot study was conducted using the preliminary version of the student and instructor questionnaires. Ten dental students and five clinical instructors from the AAUP dental school participated. They were asked to complete the survey and provide feedback about its clarity, layout, and suitability to their experience.

Their comments were analyzed and used to refine the final instruments (Appendices I, II). The changes made following the pilot test are summarized below:

1. **Expansion of Response Scales**

Pilot feedback:

Participants found the five-point agreement scale ("Strongly Disagree" to "Strongly Agree") in the initial version (e.g., *'Do you think converting the PMR to HER will improve documentation?'*) too limited and inconsistent with frequency-type questions.

Revision made:

The scale was replaced with a five-point frequency scale ("Always, Often, Sometimes, Rarely, never") to standardize responses across sections and allow for more accurate analysis of behavior rather than opinion.

2. **Clarity and Accuracy of Terminology**

Pilot feedback:

Both students and instructors reported confusion between "HER" (Health Electronic Record) and "EHR" (Electronic Health Record), and between logbooks and patient records.

Revision made:

All instances of "HER" were corrected to "EHR." Additional clarifications were added to

define *PMR (Paper-based Medical Record)* and *EHR (Electronic Health Record)* at the start of the "Medical Documentation" section.

3. **Addition of Intermediate Frequency Options**

Pilot feedback:

Respondents commented that binary or yes/no options were too restrictive, especially for behaviors that vary over time (e.g., archiving files, checking for previous X-rays).

Revision made:

All binary ("Yes/No") questions were converted to Likert-type frequency scales, which capture more nuanced behavior.

4. **Improved Logical Flow and Section Organization**

Pilot feedback:

The students were confused by the sequence of the questionnaire, particularly the "Archiving" to "Internal System Integration."

Revision made:

Sections were reordered to follow the actual workflow in a dental clinic:
Scheduling → Documentation → Preservation → Accessibility → Logbooks → Integration → Feedback.

This flow allowed respondents to answer in accordance with what their clinical experience would show.

5. **Removal of Redundant and Leading Questions**

Pilot feedback:

According to some instructors, there were various repetitious items, for instance, two questions about data collection and diagnosis documentation. There were also some apparently leading items, such as "Do you think converting PMR to HER will improve documentation?"

Revision made:

redundant items were merged and phrasing was changed from subjective or leading to neutral behaviour-based.

6. **Inclusion of Monitoring and Educational Components**

Pilot feedback:

Students suggested including items related to logbook monitoring and feedback, which were missing from the old version but essential to clinical training.

Revision made:

A new section, *"Monitoring Student Logbooks,"* was added in the latest version. It included items such as

"I believe the logbook outline was useful to my learning outcomes."

7. **Enhanced Readability and Formatting**

Pilot feedback:

Several respondents found the layout crowded and visually tiring. Some also mentioned difficulty in distinguishing sections and answer categories.

Revision made:

Spacing was increased, each question was separated by a clear line break, improving readability and user experience.

The revised research reflected a more behaviorally focused, clearly structured, and standardized format. They effectively captured both current practices (e.g., frequency of EHR use, record accessibility) and perceptions of improvement (e.g., satisfaction with data integration). The updated versions demonstrated improved face validity, content coverage, and respondent comprehension, as confirmed by informal post-pilot feedback sessions.

5.3 Quantitative Analysis

Descriptive Statistics for Student and Instructor Responses

The quantitative structured questionnaire data underwent descriptive statistical analysis to reveal its essential characteristics. The data analysis required researchers to perform calculations for all items to determine their frequencies, means, standard deviations, and percentages.

The following section displays statistical descriptions for essential domains, which consist of (1) The personal demographics domain, which contains four subdomains, which are gender, academic level, supervising instructor level, and experience. (2) Patient management

and administrative processes that cover scheduling appointments and medical record documentation and preservation and accessibility. (3) Educational and clinical training tools that focus on monitoring student logbook and feedback assessment. (4) The systemic and organizational performance domain focuses on internal system integration as its main focus.

5.3.1 Student Analysis

5.3.1.1 Descriptive Statistics for students' responses

The following section covers thorough insights into statistical descriptions for essential domains, which consist of (1) the personal demographics domain, which contains subdomains gender and academic level. (2) Patient management and administrative processes that cover scheduling appointments, medical record documentation, preservation, and accessibility. (3) Educational and clinical training tools that focus on student logbook monitoring and feedback assessment. (4) The systemic and organizational performance domain focuses on internal system integration as its main focus.

5.3.1.1.1 Descriptive Statistics for student demographics

A total of 319 students participated in the study. The table shows that 52.7% of the participants are in their 4^{th} year, with a frequency of 168, while 47.3% are in their 5^{th} year, with a frequency of 151. The gender distribution is nearly balanced.

Table 5 :Frequency Distribution of Student Gender and Academic Level

Variables	Options	Frequency (n=319)	Percentage %
Academic Level	4^{th} Year	168	52.7
	5^{th} Year	151	47.3
Gender	Male	158	49.5
	Female	161	50.5

5.3.1.1.2 Descriptive Statistics for Patient Management and Administrative Processes

The following section displays statistical descriptions for essential domains of patient management and administrative processes that cover scheduling appointments and medical record documentation, preservation and accessibility.

Descriptive Statistics for Scheduling Patient Appointments

Regarding the scheduling of patient appointments and how they are organized, the results indicate a high degree of individual responsibility, as the item "I arrange the patient's appointments by myself" has a mean of 4.87 and a standard deviation of 0.48; this shows a consistent and strong agreement among students. This is also supported by a high percentage of 97%. In contrast, the item "The head nurse at the dental department manages the patient's appointments" shows a low degree, with a mean of 1.46, a standard deviation of 1.08, and a percentage of 29%.

Table 6 :Descriptive Statistics for Scheduling Patient Appointments

The Domain	Dimension	Items	Mean	Std. Deviation	Percentage	Degree
Scheduling patient appointments	How frequently do you arrange the patient's appointment?	I arrange the patient's appointments by myself.	4.87	0.48	97%	High
		The head nurse at the dental department manages the patient's appointments.	1.46	1.08	29%	Low

Descriptive Statistics for Medical Documentation

With regard to the medical documentation domain, the results reveal a strong reliance on paper-based systems. For the item "The patient information is collected on a paper-based medical record (PMR) at the clinic," the mean is 4.77, with a standard deviation of 0.65 and a high percentage of 95%. In contrast, using an electronic health record system for patient information collection scores a low mean of 1.56 and a percentage of 31%. Similar patterns are observed for writing diagnoses and treatment plans, where the paper-based method has a

high mean of 4.65 (93%), compared to the electronic health record system method with a low mean of 1.55 (31%). For handling patients previously treated at AAUP, the mean is 4.21 (84%), indicating a high reliance on starting a new diagnosis. Documenting treatment procedures on paper shows a high mean of 3.99 (80%), while electronic health record system documentation has a low mean of 1.98 (40%).

Table 7 :Descriptive Statistics for Medical Documentation

The Domain	Dimension	Items	Mean	Std. Deviation	Percentage	Degree
Medical documentation	How do you collect the information from the patients?	The patient information is collected on a paper-based medical record (PMR) at the clinic.	4.77	0.65	95%	High
		The patient information is collected on the electronic health record system (EHR) at the clinic.	1.56	1.16	31%	Low
	How do you write your diagnosis and treatment plan for the patient?	The diagnosis and/or treatment plan are both handwritten on a paper-based medical record (PMR).	4.65	0.87	93%	High
		The diagnosis and/or treatment plan are both documented on electronic health record (EHR) system files.	1.55	1.06	31%	Low
	In case of receiving a patient, who was previously treated at AAUP dental	"In case of receiving a patient who was previously treated at AAUP clinics, I start the diagnosis and/ or treatment plan all over."	4.21	0.86	84%	High
	How do you document the treatment	I write the treatment procedure on the previous paper-based medical record (PMR)	3.99	1.50	80%	High

	procedures for the patients?					
		I document the treatment procedure on the electronic health record (EHR) system	1.98	1.47	40%	Low

Descriptive Statistics for Medical Record Preservation

Table 5.4 presents descriptive statistics for the domain of medical record preservation, ordered by descending mean values. The results show varying practices in archiving and maintaining confidentiality. For confidentiality, the highest means are observed for "I keep the patient's personal contact information with me" (mean = 4.14, 83%) and "I give back the paper-based medical record (PMR) to the dental department" (mean = 4.08, 82%), both reflecting a high degree. In contrast, "I discard the paper-based medical record (PMR) after I finish diagnosis and/or treatment" has a medium mean of 2.58 (52%).

Regarding archiving, personal archiving places (mean = 3.59, 72%) and the central place at the college (mean = 3.52, 70%) both indicate medium levels. The practice of not archiving files has a median of 3.06 (61%).

Table 8 :Descriptive Statistics for Medical Record Preservation

The domain	Dimension	Items	Mean	Std. Deviation	Percentage	Degree
Medical record preservation	How do you usually archive the patient's medical record?	I don't usually archive the patient's files.	3.06	1.29	61%	Medium
		I keep the patient's file in a personal archiving place.	3.59	1.10	72%	Medium
		I keep the patient's files at the central place at the college.	3.52	1.08	70%	Medium
	How do you keep the patient's personal	I discard the paper-based medical record (PMR) after I finish	2.58	1.44	52%	Medium

	information confidential?	diagnosis and/or treatment.				
		I give back the paper-based medical record (PMR) to the dental department.	4.08	1.13	82%	High
		I keep the patient's personal contact information with me.	4.14	1.06	83%	High

Descriptive Statistics for Medical Record Accessibility

Regarding the medical record accessibility among students. Table 5.5 indicates medium levels of accessibility. The item "I can get the patient's previous dental record easily" has a mean of 3.28, a standard deviation of 1.08, and a percentage of 66%. The item "I will have to make a new dental record for the patient" scores a higher mean of 3.62, with a standard deviation of 0.98 and a percentage of 72%.

Table 9 :Descriptive Statistics for Medical Record Accessibility (Students)

The domain	Dimension	Items	Mean	Std. Deviation	Percentage	Degree
Medical record accessibility	In case of having a patient who previously had a dental treatment at AAUP dental clinics.	I can get the patient's previous dental record easily.	3.28	1.08	66%	Medium
		I will have to make a new dental record for the patient.	3.62	0.98	72%	Medium

5.3.1.1.3 Descriptive Statistics for Educational and clinical training tools

When participants were asked to describe the key areas in educational and clinical training tools, they shared the following, which focus on student logbook monitoring and feedback assessment:

Monitoring Student's Logbooks

Most items show high degrees of agreement. "I think the electronic logbook will allow data input easily" has the highest mean (4.18), with a standard deviation of 1.09 and a percentage of 84%, followed closely by "I think the electronic logbook will allow data input quickly" with a mean of 4.11 (82%). Similarly, "I believe the written feedback provided has improved my learning outcome" and "I believe the logbook outline was useful to my learning outcomes during the course" have high means of 3.84 (77%) and 3.82 (76%), respectively. The only medium-degree item is "I forget to bring my paper-based logbook to the clinic," with a mean of 3.11, a standard deviation of 1.10, and a percentage of 62%. Table 5.6 provides descriptive statistics for the domain of monitoring students' logbooks.

Table 10 :Descriptive Statistics for Monitoring Students' Logbooks

The domain	Dimension	Items	Mean	Std. Deviation	Percentage	Degree
Monitoring Student's Logbooks	Student logbook	I believe the logbook outline was useful to my learning outcomes during the course.	3.82	1.14	76%	High
		I believe the written feedback provided has improved my learning outcome.	3.84	1.17	77%	High
		I forget to bring my paper-based logbook to the clinic.	3.11	1.10	62%	Medium
		I think the electronic logbook will allow data input easily.	4.18	1.09	84%	High
		I think the electronic logbook will allow data input quickly.	4.11	1.18	82%	High

Feedback Assessment

Table 5.7 presents descriptive statistics for the domain of feedback from students, showing a high degree of agreement with the items related to patient data documentation. The item "I believe converting the PMR to EHR will improve the patient data documentation" has the highest mean of 4.64, with a standard deviation of 0.81 and a percentage of 93%, reflecting

a strong belief in the benefits of electronic health record. Similarly, "I believe the current patient data documentation needs improvements" scores a mean of 4.23, with a standard deviation of 1.12 and a percentage of 85%, indicating a high level of agreement regarding the need for improvement.

Table 11 :Descriptive Statistics for Feedback

The domain	Items	Mean	Std. Deviation	Percentage	Degree
Feedback	I believe the current patient data documentation needs improvements.	4.23	1.12	85%	High
	I believe converting the PMR to EHR will improve the patient data documentation.	4.64	0.81	93%	High

5.3.1.1.4 Descriptive Statistics for he Systemic and Organizational Performance

Descriptive measures are presented for the core domains that assess systemic and organizational performance, with internal system integration being the main analytical focus. The domain of internal system integration among students highlights various methods of handling X-rays and referral letters. As highlighted in Table 5.8, and for managing X-rays, "I personally keep the X-ray file of the patients" has the highest mean (3.97), with a standard deviation of 1.17 and a percentage of 79%, indicating a high degree of integration. The item "We have an electronic system to keep the X-rays" scores a medium mean of 3.45 (69%), and other items like "I contact the X-ray department to check out if a previous one exists" (mean = 3.14, 63%) and "I directly request a new one regardless if a previous X-ray exists" (mean = 3.52, 70%) show medium levels of system integration.

Regarding referral letters, "I receive a written paper-based referral letter from the referring colleague" has a mean of 2.68 (54%), and "I receive an electronic-based referral letter from the referring colleague" shows a lower mean of 2.39 (48%). However, "I do not receive any referral letters, and I start my own diagnosis and treatment plan all over" has a high mean of 3.90 (78%).

Table 12 :Descriptive Statistics for Internal System Integration (Students)

The domain	Dimension	Items	Mean	Std. Deviation	Percentage	Degree
Internal system integration	"When an X-ray is required, how do you deal with that?"	I contact the X-ray department to check out if a previous one exists.	3.14	1.26	63%	Medium
		I directly request a new one regardless if a previous X ray present or not.	3.52	1.17	70%	Medium
		I review the patient record to find out if a previous X-ray exists or not.	2.94	1.34	59%	Medium
	How do you keep the X-ray record for the patients?	I discard the X-ray files after the treatment.	2.71	1.38	54%	Medium
		I ask the patients to keep the X-ray records with them.	2.66	1.41	53%	Medium
		I personally keep the X-ray file of the patients.	3.97	1.17	79%	High
		We have an electronic system to keep the X-rays.	3.45	1.21	69%	Medium
	In case of receiving a referred patient from another colleague.	I receive a written paper-based referral letter from a referring colleague.	2.68	1.41	54%	Medium
		I receive an electronically based referral letter from the referring colleague.	2.39	1.55	48%	Low

		I do not receive any referral letters and I start my own diagnosis and treatment plan all over.	3.90	1.18	78%	High

5.3.2 Instructor Analysis

5.3.2.1 Descriptive Statistics for instructor responses

The following section covers thorough insights into statistical descriptions for essential domains, which consist of (1) the personal demographics domain, which contains the subdomains gender, supervisor instructor, and experience. (2) Patient management and administrative processes that cover scheduling appointments, medical record documentation, preservation, and accessibility. (3) Educational and clinical training tools that focus on feedback assessment. (4) The systemic and organizational performance domain focuses on internal system integration as its main focus.

5.3.2.1.1 Descriptive Statistics for Instructor Demographics

Table 5.9 illustrates the gender distribution among faculty members, revealing a relatively balanced composition. Males constitute a slight majority at 52.0%, while females represent 48.0% of the sample. Moreover, regarding the clinical supervising instructors present at the dental school, there are more teaching assistants (53.3%, n=40) than specialist instructors (46.7%, n=35). The supervising experience shows that the largest group, comprising 40.0% of the sample, has 4 to less than 7 years of experience, indicating that a significant portion of the faculty is in the mid-stage of their teaching careers. Faculty members with 7 or more years of experience account for 26.7%, reflecting a solid foundation of experienced educators. Meanwhile, 33.3% fall within the 1 to less than 4-year range, demonstrating a notable presence of early-career educators.

Table 13 :Frequency Distribution of Gender, Category, and Years of Experience among Faculty Instructors

Variables	Options	Frequency (n=75)	Percentage
Gender	Male	39	52.0
	Female	36	48.5
Supervisor Instructor	Specialist instructors	35	46.7
	Teaching assistant instructors	40	53.3
Supervising Experience	1 year to less than 4 years	25	33.3
	4 years to less than 7 years	30	40.0
	7 years ≤	20	26.7

5.3.2.1.2 Descriptive Statistics for Patient Management and Administrative Processes (Instructors)

The following section displays statistical descriptions for essential domains of patient management and administrative processes that cover scheduling appointments and medical record documentation, preservation, and accessibility.

Descriptive Statistics for Scheduling Patient Appointments (Instructors):

Table 5.10 shows descriptive statistics for scheduling patient appointments among instructors, ordered by descending mean.The highest mean score of 4.65 (93%) indicates that patients' appointments are primarily managed by students, reflecting a high reliance on them. Satisfaction with the current workflow arrangements also scored high at 3.80 (76%), suggesting general approval. However, the role of the head nurse in managing appointments received a low mean score of 1.99 (40%), highlighting limited involvement.

Regarding alternative methods for arranging appointments or managing patients, a significant portion of respondents, totaling 52.0%, denied the existence of alternative methods, providing responses such as "no," "none," and "nothing." Additionally, 16.0% indicated that students play a primary role in managing or organizing patient appointments, either directly or through distribution committees. About 5.3% reported that appointments

are handled through primary diagnostic or dental clinics, while 2.6% mentioned that patients sometimes arrive without prior appointments. Furthermore, 2.6% indicated that phone calls are used as a method to arrange appointments.

Table 14 :Descriptive Statistics for Scheduling Patient Appointments (Instructors)

The domain	Dimension	Items	Mean	Std. Deviation	Percentage	Degree
Scheduling patient appointments	How are your patients arranged at the department's clinics?	The patient's appointments are managed by the students themselves.	4.65	0.65	93%	High
		I am satisfied by the current patient workflow arrangements.	3.80	0.74	76%	High
		The head nurse at the dental department manages the patient's appointments.	1.99	1.03	40%	Low

Descriptive Statistics for Medical Documentation (Instructors)

Table 5.11 shows descriptive statistics for medical documentation among instructors, with items listed in descending order based on mean scores. The highest-rated item is "Data is collected on paper-based medical records (PMR) gathered at the clinic," with a mean score of 4.63 (93%), indicating a strong reliance on paper-based documentation. In contrast, the electronic health record (EHR) system for data collection scored lower at 2.49 (50%), suggesting a moderate use of electronic records.

When it comes to writing diagnoses and treatment plans, the highest mean score of 4.52 (90%) is for "Diagnosis and treatment plan are both hand-written on paper-based medical record (PMR)," further reflecting the dominance of paper-based methods. Satisfaction with current patient data documentation scored 3.65 (73%), indicating moderate approval. However, the

use of EHR for documenting diagnosis and treatment plans received the lowest score of 2.19 (44%). The total score for this dimension is 3.45 (69%), also classified as medium.

Table 15 :Descriptive Statistics for Medical Documentation (Instructors)

The domain	Dimension	Items	Mean	Std. Deviation	Percentage	Degree
Medical documentation	How do you collect the data from the patients?	Data is collected on paper-based medical records (PMR) gathered at the clinic.	4.63	0.77	93%	High
		Data is collected on the electronic health record system gathered at the clinic (EHR).	2.49	1.13	50%	Medium
	How do you write your diagnosis and treatment plan for the patient?	Diagnosis and treatment plan are both handwritten on paper-based medical record (PMR).	4.52	0.76	90%	High
		I am satisfied with the current patient data documentation.	3.65	0.78	73%	Medium
		Diagnosis and treatment plan are both documented on electronic health record (EHR) system files.	2.19	0.93	44%	Low

Descriptive Statistics for Medical Record Preservation (Instructors):

In terms of storing student logbook files table 5.12, the highest mean score of 3.24 (65%) indicates that these files are generally kept in a central location within the college, but this

practice is not universally consistent. Storing logbook files in personal storage areas scored 2.85 (57%), reflecting a moderate level of personal responsibility for file management.

Regarding the preservation of patient personal information and confidentiality, the highest-rated item is "I give back the paper-based medical record (PMR) to the dental department," with a mean score of 4.08 (82%), reflecting a strong practice of returning records to the department for proper handling. Satisfaction with patient data storage management scored 3.51 (70%), indicating moderate contentment with current storage practices. However, the item "I discard the paper-based medical record (PMR) after I finish diagnosis and/or treatment" received a lower score of 2.31 (46%), suggesting that discarding records is not a common practice among respondents.

Table 16 :Descriptive Statistics for Medical Record Preservation (Instructors)

The domain	Dimension	Items	Mean	Std. Deviation	Percentage	Degree
Medical record preservation	How frequently do you store the student logbook files?	The student logbook files are kept at the central place at the college.	3.24	1.08	65%	Medium
		I keep the student logbook files in a personal storage place.	2.85	1.31	57%	Medium
	Where do you keep the patient's personal information & confidentiality?	I give back the paper-based medical record (PMR) to the dental department.	4.08	0.90	82%	High
		I am satisfied with the patient data storage management.	3.51	0.89	70%	Medium
		I discard the paper-based medical record (PMR) after I finish diagnosis and/or treatment.	2.31	1.19	46%	Medium

Descriptive Statistics for Medical Record Accessibility (Instructors):

Most respondents are moderately satisfied with the accessibility of patient records table 5.13, with scores of 3.55 (71%) for satisfaction and 3.53 (71%) for ease of accessing old records. However, creating new records when old ones are not accessible scored 3.16 (63%), and the current filing system does not fully meet research needs, scoring 2.99 (60%).

Table 17 :Descriptive Statistics for Medical Record Accessibility (Instructors)

The domain	Dimension	Items	Mean	Std. Deviation	Percentage	Degree
Medical record accessibility	In case you have a patient who previously had a dental treatment at AAUP dental clinics.	I am satisfied with the patient data accessibility management.	3.55	0.87	71%	Medium
		I can get his/her old dental record easily.	3.53	0.76	71%	Medium
		I will make a new dental record for the patient.	3.16	0.94	63%	Medium
		I feel the current filing process satisfies my needs for research purposes.	2.99	1.18	60%	Medium

5.3.2.1.3 Descriptive Statistics for Educational and Clinical Training Tools (Instructors)

This section provides a statistical overview of the core domains underpinning educational and clinical training tools, highlighting the assessment of feedback as a central component.

Descriptive Statistics for Feedback (Instructors):

The highest score is for the belief that converting from paper-based records (PMR) to electronic records (EHR) will improve documentation, with a mean of 4.63 (93%). Respondents also agree that the current documentation system needs improvement, with a score of 4.29 (86%) table 5.15.

Table 18 :Descriptive Statistics for Feedback (Instructors)

The domain	Items	Mean	Std. Deviation	Percentage	Degree
Feedback	I believe converting the PMR to EHR will improve the patient data documentation.	4.63	0.69	93%	High
	I believe the current patient data documentation needs improvements.	4.29	1.09	86%	High

5.3.1.1.4 Descriptive Statistics for The Systemic and Organizational Performance (Instructors)

This section provides a statistical overview of the core domains, highlighting internal system integration as the primary focus.

Descriptive Statistics for Internal System Integration (Instructors):

The highest scores are for using electronic systems to store X-rays (4.16, 83%) and performing verbal referrals for consultations (4.15, 83%) table 5.14. Satisfaction with the current system scored 3.69 (74%), indicating general contentment. However, lower scores were given to practices like personally keeping X-ray files (2.55, 51%) and discarding them after treatment (2.33, 47%). Asking patients to keep X-ray records and using electronic referrals received the lowest scores (2.25, 45% and 2.19, 44%, respectively).

Table 19 :Descriptive Statistics for Internal System Integration (Instructors)

The domain	Dimension	Items	Mean	Std. Deviation	Percentage	Degree
Internal system integration	"In case of referring a patient to do an X-ray, how do you know if the patient already had a	I directly request a new X-ray regardless if a previous X-ray is present or not.	3.25	1.19	65%	Medium

	recent X-ray?"					
		I contact the X-ray department to check out if a previous X-ray exists.	3.24	1.05	65%	Medium
	How do you keep the X-ray record for the patients?	We have an electronic system where we keep the X-rays.	4.16	0.94	83%	High
		"In case of referring patient for consultation in another department, I would perform a verbal referral."	4.15	0.93	83%	High
		I am satisfied with the current internal system integration.	3.69	0.80	74%	High
		"In case of referring patient for consultation in another department, I would perform a written referral form."	3.25	1.13	65%	Medium
		I personally keep the X-ray file of the patients.	2.55	1.18	51%	Medium
		I discard the X-ray files after the treatment.	2.33	1.21	47%	Medium

		I ask the patients to keep the X-ray records with them.	2.25	1.23	45%	Medium
		"In case of referring a patient for consultation in another department, I would perform an electronic referral form."	2.19	0.98	44%	Medium

5.3.3 Dental School Management Analysis

Descriptive Statistics for Strategic Planning:

For patient workflow, "I believe the process provides credible data to measure" has the highest mean of 4.20, with a standard deviation of 0.45 and a percentage of 84%, indicating a strong belief in the credibility of the data. The item "I believe the data of the oral healthcare delivery process provides you with rich information" has a slightly lower mean of 4.00 but still falls within the high degree range with 80%.

Regarding treatment procedures, both "I believe the treatment procedures provide credible data to measure" and "I believe the employed concurrent procedures maintain an appropriate supply chain in relation to the needed stocks" have means of 3.40 and percentages of 68%, reflecting a medium degree of agreement. For the oral healthcare delivery process, "I believe the process data will accurately reflect reality" scores a mean of 2.80 with 56%, indicating a medium degree of confidence in the accuracy of the process data.

Table 20 :Descriptive Statistics for Strategic Planning (Dental School Management)

The domain	Dimension	Items	Mean	Std. Deviation	Percentage	Degree
Strategic planning	Patient workflow starting from primary dental	I believe the process provide credible data to measure.	4.20	0.45	84%	High

	clinic throughout the department clinics.					
		"I believe the data of the oral healthcare delivery process provides you with, rich information. "	4.00	0.00	80%	High
	The treatment procedures at the department/s.	I believe the treatment procedures provide credible data to measure.	3.40	0.55	68%	Medium
	The treatment procedures at the department/s.	I believe the employed percurrent procedures maintain appropriate supply chain in relation to the needed stocks.	3.40	0.55	68%	Medium
	Oral healthcare delivery process in the dental departments	I believe the process data will accurately reflect reality.	2.80	0.84	56%	Medium

5.4 Qualitative Analysis (PEEL Method)

This section analyzes the responses from qualitative data using the PEEL method (Point, Evidence, Explanation, Link) for each question as a framework to structure reporting the

qualitative results, calculating the agreement and disagreement percentages among the five participants.

Initial Coding

The participants' responses were segmented into key ideas and concepts. The table below summarizes the initial codes derived from each question.

Question	Key Ideas/Codes
1 – Description of process	Patient registration, Initial/comprehensive examination, Treatment planning, Supervised procedures, Follow-up, Patient distribution, Community orientation, Workflow management
2 – Major changes	Evidence-based practice, new technologies (CAD/CAM, digital radiography), Infection control, Curriculum updates, Establishment of primary clinics, Workflow committees
3 – Strengths & weaknesses	Comprehensive care, Modern technology, Community service, Evidence-based education, Limited appointments, Paper-based records, long treatment times, Resource constraints, Occupation-related challenges

Searching for Themes

Codes were grouped into potential themes that reflected recurring ideas across all responses.

Category	Potential Themes
Processes	Structured Oral Healthcare Workflow; Community-Integrated Service Delivery
Changes/Improvements	Modernization and Digital Transformation; Evidence-Based Curriculum Reform

Strengths	Comprehensive and Patient-Centered Care; Technological Advancement; Community Engagement
Weaknesses/Challenges	Operational Limitations; Administrative Constraints; Educational Context Limitations

Reviewing Themes

Each theme was examined for coherence and distinctiveness. The following summarizes the reviewed themes:

Structured Workflow & Community Integration – Participants described systematic care delivery that serves both academic and community needs.

Digital Transformation & Evidence-Based Reform – Widespread adoption of new technologies and evidence-based curricula.

Comprehensive, Patient-Centered Care – Dual focus on learning and patient service.

Operational & Administrative Challenges – Common limitations in scheduling, record systems, and treatment duration.

Defining Themes

Themes were refined and clearly defined as shown below:

Theme	Definition
Structured Workflow and Community Integration	A clearly organized clinical process emphasizing systematic care delivery and responsiveness to community needs.
Digital and Evidence-Based Transformation	Integration of technology and evidence-based education into the dental school's healthcare delivery process.
Comprehensive, Patient-Centered Learning Environment	Balancing high-quality patient care with educational objectives under faculty supervision.
Systemic and Resource Constraints	Limitations arising from administrative systems (e.g., paper-based records) and institutional logistics (e.g., appointment availability).

Qualitative Data: Agreement and Disagreement Calculation

Participants were in agreement between 80% and 90% on all questions. The differences mainly lie in minor details like “workflow management” or “occupational problems.” Most disagreements are about details relating to local context, organization changes, and obstacles. This variation manifests in around 10-15% of the replies.

5.5 The Oral healthcare delivery process

During data collection, the paper-based medical record was being filled out in different departments of the university dental training clinics including the departments of Conservative Dentistry, Prosthodontics, Periodontology and Oral Surgery, Pedodontics, and Orthodontics for medical documentation. Dental students are the frontline healthcare provider and generate the initial recording during each patient’s visit. The medical record contains forms and documents for medical history and comprehensive dental examination, printed radiographs, laboratory reports, and referral letters. These documents are together the main information base of clinics for clinical procedure decision-making.

As each department generates information, it will keep that information locally, which will then be used for departmental evaluation and treatment planning. However, the interdepartmental integration usually occurs as informal verbal communication and, in some situations, through paper referrals or printed documents.

Subsequently, each case is screened against the specified clinical requirement criteria for the student training course individually, and cases that do not meet these criteria are not included in the student-managed treatment pathways. After deciding a case is suitable, the case enters the comprehensive diagnostic area. The students are expected to obtain further diagnostic aids, such as further radiographs or tests at chairside, as the case unfolds.

However, after diagnosis, the process goes through a series of organized yet completely four manual steps. 1st Step, Students fill in standardized paper forms documenting the case. 2nd Step, a trained clinical instructor reviews the submission for accuracy, completeness and clinical appropriateness. When the procedure is approved, the student moves on to 3rd step to carry out the treatment procedure under close supervision of the teaching staff and any follow-up or recall visits are documented in paper format and inserted into the patient file.

When the case is complete, it is checked out by specialist supervisor that all diagnostic and procedural procedures were followed or not. As appropriate, cases requiring additional work are returned to recall visits.

Cases fulfilling both clinical and training needs go on to the last 4th step; documentation is manually filed and archived. All of the documents at the completion stage will be completely in paper form. This includes patient files, X-ray prints, and student logbooks. Even though the workflow is functional, it is highly reliant on repetitive manual data entry, widely physically stored files, and the constant filing and re-filing of records.

As a result of these characteristics, the data are fragmented, clinical information is not easily and fully accessible, inefficiencies affecting service delivery. Overall, these shortcomings combine to call for a centralized, standardized, electronic documentation system that enhances the integrity and availability of data while improving clinic performance.Figure 5

5.6 Proposed Framework for an Electronic Dental Registry at the Faculty Dental Clinics

Based on the study's findings, a comprehensive framework for establishing an electronic dental registry must address the four key variable categories and integrate the identified challenges and facilitators. This framework is a phased, user-centric model designed to ensure successful adoption and long-term sustainability. As shown in the figure 6, integrated electronic workflow for case management in the AAUP dental training clinics will be achieved through a central registry.

The process starts at the Primary Diagnostic Clinic, where a teaching assistant makes the first examination and inputs details in the dental software. At this stage, core clinical inputs are captured in a structured manner. These include examination forms, radiographic findings, referrals, laboratory investigations, etc. They are then used for formulation of dental requirement classification based on the clinical requirements for the dental students at deferent academic level.

Furthermore, all cases are assigned with appropriate classification. Finally, they are funnelled into the downstream clinical services. After assorting and classifying the cases, they are sent to the respective clinical departments – Conservative Dentistry, Prosthodontics,

Periodontology and Surgery and Pedodontics and Orthodontics where dental students act as principal healthcare providers under close supervision.

One of the model's exploring activities is the capacity to integrate all the activities of the departments in a single electronic record, allowing documentation and continuity of care across specialists.

The designed integrated structure aimed at reducing fragmentation, fostering multidisciplinary case determination, and permitting any clinical data generated in one department to be used by other departments when necessary.

The workflow proceeds through a series of steps managed electronically at the operational level. The documentation of the case electronically constitutes (Step 1), while (Step 2) entails the clinical instructors verifying the record for completeness and correctness during the beginning and ending of clinical tasks alongside entries in electronic student logbooks. The decision point then decides whether additional diagnostics are required and, if so, supplementary diagnostics are requested and documented, and the case continues along the care pathway. The 3rd step is the electronic documentation of treatment procedures (recallr follow-up visits where applicable). At the end of treatment, a final decision assesses whether the case is ‘completed’. Completed ones go through to (Step 4) (electronic archiving) whereas incomplete ones are sent back to previous steps to resolve outstanding diagnostics or procedure requirements. The system illustrated in broad terms makes use of a closed electronic loop. It serves to ensure standardized documentation and monitoring, follow-up over time and archiving in a dental registry system.

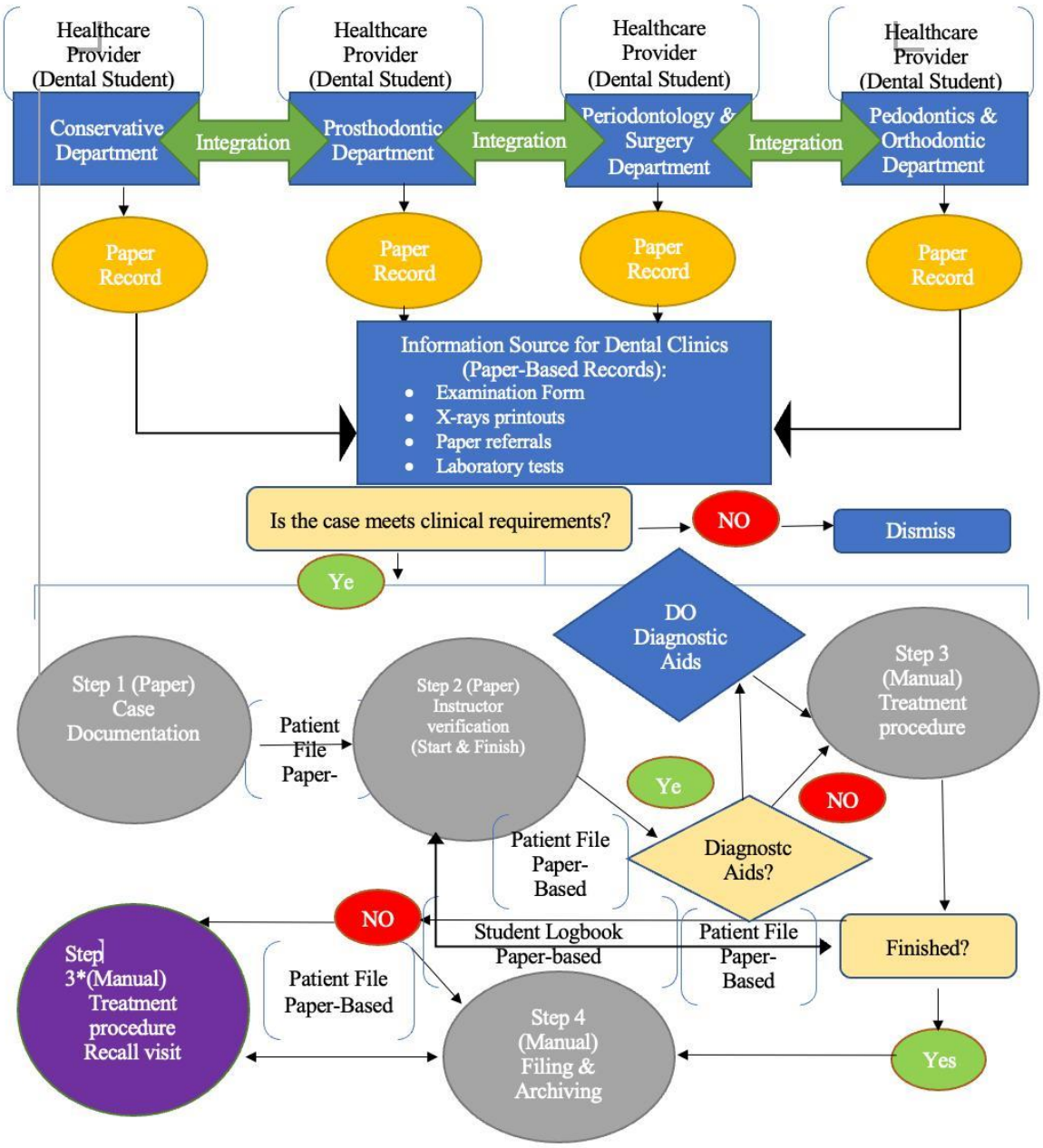

Figure 5: The Oral healthcare delivery process

Figure 5 : The Oral healthcare delivery process

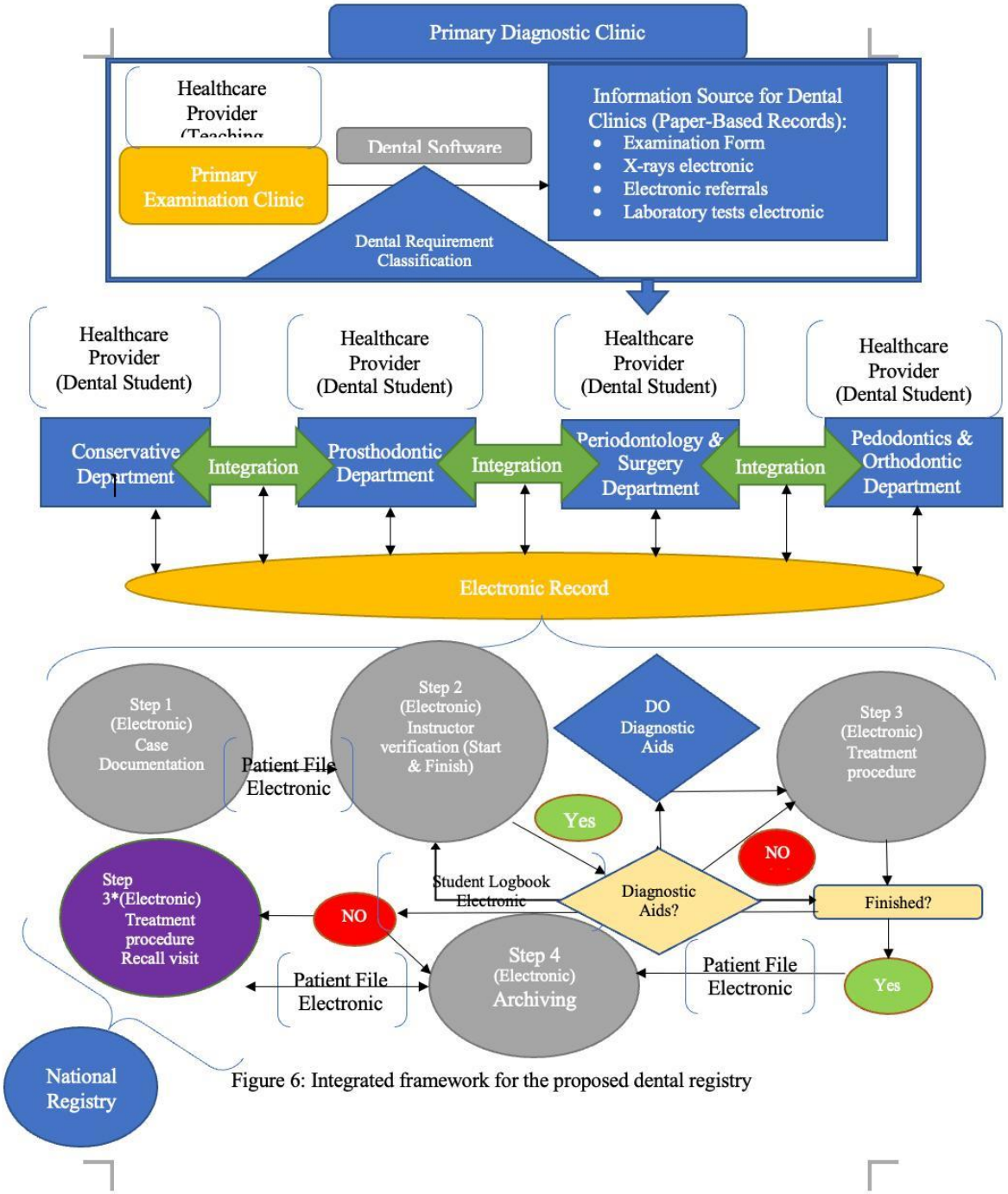

Figure 6: Integrated framework for the proposed dental registry

Figure 6 : Integrated framework for the proposed dental registry

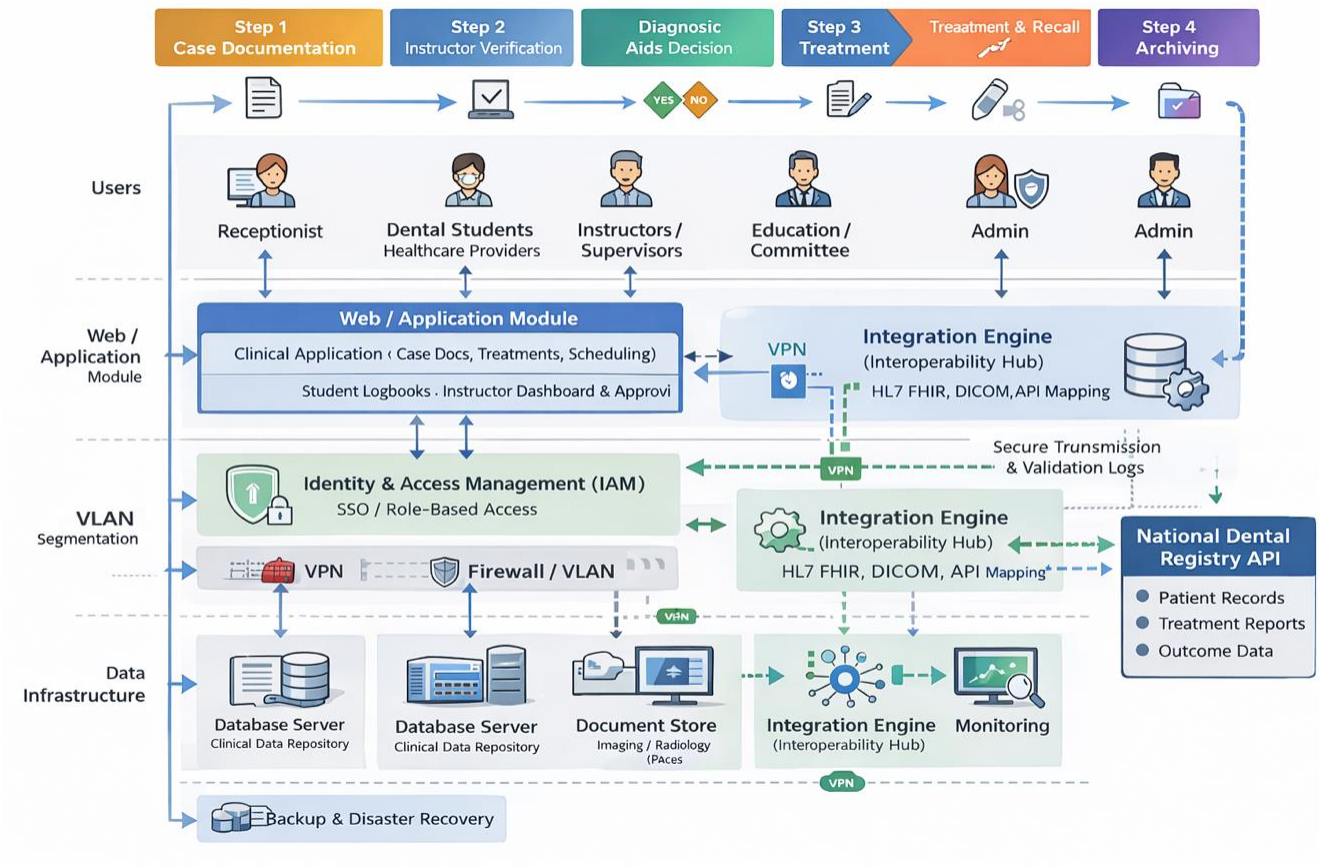

Figure 5: Proposed IT infrastructure for AAUP electronic dental registry

Furthermore, Figure 6 extends this workflow by providing the supporting information-technology (IT) environment that will make the registry operational and secure interoperability. The model integrates clinical activities of documentation, verification, diagnostic support, treatment, recall and archiving in an overarching architecture comprising a web-based clinical application, centralised database services and a radiology repository of images. An identity and access management layer enforces role-based access control, so that each user group, such as a receptionist, students, instructors and administrators, only interacts with functions that are relevant to them. At the same time, the figure also presents core cybersecurity and governance safeguards network segmentation, firewall controls, encrypted communication channels (VPN/TLS), and continuous audit logging that can collectively ensure confidentiality, preserve data integrity, and maintain accountability at a teaching-clinic. It also shows that a specific interoperability layer (integration engine) can enhance

scalability outside the institutions. The registry may generate validated reporting outputs mapped to standardized exchange formats (for example, HL7 FHIR for clinical data and DICOM for imaging metadata) of the internal clinical datasets. Through secure APPs, this architecture facilitates a practical connection from the AAUP registry to a national dental registry, enabling periodic or near real-time submission of standardized patient records, treatment summaries, and outcome indicators. Thus, in addition to the clinical components of the system process flow, which we have just presented, effective electronic integration will also require strong infrastructure, security controls and interoperability mechanisms that together allow for sustainable registry deployment and national linkages.

5.5 Summary

The findings from both the quantitative and qualitative analyses performed in this study were outlined in this chapter. Further, this chapter will also highlight the current workflow and the improvements that are required in it. Findings suggest that moving to an electronic registry would bring significant benefits. They show evidence of efficiency, accuracy and stakeholder satisfaction in other regions.

Chapter Six: Discussion

6.1 Introduction

This study aimed to provide AAUP with an evaluation of their oral health care delivery system as a first step towards establishing a electronic dental registry. Important information about current practices was gathered from quantitative data obtained through surveys of students, instructors, and management involved in the study, as well as qualitative data from interviews with management.

6.2 Dominance of Paper-Based Documentation and its Implications

The use of paper-based medical records (PMRs) for patient information collecting, diagnosis, and treatment planning is overwhelmingly prevalent, as indicated by 95% of students and 93% of instructors. This reliance on manual processes is in line with the difficulties that dental practices face in lower- and middle-income countries (LMICs) (Bostan, S., Johnson, O.A. Jaspersen, L.J. et al. (2024) when trying to adopt electronic medical records. Difficulties arise from factors such as limited IT infrastructure, user resistance, high implementation costs, and an absence of sufficient training (Mohammadi, T., Saadat, S., & Rahimi, B. 2023), (Wang, X., Song, M., & Yang, S. 2023), (Sheng Qian Yew et al (2025)). Consider the Middle East; numerous studies have shown that inadequate IT support and high costs are the two main obstacles to the adoption of electronic health records (S. S. Jayakumar.;2023).

Students are more likely to start new diagnoses for referred patients (78%), and instructors are more likely to initiate treatment plans for returning patients (84%), demonstrating that the dependence on PMRs directly effects efficiency. It appears that there is a serious problem with the smooth transfer of information, which might cause unnecessary tasks to be repeated and even medical mistakes. Contrasted with the ideals of integrated, patient-centered care promoted by contemporary healthcare informatics, these inefficiencies are an acknowledged byproduct of decentralized paper-based systems (Richesson,R.L.& Hammond, W. E. 2021).

6.3 Strong Perceived Need and Positive Attitude Towards Digital Transformation

Although paper is still used, 93% of students and 93% of teachers agree that moving PMRs to EHRs will greatly enhance the documentation of patient data. This high degree of perceived usefulness is an important factor in the effective adoption of electronic health records (Mohammadi, T., Saadat, S., & Rahimi, B. 2023). The fact that students strongly believe in the ease of data entry in electronic logbooks (84%) and its rapidity (82%) further supports their positive attitude on electronic tools. The results show that the users are open to change and that digital tools can improve productivity, accuracy, and patient care in dentistry, which aligns with the global literature (Schwendicke, F., et al 2023).

6.4 Electronic Logbooks as a Future Development

Particularly noteworthy for potential future growth at AAUP Dental College is the high level of positive feelings among students towards electronic logbooks (84% for ease, 82% for quickness of data input). Students often fail to bring their paper logbooks (62% of the time), which is a real obstacle to efficient clinical tracking and feedback. The use of electronic logbooks has brought clinical education and evaluation into the current era by streamlining feedback processes, improving oversight of student progress, and capturing data in real-time (Shahzad Mehranfard D et al 2022). In order to evaluate curricula, find learning gaps, and personalize educational interventions, modern e-logbooks can connect easily with bigger EHR systems.

In addition to improving student learning with organized and easily accessible clinical data, this system would help the university's digital transformation efforts by creating a digital foundation that can be used to build an electronic dental registry (Tassoulas, A., Kavoura, A., & Kavoura, C. 2023), (*WHO Guideline* 2021). Leading dental education institutions worldwide use technology to improve administrative efficiency and educational methods; this development would bring AAUP into line with them (Margarita Iniesta, 2025).

6.5 Inconsistencies and Lack of Standardization in Current Workflow Management

In particular, the findings show a lack of uniformity and consistency in accessibility, internal system integration, and medical record retention. There is a "medium" degree of consistency

in the practices used to preserve student logbooks and patient records, with some depending on informal or personal storage. When it comes to patient records, accessibility is also deemed "medium," and there is a noticeable trend towards creating fresh records for patients who return. As the importance of integrated electronic dental records for longitudinal patient tracking and evidence-based practice continues to grow, this poses a challenge for continuous care and research.

When it comes to internal system integration, X-ray storage (83% of instructors) and verbal referrals (83%) are rather low, on the one hand, while electronic referrals (44%) are low, on the other. The fragmentation in the flow of information is further shown by the high tendency for instructors to initiate a new diagnostic (78%) in the absence of a referral letter. The findings show the need for more standardization and interoperability of processes which most health organizations face due to moving from manual work to digital (Tassoulas, A., Kavoura, A., & Kavoura, C. 2023), (WHO Guideline 2021)). Health Information System needs interoperability to enable information flow and address fragmentation of data (Margarita Iniesta, 2025).

6.6 Strategic Planning and Management Perspectives

The management of the dentistry school has a strong belief in the validity and richness of patient workflow data for strategic planning. Still, they rate credibility of the treatment procedures “medium” (68% probability) and the appropriateness of supply networks as “medium” (56% conviction) regarding process data that reflects reality. This seemingly contradictory impression suggests that data has great value, but it is either not understood fully or that strong systems are not in place to ensure its accuracy and relevant in every area of operations. These findings indicate that the current situation regarding data quality and its influence on decision-making could certainly be improved to aid effective digital transformation strategy planning (Schwendicke, F., et al 2023).

6.7 Alignment with Qualitative Findings

The qualitative study supported by the PEEL method supports quantitative findings. Almost all the participants (nearly 85%) responded positively to the delivery of the dental care, major

modification, strengths and limitations of the process. While the qualitative data supports some of the positives (such as evidence based training and thorough treatment) it is also the case that some of negatives are confirmed; e.g., that paper records create inefficiencies and those appointments are less available The findings are shaped by quantitative and qualitative research, giving comprehensive insight into where AAUP is at the moment.

6.8 Practical Implications for the Palestinian Context

It is relevant to the context of Palestine to interpret the findings of this study. Digital projects' viability or healthcare systems are impacted by underfunding, ongoing politico-economic conflicts, and other budgetary constraints. The findings show a clear need at the level of universities. The Palestinian Ministry of Health has made recent attempts to unify health data using the DHIS2. An example of this is the dental registry to follow oral health services in specific districts. As mentioned in chapter one, the architecture only gives an overview of public health surveillance and aggregate data. Thus, the proposed architecture aims at filling the framework notably designed for the national registry in the context of AAUP. This can help in better patient management, quality improvement, and academic research.

This study highlights the necessity of customized interventions aligned with local infrastructure and user readiness as low-income countries are unable to scale up more complex digital health interventions and mainly depend on paper and informal referral systems (Mohammadi, T., Saadat, S., & Rahimi, B. (2023). It is important to have a good electronic dental Registry of AAUP, as the findings concluded. Instructors and students are prepared for digital changes, as the present-process is inefficient and paper driven. To keep up with new trends in the world, the AAUP is busy improving all aspects of healthcare delivery, oral health care, student training and research. The Electronic Registry Framework should bridge the gaps in standardization, accessibility and internal integration.

The outcomes that we want to achieve through addressing them would include reduced waits and delays to improve oral health outcomes, appropriate medical data management systems for safe and effective delivery of oral health care, and an improved training monitoring system for trainee education. The positive electronic registries used for tracking and monitoring support data-led decisions and continuous quality development of healthcare systems (for example, dentistry) (Richesson & Hammond, 2021).

6.9 Strengths and Weaknesses of the Thesis

The thesis offers a considerable understanding of the oral health care delivery at AAUP, through the use of mixed method study design that triangulated data got from focus group discussions, observations and surveys. The study improves the ecological validity of its findings by capturing a broad range of experiences and perceptions by including viewpoints from several stakeholder groups—students, and instructors. In addition, it is a noteworthy contribution that key users have clearly identified a strong perceived demand for an electronic register. This suggests that the environment is open to future digital transformation activities. But on other hand, due to its design as a cross-sectional observational study, it is limited in its ability to determine cause and effect or monitor changes in workflow efficiency over time; however, it can describe present practices and perceptions. Despite its usefulness, relying on self-reported data from interviews and surveys introduces bias and the limited number of participants at the qualitative data collection . Furthermore, the results may not be applicable to other institutions or broader healthcare contexts without additional comparative research since the study is limited to one university dental college. Lastly, this thesis is more of a framework proposal than intervention research; as a result, it doesn't cover the steps for creating or evaluating an electronic dental registry.

Chapter Seven: Conclusion and suggested future work

7.1 Conclusion

The assessment of the oral healthcare delivery at the Faculty of Dentistry, Arab American University–Palestine (AAUP) (study site), could be useful (as an initial step) to develop an electronic dental registry. Using a mixed-method design to combine quantitative and qualitative data on the donor, the study offered a holistic account of the existing practices, challenges, and opportunities for digital transformation in the faculty's clinical-educational practices.

Based on the results, it was found that more than 90% of students and instructors rely on paper-based medical records (PMRs) as a critical part of the workflow. As a result, data retrieval has not been uniformly efficient or a reliable means to understand the previous patient picture. The difficulties faced with the adoption of technologies by the hospitals in the Western world are similar to those in lower- and middle-income countries due to infrastructure problems, training issues, and costs (Zharima et al., 2023). In spite of these limits, the students and instructor had a very positive attitude towards digitization. More than 90% said that moving to EHR improves the quality of documentation, the efficiency of workflow, and the quality of patient care. This state of readiness is conducive to the gradual introduction of an electronic dental registry.

In addition, the researchers believed that electronic logbooks could be used as a feasible first step for digitalization. The students were pleased with the e-logbooks and believed that data entry is easy and timely feedback helps to monitor academic performance better. A bridge can link their adoption to the training and the bigger digital registry system for data normalization and better supervision. The qualitative results supported the quantitative findings and showed a general consensus on the various strengths.

Some strengths included holistic patient care, updated teaching practices and technological upgrading. The limitations that were highlighted were inappropriate administrative fragmentation, limited interoperability and resource constraints. The triangulated outcomes were adopted to develop a user-centered framework with three phases for the electronic dental registry which involved planning and design, implementation and training, and monitoring and sustainability. The framework promotes user participation, standardization,

compatibility, and continuous improvement as key enablers for successful utilization. This study presents a model that can be adapted to local realities with limited resources and nascent digital health initiatives in Palestine. The registry we are proposing aligns with the national objective of integration of data and quality improvement. Overall, it creates a platform for institutional digital transformation in evidence-based education, timely management of patients, and policymaking of oral health.

7.2 Recommendation

Given the mixed-method evidence produced in this study, the Faculty of Dentistry at Arab American University–Palestine (AAUP) is advised to transition from paper-based medical records to an integrated electronic dental registry that is user-centred and assists in clinical service delivery as well as competency-based dental education. The quantitative findings indicated that over 90 percent of students and instructors currently rely on paper-based records. This was evident in inconsistent documentation retrieval and limited ability to reconstruct a complete longitudinal patient picture across departments. The literature has observed before that paper-based records risk fragmentation and may not always be available when they are needed at the point of care. Such factors cause delays in gaining access to prior information and compromise continuity and timely clinical decision making. The study designated strong readiness for change with 90 percent plus of participants claiming that digitisation would improve documentation quality, workflow efficiency and, most importantly, patient care.

This indicates that AAUP has a key ingredient crucial for successful adoption - high perceived value and acceptance among end users. Similarly, EHR initiatives in low- and middle-income contexts are more likely to succeed when there is user buy-in, and implementation is staged so that service delivery and usability-related resistance is not disrupted. . The AAUP must start with digital components that are high feasibility which can address operational bottlenecks immediately while building institutional capacity for a digital transformation that is broader in scope. The results of this study suggest that electronic logbooks represent a viable entry point, as the students found them easy to use, facilitating feedback at the right time and monitoring academic performance. By embedding e-logbooks within a standard approach for documentation (structured clinical forms, uniform datasets,

and clear cut case classification rules), there can be early benefits in consistency and supervision whilst progressively preparing users for the full registry usage. Because successful digital health systems are dependent on socio-technical factors, not simply on technical design, we propose a phased implementation approach. These factors include governance, workflow fit, staff capacity to use technology, reliable infrastructure, and continuous user support, especially in resource-poor settings. Implementation research has shown that these “socio-technical” factors affect the success of technology, not simply its design.

As such, a registry programme should institutionalise (i) a governance structure covering standards for data, roles, privacy and quality assurance; (ii) ongoing training and local technical assistance to continuously improve implementation; and (iii) an iterative monitoring plan that evaluates usability, adoption, completeness of documentation, retrieval time, and inter-departmental consistency of information to improve feasibility and ongoing optimisation. . Ultimately, to increase strategic value above university level, the electronic dental registry should be designed from the outset with interoperability in mind, enabling future linkages with national health information systems (e.g. DHIS2) to support continuity of care and strengthen oral health reporting and surveillance. The guidance for implementing and integrating DHIS2 emphasizes interoperability and the use of an interoperability layer to prevent siloed systems and enable data sharing across platforms. This reflects the results of the study regarding the administrative fragmentation of the implementation and limited integration across departments. Once the routine collection of digital data stability can be assured, AAUP can further enhance the value of the registry through monitoring quality improvement and education through analytics dashboards. Later responsible use of predictive analytics and AI can help identify patterns in oral disease and treatment outcomes, while supporting evidence-based education, clinical governance, and national oral health policy development.

7.3 Suggested future work

Based on the findings and framework set out in this study, future research and development may be conducted.

1. **Trial Implementation and Assessment of the Digital Database**.

The electronic dental registry should be designed, developed, and pilot tested in selected AAUP clinics in future work. Assessing the usability, interoperability, and user satisfaction will benefit practically in optimizing the system.

2. **Integration with National Health Information Systems.**

Steps should be taken to create a connectivity link between the institutional dental registry and that of the Palestinian Ministry of Health (e.g., DHIS2). By integrating electronic health records, continuous patient care can be enhanced while optimizing national oral health surveillance.

3. **Longitudinal Impact Studies.**

Future research should evaluate how digital transformation affects workflow efficiency, patient experiences, and education performance over the long run. Studies like this can help assess the merits of electronic systems over paper ones.

4. **Expansion to Other Academic and Clinical Settings**.

To make the framework more generalizable, it is recommended to use it in other Palestinian universities. Through a comparative analysis, we can develop a national digital health strategy for dental education to understand the challenges and success factors.

5. **Development of Interoperable Educational Platforms**.

Future actions must deliver a unified platform for e-logbooks, clinical management systems and academic performance dashboards that will backend support learning and clinical documentation.

6. **AI and Analytics Integration**.

Eventually, once we start routinely collecting digital data, we could use AI and predictive analytics to identify trends in oral disease, improve clinical decisions and enhance research.

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Appendices

Appendix A :Student survey

The objective	Question	Branch	Answer
Student's personal information	Academic level		○ 4th year ○ 5th year
	Gender		○ Male ○ Female
Scheduling patient appointment	How do you frequently arrange the patient's appointment?	○ I arrange the patient's appointments by myself.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
		○ The head nurse at the dental department manages the patient's appointments.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
		○ Other ways, specify please----------	
Medical documentation	How do you collect the information from the patients?	○ The patient Information is collected on a paper based medical record (PMR) at the clinic.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
		○ The patient information is collected on electronic health record system (EHR) at the clinic.	○ Always ○ Often ○ Sometimes ○ Rarely

			○ Never
	How do you write your diagnosis and treatment plan for the patient?	○ The diagnosis and/or treatment plan are both hand written on paper based medical record (PMR).	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
		○ The diagnosis and/ or treatment plan are both documented on electronic health record (EHR) system files.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
	In case of receiving a patient who previously treated at AAUP dental	○ In case of receiving a patient who previously treated at AAUP clinics, I start the diagnosis and/ or treatment plan all over.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
	How do you document the treatment procedures for the patients?	○ I write the treatment procedure on the previous paper based medical record (PMR)	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
		○ I document the treatment procedure on electronic health record (EHR) system	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
Medical record preservation	How do you usually archive the patient's medical record?	○ I don't usually archive the patient's files.	○ Always ○ Often ○ Sometimes

			○ Rarely ○ Never
		○ I keep the patient's file in personal archiving place.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
		○ I keep the patient's files at the central place at the college.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
	How do you keep the patient personal information confidentiality?	○ I discard the paper based medical record (PMR) after I finish diagnosis and/or treatment.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
		○ I give back the paper based medical record (PMR) to dental department.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
		○ I keep the patient's personal contact information with me.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
Medical record accessibility	In case of having a patient who previously had a dental	○ I can get the patient previous dental record easily.	○ Always ○ Often

	treatment at AAUP dental clinics.		○ Sometimes ○ Rarely ○ Never
		○ I will have to make a new dental record for the patient.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
Monitoring student's logbooks		○ I believe the logbook outline was useful to my learning out comes during the course.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
		○ I believe the written feedback provided has improved my learning outcome.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
		○ I forget to bring my paper-based logbook to the clinic.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
		○ I think the electronic logbook will allow data input easily.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never

		○ I think the electronic logbook will allow data input quickly.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
Internal system integration	When an X-ray is required, how do you deal with that?	○ I contact the X-ray department to chick out if a previous one exists.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
		○ I directly request a new one regardless if a previous X ray present or not.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
		○ I review the patient record to find out if previous X ray exists or not.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
	How do you keep the X-ray record for the patients?	○ I discard the X-ray files after the treatment.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
		○ I ask the patients to keep the X-ray records with them.	○ Always ○ Often ○ Sometimes ○ Rarely

			○ Never
		○ I personally keep the X-ray file of the patients.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
		○ We have electronic system to keep the X-rays.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
	In case of receiving a referred patient from another colleague.	○ I receive a written paper-based referral letter from referring colleague.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
		○ I receive an electronic based referral letter from the referring colleague.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
		○ I do not receive any referral letters and I start my own diagnosis and treatment plan all over.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
Feedback		I believe the current patient data documentation needs improvements.	○ Always ○ Often ○ Sometimes

			○ Rarely ○ Never
		I believe converting the PMR to EHR will improve the patient data documentation.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never

Appendix B :Instructor's survey

The objective	Question	Branch	Answer
Instructor's personal information	Academic title		○ Full Professor ○ Associate Professor ○ Assistant Professor ○ Lecturer ○ Teaching Assistant
	Specialty (except TA)		○ Orthodontics ○ Pediatrics ○ Surgery ○ Periodontology ○ Endodontics ○ Conservative ○ Prosthodontics ○ Oral medicine
	Gender		○ Male ○ Female
	Years of teaching experience		○ 1 year or less ○ 2-4 years ○ 5-7 years ○ 8 years and more
Scheduling patient appointments	How are your patients arranged at the department's clinics?	○ The patient's appointments are managed by the students themselves.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
		○ The head nurse at the dental	○ Always ○ Often

		department manages the patient's appointments.	○ Sometimes ○ Rarely ○ Never
		○ Other ways, specify please---------- ----------	
		○ I am satisfied by the current patient workflow arrangements.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
Medical documentation	How do you collect the data from the patients?	○ Data are collected on paper-based medical record (PMR) gathered at the clinic.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
		○ Data are collected on electronic health record system gathered at the clinic (EHR).	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
	How do you write your diagnosis and treatment plan for the patient?	○ Diagnosis and treatment plan are both hand written	○ Always ○ Often ○ Sometimes

		on paper-based medical record (PMR).	○ Rarely ○ Never
		○ Diagnosis and treatment plan are both documented on electronic health record (EHR)system files.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
		○ I am satisfied with the current patient data documentation.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
Medical record preservation	How do you frequently store the student logbook files?	○ I keep the student logbook files in personal storage place.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
		○ The student logbook files are kept at the central place at the college.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
	Where do you keep the patient personal information & confidentiality?	○ I discard the paper-based medical record (PMR) after I	○ Always ○ Often ○ Sometimes ○ Rarely

		finish diagnosis and/or treatment.	○ Never
		○ I give back the paper-based medical record (PMR) to dental department.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
		○ I am satisfied with the patient data storage managements.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
Medical record accessibility	In case you have a patient who previously had a dental treatment at AAUP dental clinics.	○ I can get his/her old dental record easily	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
		○ I will make a new dental record for the patient.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
		○ I feel the current filing process satisfy my needs for research purposes.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
		○ I am satisfied with the patient data	○ Always ○ Often

		accessibility managements.	○ Sometimes ○ Rarely ○ Never
Internal system integration	In case of referring a patient to do an X-ray, how do you know if the patient already had a recent X-ray?	○ I contact the X-ray department to chick out if a previous one exists.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
		○ I directly request a new one regardless if a previous X ray present or not.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
	How you keep the X-ray record for the patients?	○ I discard the X-ray files after the treatment.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
		○ I ask the patients to keep the X-ray records with them.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
		○ I personally keep the X-ray file of the patients.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never

		○ We have electronic system where we keep the X-rays.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
		○ In case of referring patient for consultation in another department, I would perform a written referral form.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
		○ In case of referring patient for consultation in another department, I would perform an electronic referral form.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
		○ In case of referring patient for consultation in another department, I would perform a verbal referral.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
		○ I am satisfied with the current	○ Always ○ Often

		internal system integration.	○ Sometimes ○ Rarely ○ Never
Feedback		○ I believe the current patient data documentation needs improvements.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
		○ I believe converting the PMR to EHR will improve the patient data documentation.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never

Appendix C :Dental school management survey

The objective	Topic	Question	Answer
Strategic planning	Patient workflow starting from primary dental clinic throughout the department clinics.	○ I believe the process provide credible data to measure.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
		○ I believe the data of the oral healthcare delivery process provides you with, rich information.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
	The treatment procedures at the department/s.	○ I believe the treatment procedures provide credible data to measure.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
	The treatment procedures at the department/s.	○ I believe the employed percurrent procedures maintain appropriate supply chain in relation to the needed stocks.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never
	Oral healthcare delivery process in the dental departments	○ I believe the process data will accurately reflect reality.	○ Always ○ Often ○ Sometimes ○ Rarely ○ Never

1. Can you provide a brief description of your dental school oral healthcare delivery process.
2. Are there any major changes happened on your dental school oral healthcare delivery process since was established?
3. Please indicate what you feel the strengths and weakness of your dental school oral healthcare delivery process.

الملخص

يعتمد تقديم خدمات الرعاية الصحية الفموية في عيادات طب الأسنان الجامعية على الوصول السريع إلى معلومات المرضى الكاملة والدقيقة. مع ذلك، في العديد من البلدان ذات الدخل المنخفض والمتوسط، تُحفظ الوثائق بشكل أساسي ورقياً. يؤثر هذا سلباً على استمرارية الرعاية، وقابلية التدقيق، والإشراف التعليمي القائم على البيانات. هدفت هذه الأطروحة إلى تقييم سير العمل الحالي لتقديم خدمات الرعاية الصحية الفموية وتوثيقها في كلية طب الأسنان بالجامعة العربية الأمريكية - فلسطين، وذلك بهدف توفير أدلة تدعم تصميم سجل إلكتروني عملي وسهل الاستخدام لطب الأسنان، ووضع خارطة طريق لتنفيذه على مراحل. اعتمدت الدراسة على منهجية مختلطة، تجمع بين المسح الكمي والبحث النوعي. في الفترة ما بين فبراير ويوليو 2023، جُمعت البيانات الكمية من طلاب طب الأسنان الجامعيين (ن = 319) والمدرسين السريريين (ن = 75). تم ذلك من خلال استبيان منظم تناول إدارة المرضى والعمليات الإدارية، وحفظ السجلات، وأدوات التدريب التعليمي والسريري (سجلات المتابعة والتقييم)، وتكامل النظام الداخلي، والأداء التنظيمي. أُجريت مقابلات منظمة مع إدارات كليات طب الأسنان للحصول على بيانات نوعية فيما يتعلق بالتحديات السياقية، والعوامل المساعدة، والأولويات الاستراتيجية.

تم تحليل البيانات الكمية باستخدام الإحصاء الوصفي (المتوسطات، والانحرافات المعيارية، والنسب المئوية، والتكرارات)، بينما تم تحليل البيانات النوعية تحليلاً موضوعياً. دُمجت النتائج النوعية مع نتائج الاستبيان لتطوير إطار عمل قائم على الأدلة. أشارت النتائج إلى الاعتماد الكبير على السجلات الطبية الورقية كعنصر أساسي في سير العمل السريري. وقد نتج عن ذلك تباينات في سهولة استرجاعها، وتشتت المعلومات بين الأقسام، ومحدودية في المتابعة الطولية، فضلاً عن قصور في إعداد التقارير المؤسسية. على الرغم من أن هذه المعوقات التي حُددت في الأدبيات المتعلقة بتبني نظم المعلومات الصحية (مثل جاهزية البنية التحتية، والقدرة التدريبية، والتكلفة) كانت مصدر قلق، إلا أن الطلاب والمدرسين كانوا على أتم الاستعداد للتحول الرقمي. كان كلا الفريقين واثقين من أن الأنظمة الإلكترونية ستُحسّن جودة التوثيق، وكفاءة سير العمل، ورعاية المرضى. اعتقد المشاركون أن السجل الإلكتروني أداة ملموسة لبدء رحلة التحول الرقمي. وقد تم تسليط الضوء على سهولة إدخال البيانات، فضلاً عن إمكانية تلقي ملاحظات

سريعة قابلة للتتبع وذات قيمة تعليمية. استنادًا إلى الأدلة التي تم جمعها من خلال أساليب مختلطة، تقترح الأطروحة إطار عمل ثلاثي المراحل يركز على المستخدم لسجل إلكتروني لطب الأسنان خاص بـالجامعة العربية الامريكية.

شملت المراحل التخطيط والتصميم للتوحيد والمشاركة، والتنفيذ والتدريب وفقًا للبيئات السريرية والأكاديمية، والمراقبة والاستدامة للتقييم المستمر والحكومة والتكيف. يتضمن الإطار المقترح للسجل مسارًا مناسبًا للسياق مصممًا للتحول الرقمي المؤسسي فيما يتعلق بتعليم طب الأسنان الفلسطيني، ويوفر أساسًا للتوافق المستقبلي مع أنظمة تكنولوجيا المعلومات الوطنية للصحة، ومبادرات تحسين الجودة، وسياسات صحة الفم.

الكلمات المفتاحية: السجل الإلكتروني لطب الأسنان؛ تعليم طب الأسنان؛ الأساليب المختلطة؛ السجلات الطبية الورقية؛ السجل الإلكتروني؛ سير العمل؛ قابلية التشغيل البيني؛ فلسطين.