JOURNAL OF HEALTHCARE SCIENCES
Volume 5 Issue 6 2025, Article ID: JOHS2025001054
http://dx.doi.org/10.52533/JOHS.2025.50606
e-ISSN: 1658-8967

Original Article

Implementing Integrated Practice Unit for Dental Implant Treatment at a Tertiary Military Hospital Dental Service: A Value-Based Improvement Effort

Fahad A Khalifa [1*], Khuloud S Alhazmi [2], Kawther A Mirza [3], Abdulrahman O Alhowaish[2], Wissam S Fattani [3], Yasser Rhbeini [1,4], Khalid N. Thallab [5]

1 Department of Periodontics, King Fahd Armed Forces Hospital (KFAFH), Jeddah, Saudi Arabia
2 Department of Orthodontics, King Fahd Armed Forces Hospital (KFAFH), Jeddah, Saudi Arabia
3 Department of Restorative Dentistry, King Fahd Armed Forces Hospital (KFAFH), Jeddah, Saudi Arabia
4 Strategy Implementation Office, King Fahd Armed Forces Hospital (KFAFH), Jeddah, Saudi Arabia
5 Quality Improvement & Patient Safety (CQI&PS) Department, King Fahd Armed Forces Hospital (KFAFH), Jeddah, Saudi Arabia

Correspondence should be addressed to **Fahad A Khalifa**, Department of Periodontics, King Fahd Armed Forces Hospital (KFAFH), Jeddah, Saudi Arabia, email: fkhalifa1980@gmail.com

Received: 09 April 2025, Revised: 16 April 2025, Accepted: 18 June 2025, Published 30 June 2025.

Abstract

Background: The dental department faces challenges such as delays in access to care and prolonged treatment durations, exacerbated by a growing patient population, with an estimated 45,143 adults needing Implant-supported Prosthesis. This demand-supply mismatch leads to patient dissatisfaction and potential negative impacts on their health.

Methods: This is an Observational Quality Improvement Study. The study was conducted over a 26-month period, with baseline data collected from January to December 2019 and post-intervention data from January 2021 to December 2022. Data collection tools included IT-generated reports from the hospital OASIS system, patient charts from the R4 dental system, and dental laboratory records.

Results: The total number of Implant-supported Prosthesis cases completed in 2022 is 1733. The results indicate a significant improvement in the efficiency and outcomes of the Implant-supported Prosthesis treatment. Average treatment time decreased by 53.61%, and appointment waiting times were reduced by 66.67%. The number of appointments required for treatment dropped by 31.4%, alongside substantial reductions in laboratory turnaround times for prostheses and crowns/bridges. The biological failure rate for implant-supported prostheses fell dramatically by 87.6%, and the technical failure rate reached 0% in 2021 and 2022. Patient experience scores improved from 77.20% to 84.24%, and the annual cost savings are estimated at around 4,790,817 SR.

Conclusion: Overall, these changes suggest that minor adjustments in the system can lead to significant benefits without the need for additional costs or expansions.

Keywords: Value-based practice, Patient experience, Improved clinical outcome, Digital Transformation, Process improvement, Resource utilization, Implant-supported Prosthesis

Introduction

Due to the increased demand and spending in healthcare, the Kingdom of Saudi Arabia has introduced a new vision for 2030 across multiple sectors. This vision aims to improve the quality of healthcare services and emphasizes beneficiary satisfaction and quality of life while ensuring cost-effective spending. Value-based healthcare is a delivery model in which providers, including hospitals and physicians, are incentivized based on patient health outcomes. While this model has gained considerable traction in general medicine, it remains underutilized in oral healthcare (1, 2).

There is increasing recognition of the connection between oral diseases and various chronic health conditions such as cardiovascular diseases, chronic obstructive pulmonary disease, diabetes, kidney disease, and asthma. It was suggested that overall health increases when dental care is integrated with medical care (3). An estimated 1.5 million (11.5%) visited for a routine check-up, and 6.3 million (48.6%) for a complaint, among Saudi residents aged 15 years or older in the past year. Studies have suggested that these figures have grown in recent years, which reflects the increased demand for dental services in the Kingdom (4). Improper implant placement and misalignment at the abutment-prosthesis interfaces are thought to generate uncontrolled stresses in the prosthetic components, leading to technical complications such as screw loosening, component fractures, loss of implants or prostheses, and, in severe instances, difficulties in fabricating the prosthetic component (5).

According to the American Academy of Implant Dentistry (AAID), the entire process of treatment takes from six to twelve months with some variation depending on the complexity of the case. Much of that time is spent on surgical healing and osseointegration, as well as on the multi-phase fabrication of a custom prosthesis in the dental laboratory. To better understand existing gaps, current practices and processes in dental care services were analyzed using a fishbone diagram to identify the root causes of the problem (6, 7) **(Figure 1)**.

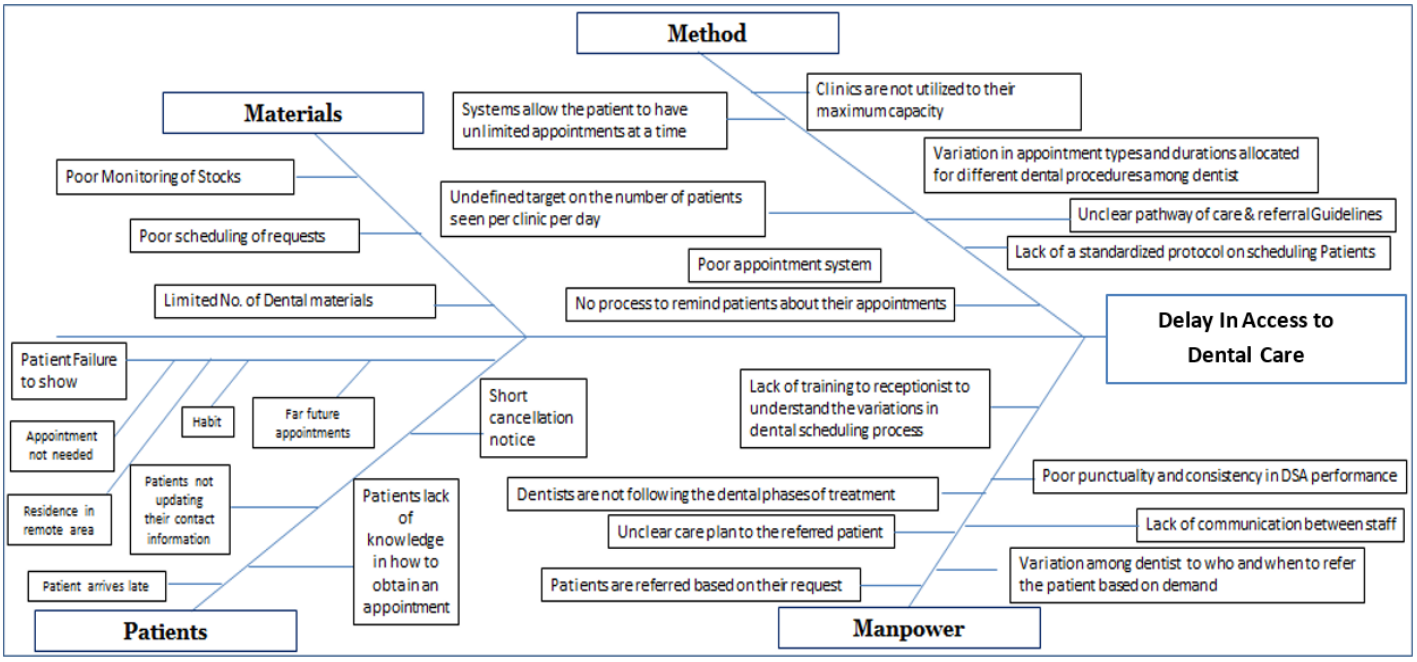


Figure 1: Fishbone Tool

http://dx.doi.org/10.52533/JOHS.2025.50606

The purpose of the study is to enhance the efficiency and effectiveness of dental implant treatments by implementing an Integrated Practice Unit (IPU). The primary goal is to reduce the average time to complete the course of treatment for implant-supported prosthesis by 50% from the baseline by the end of 2022 through the implementation of the IPU for Dental Implant treatment.

Methods

Settings and duration

The Tertiary Military Hospital is situated in Jeddah. The hospital operates five city-wide satellite clinics that are integrated into a nationwide network of healthcare facilities overseen by the Health Services Division of the Ministry of Defense. The number of active files at the Hospital is estimated to be 455,864 files. The dental care services at the Tertiary Military Hospital provide quality dental care in a wide variety of areas: general dentistry, advanced restorative dentistry, pedodontics, periodontics, endodontic, oral and maxillofacial surgery, orthodontic, prosthodontic, implantology, dental hygiene and public health. The study was conducted over a 26-month period, with baseline data collected from January to December 2019 and post-intervention data from January 2021 to December 2022.

Inclusion and exclusion criteria

Patients eligible for inclusion in this study were those referred for dental implant-supported prosthesis treatment between January 2021 and December 2022. Inclusion criteria required patients aged 18 years or older with partial or complete edentulism who required fixed implant-supported prostheses. All included patients had to have complete medical and dental records available in the R4 dental system and had to consent to participate in the full course of treatment and follow-up within the IPU framework. Patients were excluded from the study if they had only undergone either the surgical or prosthetic phase of treatment, thereby not completing the full implant workflow. Additionally, patients with medical contraindications for implant placement—such as uncontrolled diabetes, untreated periodontal disease, or poor oral hygiene—were excluded. Cases that were cancelled or deferred due to patient-related reasons, such as non-compliance or missed appointments, were also excluded. Furthermore, patients receiving removable prostheses or overdentures instead of fixed implant-supported prostheses were not included in the analysis.

Study tools

Data for this study were collected using multiple tools. Quantitative clinical and operational metrics, such as treatment duration, waiting times, failure rates, and laboratory turnaround times, were obtained through hospital IT-generated reports from the OASIS system, R4 dental system charts, and dental laboratory records. These data sources were used to measure outcome, process, and balancing indicators before and after the intervention. In addition, a structured patient experience survey was conducted annually to assess satisfaction with the IPU for dental implant treatment. The survey covered key domains including accessibility, communication, and overall care experience. Patients were asked to rate their experience using a standardized 5-point Likert scale. Survey responses were collected anonymously and aggregated to generate an overall performance score for the IPU.

Interventions

The interventions by the team were focused on redesigning our patient flow and processes to reduce the time to complete the course of treatment for Implant-supported Prosthesis through implementing 3 main strategies (minimizing practice variations among health care providers, eliminating errors and redoing procedures, minimizing cost of materials and waste) in all the

http://dx.doi.org/10.52533/JOHS.2025.50606

3 phase of dental implant treatment to maximize efficiency as follows: **(Figure 2)**

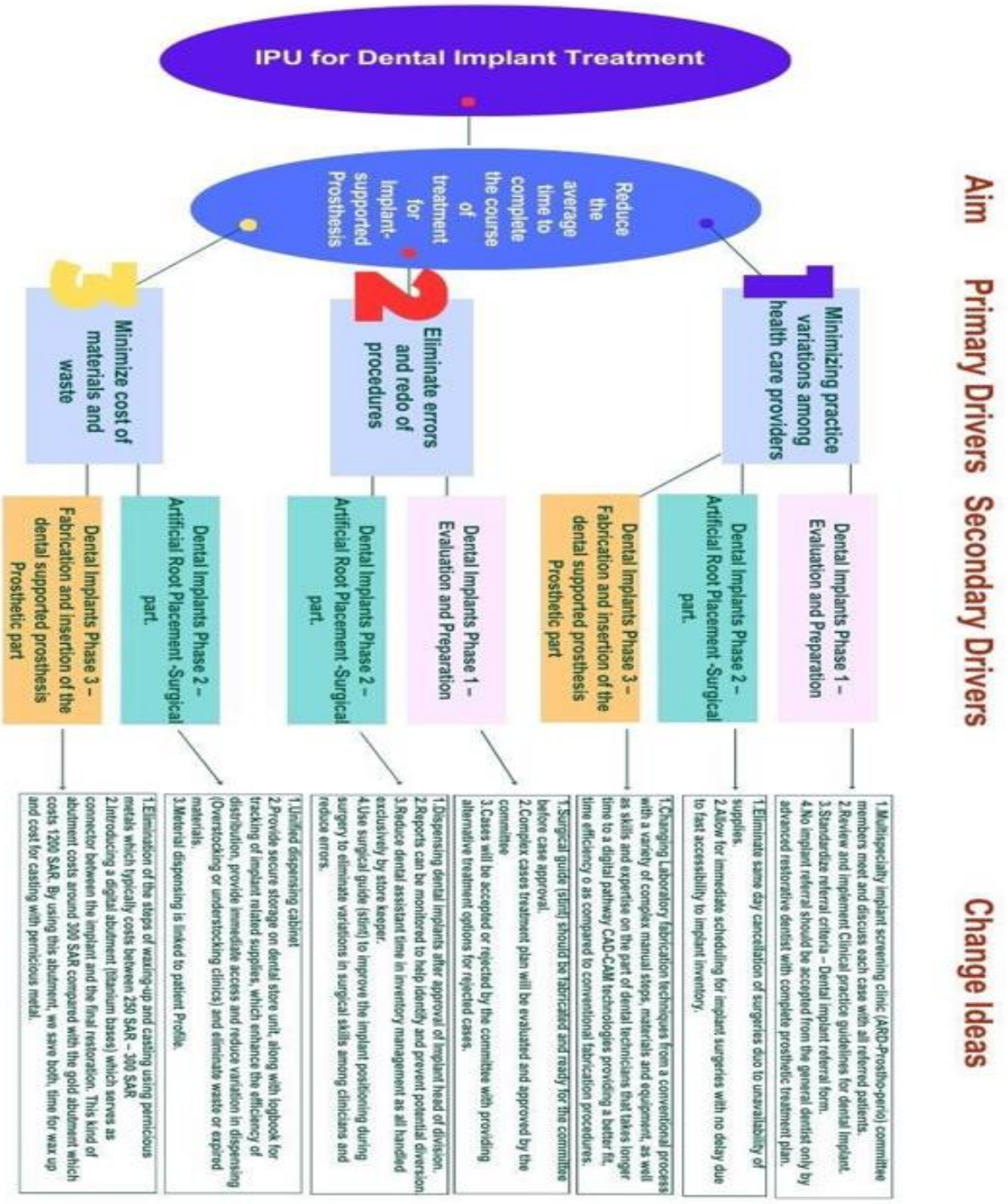
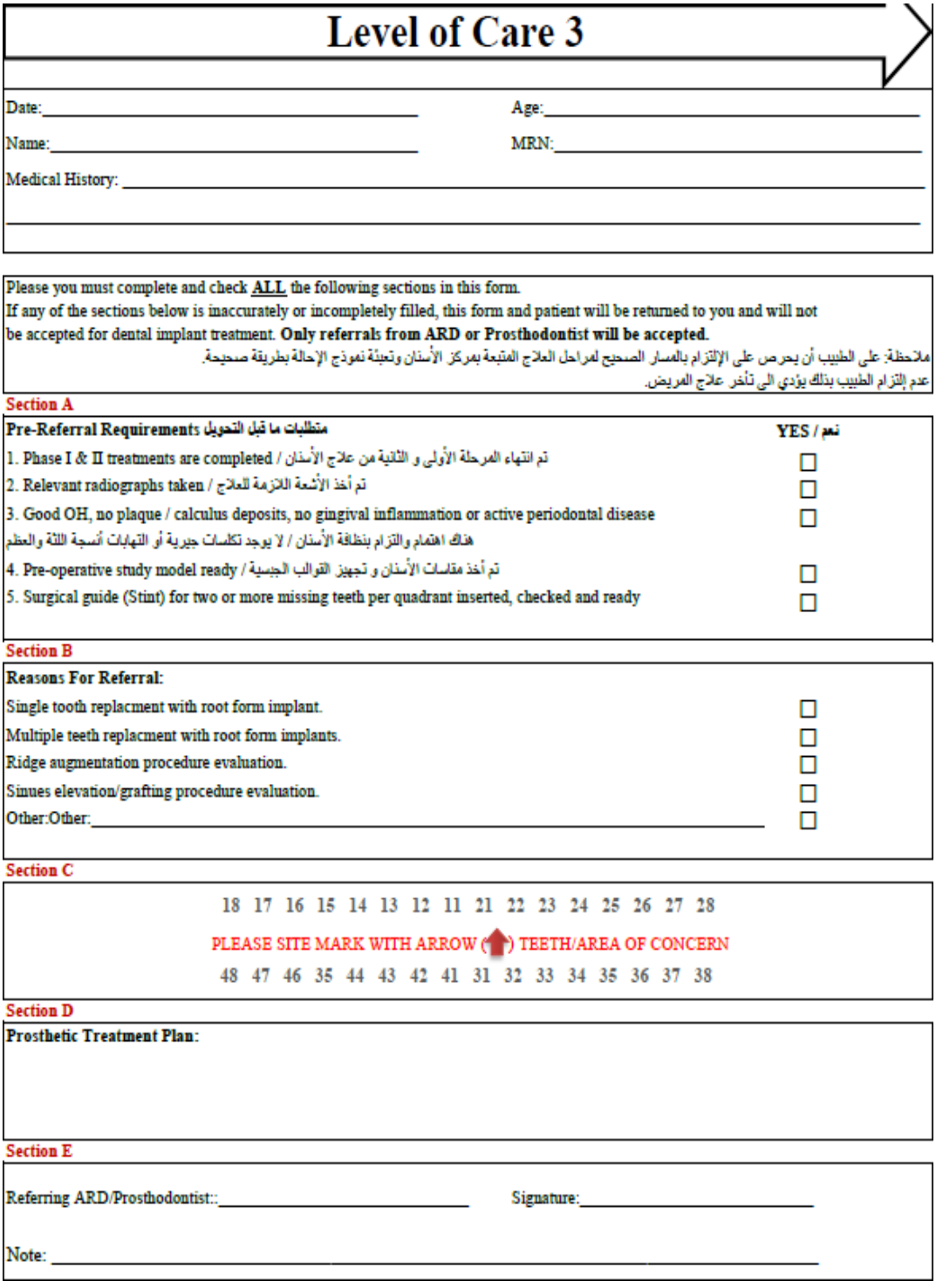


Figure 2: Project Drivers diagram

http://dx.doi.org/10.52533/JOHS.2025.50606

Dental Implants Phase 1 – Evaluation and Preparation:

The IPU dental implant team meets and discusses each case with all referred patients. Then review and implement clinical practice guidelines for dental Implant **(Table 1)**. Then standardize referral criteria – Dental implant referral form **(Figure 3)**.



Level of Care 3

Date:_____ Age:_____

Name:_____ MRN:_____

Medical History: _____

_____

Please you must complete and check **ALL** the following sections in this form.
If any of the sections below is inaccurately or incompletely filled, this form and patient will be returned to you and will not be accepted for dental implant treatment. **Only referrals from ARD or Prosthodontist will be accepted.**
ملاحظة: على الطبيب أن يحرص على الإلتزام بالمسار الصحيح لمراحل العلاج المتبعة بمركز الأسنان وتعبئة نموذج الإحالة بطريقة صحيحة.
عدم إلتزام الطبيب بذلك يؤدي الى تأخر علاج المريض.

Section A

Pre-Referral Requirements متطلبات ما قبل التحويل	**YES / نعم**
1. Phase I & II treatments are completed / تم انتهاء المرحلة الأولى و الثانية من علاج الأسنان	☐
2. Relevant radiographs taken / تم أخذ الأشعة اللازمة للعلاج	☐
3. Good OH, no plaque / calculus deposits, no gingival inflammation or active periodontal disease هناك اهتمام والتزام بنظافة الأسنان / لا يوجد تكلسات جيرية أو التهابات أنسجة اللثة والعظم	☐
4. Pre-operative study model ready / تم أخذ مقاسات الأسنان و تجهيز القوالب الجبسية	☐
5. Surgical guide (Stint) for two or more missing teeth per quadrant inserted, checked and ready	☐

Section B

Reasons For Referral:

Single tooth replacment with root form implant.	☐
Multiple teeth replacment with root form implants.	☐
Ridge augmentation procedure evaluation.	☐
Sinues elevation/grafting procedure evaluation.	☐
Other:Other:_____	☐

Section C

18 17 16 15 14 13 12 11 21 22 23 24 25 26 27 28

PLEASE SITE MARK WITH ARROW (↑) TEETH/AREA OF CONCERN

48 47 46 35 44 43 42 41 31 32 33 34 35 36 37 38

Section D

Prosthetic Treatment Plan:

Section E

Referring ARD/Prosthodontist::_____ Signature:_____

Note: _____

Figure 3: Implant referral form

http://dx.doi.org/10.52533/JOHS.2025.50606

Table 1: Clinical Practice Guidelines for Dental Implant

CRITERIA	CANDIDATE	RELATIVE CONTRAINDICATED	ABSOLUTE CONTRAINDICATION
Age	At least 21 years old and dentally mature.	None	Craniofacial growth is incomplete (how would you confirm?)
Medical status	- Healthy patient with no chronic illness (ASA 1) - DM: HbA1C < 7.2%	DM: HbA1C: 7.2% -7.5%	DM: HbA1C > 7.6%
	Should be within the last 3 months		
			Patients who were treated with radiation therapy for the oro-facial region. → Patients who have received more than (>50 Gy) radiation therapy. *
			* Medical consultation is recommended
			Patients who are receiving chemotherapy → dental implant treatment should be delayed until six months after completion of the treatment and hematological recovery of the patient*
			* Medical consultation is recommended
			Patients who have undergone open heart surgery procedures to receive prosthetic heart valves suffered myocardial infarction and cerebrovascular accident (stroke). A Dental implant surgery should be delayed for six months since discharge/ recovery or according to the advice of the treating clinician*
			Medical consultation is recommended.
		Patients who are on oral bisphosphonates for osteoporosis	- Patients who are receiving intravenous (IV) bisphosphonates
		Patient on anticoagulants * Subjects with bleeding disorders *	- Subjects with severe psychoses/neuroses.
		Medical consultation is recommended, and a proper treatment plan should be done with the patient's physician. The current recommendation is to undertake the implant surgical procedure without modifying the anticoagulation, provided the INR is less than 3 or 3.5 Bone disorders including Osteopetrosis, Paget's disease of bone involving the proposed implant site, Florid Cemento- Osseous Dysplasia, and Fibrous dysplasia affecting the site of the implant. * * Medical consultation is recommended	

http://dx.doi.org/10.52533/JOHS.2025.50606

CRITERIA	CANDIDATE	RELATIVE CONTRAINDICATED	ABSOLUTE CONTRAINDICATION
			Uncontrolled metabolic disorders, late stages of chronic nephritis, liver failure, severe systemic diseases including severe immunosuppression, acute leukemia, or relapse of chronic leukemia.
		Hypo salivation patients	
		Immunocompromised patients * * Medical Consultation is recommended and strict anti-infective measures should be enforced when treating these patients	
		- Corticosteroid therapy * * Medical consultation is recommended. * Consider Corticosteroid cover	
			- **Titanium allergy**
Oral hygiene	- Healthy periodontium with probing depth < 3 mm - Caries free - Absence endodontic lesions - Absence of oral pathology - Proper oral hygiene habits		- **Presence of periodontal pocket > 4mm** - **Plaque index > 20%** - **Bleeding Index >10%** - **Presence of Dental caries or periapical lesions**
	- **Comprehensive dental and periodontal examination and charting MUST be done before dental implant-related procedures** - **Radiographic examinations: Intraoral radiographs, OPG, and CBCT** - **Diagnostic Casts (digital or conventional)**		
Bone level	- Adequate bone quality and volume about anatomical structures and the planned restoration* * At least 2 mm buccal bone and 1 mm lingual bone should be maintained when the proper size implant is placed	- Inadequate bone quality and volume about anatomical structures and the planned restoration. * - (simultaneous GBR is predictable)	- **Inadequate bone quality and volume about anatomical structures and the planned restoration.** * - **(simultaneous GBR is not predictable)** * **Bone grafting or augmentation should be considered before the dental implant procedure. Consultation with OMFS / Periodontist is recommended.**
Dental aspect			- **Unrepaired clefts and inadequate bone volume.** • **Bone grafting or augmentation should be considered before the dental implant procedure.** • **Team approach**

http://dx.doi.org/10.52533/JOHS.2025.50606

CRITERIA	CANDIDATE	RELATIVE CONTRAINDICATED	ABSOLUTE CONTRAINDICATION
	- Non-restorable teeth - Missing teeth (congenital, trauma, or extracted teeth due to caries or periodontal disease) - Ectopic teeth that cannot be treated by orthodontics		
Smoking	Non-smoker Patient	Smoking/Vape < 10 / day	**Smoking/Vape > 10 / day**
		Smoking cessation must be considered.	
Occlusion	**Stable occlusion and proper alignment of teeth**	- **Bruxism*** - **Compromised edentulous spaces with supra-eruption of opposing teeth or drifting of adjacent teeth** ** *** Consider Night Guard** **** Implant placement should allow proper homecare and the implant can be restored**	

Dental Implants Phase 2 – Artificial Root Placement - Surgical Part

Standardize the implant dispensing cabinet. Store all implant-related supplies securely in the dental store unit and maintain a logbook for tracking. This system improves distribution efficiency, allows quick access, minimizes dispensing inconsistencies (such as overstocking or understocking), and prevents waste and expiry. Implant dispensing should be linked to each patient's profile **(Figure 4)**. Dispense dental implants only after approval from the implant or periodontics division head, with reports monitored to detect and prevent diversion. Assign inventory management to the storekeeper to reduce the dental assistant's workload. This setup prevents same-day surgery cancellations due to missing supplies and allows immediate scheduling of implant procedures through reliable inventory access. Use a surgical guide (stent) during surgery to standardize implant placement and reduce variation in clinical technique.

Dental Implants Phase 3 – Fabrication and insertion of the dental-supported prosthesis - Prosthetic part

Changing Laboratory Fabrication Techniques: Historically, a conventional method for implant-supported prostheses was employed, involving dental stone castings with implant analogs derived from standard implant impressions. Subsequently, abutments and superstructures are designed on the stone cast utilizing a hand wax-up. Next, the production process entails casting or pressing methods utilizing the lost wax technique. After the mesostructure is fabricated and verified for passive fit intraorally, the final restoration is then enveloped in aesthetic veneering material (ceramic, composite, resins); this procedure entails numerous intricate manual steps, materials, and equipment, alongside the requisite skills and expertise of dental technicians, resulting in an extended duration of completion. Post-Intervention: a digital process to produce implant-supported prostheses may encompass the scanning of traditionally fabricated models, computer-aided design of both provisional and definitive reconstructions, and computer-aided manufacturing of devices/prostheses utilizing additive and/or subtractive methods.

http://dx.doi.org/10.52533/JOHS.2025.50606

DENTAL DEPARTMENT- DENTAL SUPPLY

IMPLANT DISPENSARY FORM

Date Request:	**Date Received:**
Patient Name:	**Name of DA**
MRN:	**Signature DA:**
Pt. Age:	
Implant Dr:	
Restorative Dr:	
Dental Assistant:	

Treatment Plan:

Parts Required							
No.	**Description**	**QTY.**	**REF.#**	**LOT#**	**ISSUED**	**USED**	**RET.**
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

Implant Dr:	**Restorative Dr:**
Signature:	**Signature:**
Date:	**Date:**

Head of Perio/Implant Division Approval

Signature: **Date:**

DEN01.F72/1 Page 1 of 1

Figure 4: Implant Dispensary form

Team Members

The project team consists of a diverse group of leaders and specialists, each contributing their expertise to enhance the implementation of the IPU for dental implant treatment. The team members and their roles include: The director of dental services oversees all dental services and ensures alignment with the project's overall goals, whilst the director of continuous quality improvement and patient safety (CQI&PS) focuses on enhancing the quality of care and patient safety standards throughout the treatment process. The director of the strategy implementation office has the responsibility for executing the strategic vision and ensuring that project objectives are met effectively and efficiently, and the head of the perio/implant division provides expertise in periodontics and dental implants, guiding treatment protocols and best practices. The Head of the Prosthodontic

http://dx.doi.org/10.52533/JOHS.2025.50606

Division offers insights on prosthetic rehabilitation, ensuring that implant-supported prostheses meet high standards of quality and functionality whilst the head of the Dental Laboratory Division manages the laboratory aspects of dental treatments, facilitating the timely production of prosthetic devices. The general dentist division head ensures integration between general dental practices and specialized procedures within the implant treatment workflow study. The CQI&PS deputy director assists in monitoring and enhancing initiatives related to care quality and patient safety and performs data analysis support.

Stakeholders

Stakeholders Review: shown in **(Table 2)**.

Stakeholders List	Impact Level	Level of Support	Reason for Resistance or Support	Actions to Address the Stakeholder
Director of Dental Department	Decision Authority	Supporter	Expected Benefits	Fully Engage, Be Transparent
Head of Perio/Implant division	Decision Authority	Supporter	Improve Work	Fully Engage, Be Transparent
Head of Prosthodontic division	Impacts Outcome	Neutral	Improve Work	Engage, Keep Informed, Enable Innovation, Build support , Identify champions
Head of Dental Laboratory division	Decision Authority	Supporter	Improve Work	Fully Engage
Head of General dentist division	Impacts Outcome	Neutral	No Tangible Benefits	Engage, Keep Informed, Enable Innovation, Build support , Identify champions
Head of Dental Education and Training Unit	Impacts Outcome	Neutral	No Tangible Benefits	Engage, Keep Informed, Enable Innovation
Patient's representative	Impacts Outcome	Neutral	Expected Benefits	Engage, Keep Informed, Enable Innovation
Director of Supply	Impacts Outcome	Resister	Resistance to Change	Monitor
Director of Medical Administration	Decision Authority	Supporter	Expected Benefits	Early Engagement, Share Success
Director of Finance	Decision Authority	Resister	Resistance to Change	Early Engagement, Share Success
Director of Quality and Patients Safety	Decision Authority	Supporter	No Tangible Benefits	Fully Engage
Director of Communications and Information Technology	Impacts Outcome	Neutral	No Tangible Benefits	Monitor

Table 2: Stakeholders Review

Outcome Measures

To evaluate the impact of the new interventions, three outcome measures were selected: the average monthly treatment time for implant-supported prostheses, the annual percentage of survival vs biological failure of these prostheses, and the annual overall patient experience score for the implant treatment unit. Five process measures were used to monitor different steps of the workflow: the average waiting time from referral to appointment (monthly), the average number of appointments needed to complete treatment (annually), the laboratory turnaround time for implant-supported prostheses (monthly), the annual percentage of accepted vs rejected implant referrals, and the annual rate of mechanical or technical success vs failure. Two balancing measures were tracked to identify any negative effects on other services: the monthly laboratory turnaround times for crowns and bridges, and for dentures.

http://dx.doi.org/10.52533/JOHS.2025.50606

Analysis

All data were obtained through IT reports from the hospital oasis system, R4 dental system charts, and dental lab records. Data were displayed in line graphs to examine variation occurring at the aggregate level as well as linearity trend lines by using linear regression analysis to test a significant slope and controlling chart, over 36 months (January 2019 – December 2019) as a baseline and (January 2021 – December 2022) after the intervention. Due to COVID-19, elective dental procedures and appointments were on hold, and data from January to December 2020 were excluded from this project. Data were collected and analyzed on an annual basis comparing baseline vs after intervention.

Ethical Considerations

No conflict of interest or confidentiality issues pertain to patients or staff. This project was conducted as part of an internal quality improvement initiative. According to applicable guidelines, ethical approval was not required.

Results

The overall outcomes following the interventions demonstrated a 53.61% reduction in the average treatment time for implant-supported prostheses in 2022, decreasing from 19.58 months in 2019 to 9.08 months. The average waiting time from implant referral to the appointment was reduced by 66.67%. Additionally, laboratory turnaround times for implant-supported prostheses and dental prostheses (crowns and bridges) decreased by 78.6% and 61.3%, respectively. However, the turnaround time for dental prostheses (dentures) remained largely unchanged, with a minor, non-significant reduction of 3.3%. In contrast, the annual acceptance rate for implant cases declined from 82% to 41%, while rejected cases increased from 18% to 59%. A significant improvement was observed in biological failure rates for implant-supported prostheses, which dropped by 87.6%, from 10.5% to 1.3%, achieving an implant survival rate of 98.7%. Moreover, the technical failure rate was eliminated in 2021 and 2022, compared to 8% in 2019. Lastly, patient experience scores for the dental implant integrated practice unit improved from 77.20% to 84.24%, surpassing the baseline scores of the separate unit practice **(Figures: 5 (A,B,C),6 (A,B,C,D,E), 7 (A,B) and Figure 8)**.

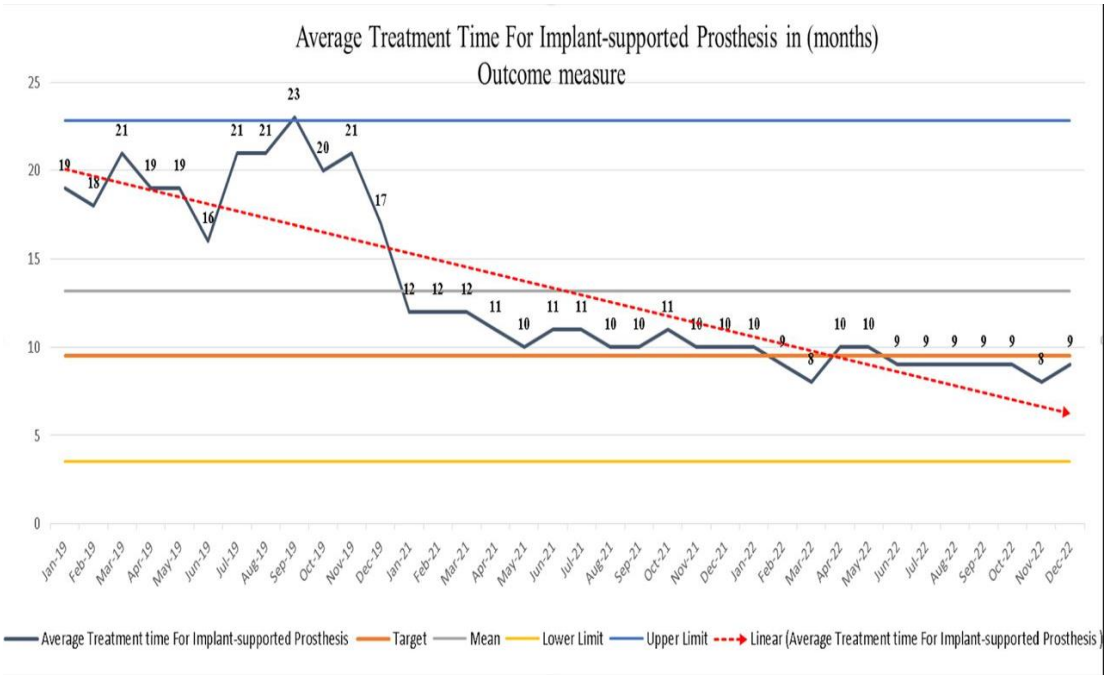


Figure 5A: Impact of IPU for Dental Implant Treatment on Accessibility

http://dx.doi.org/10.52533/JOHS.2025.50606

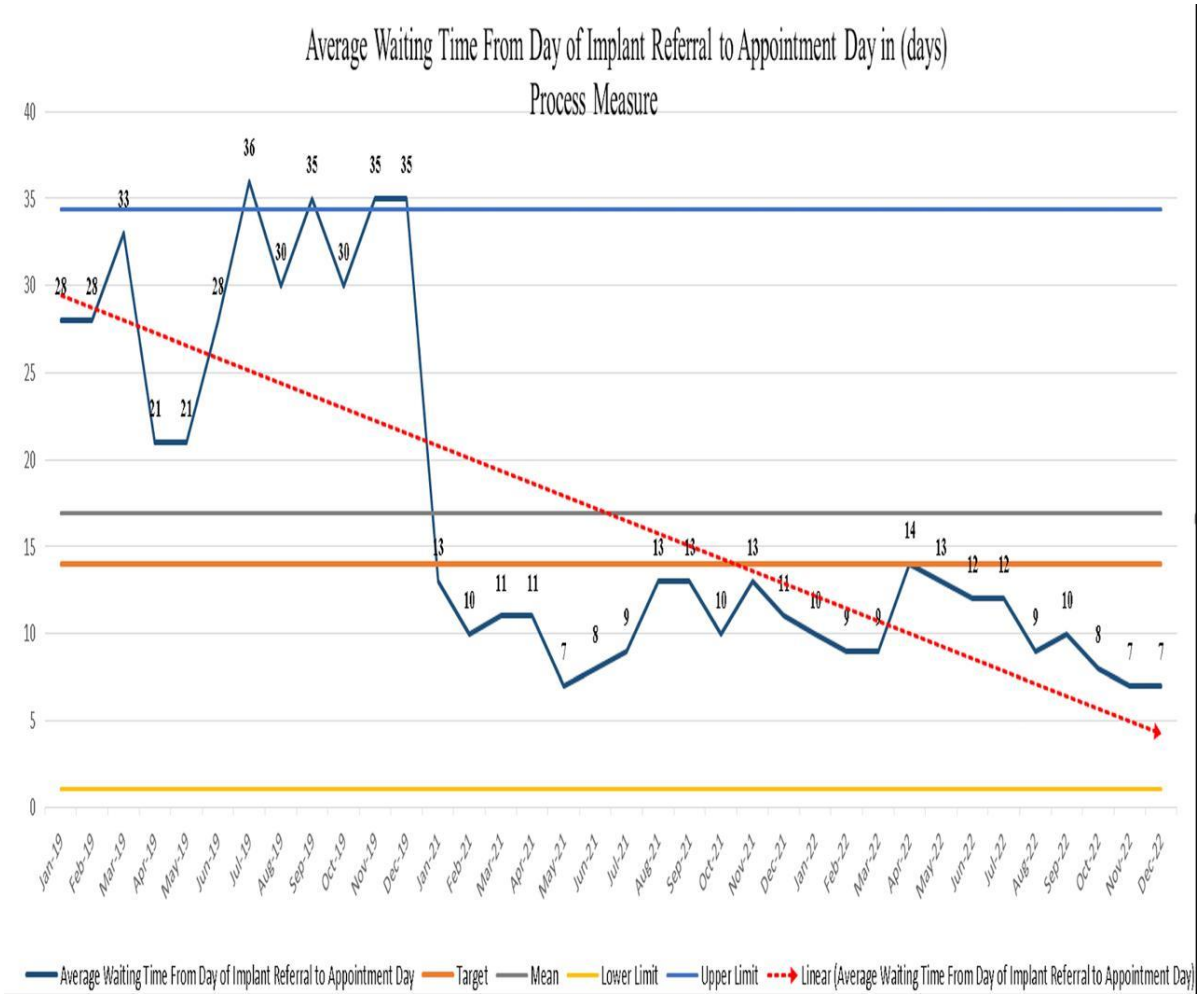


Figure 5B: Impact of IPU for Dental Implant Treatment on Accessibility

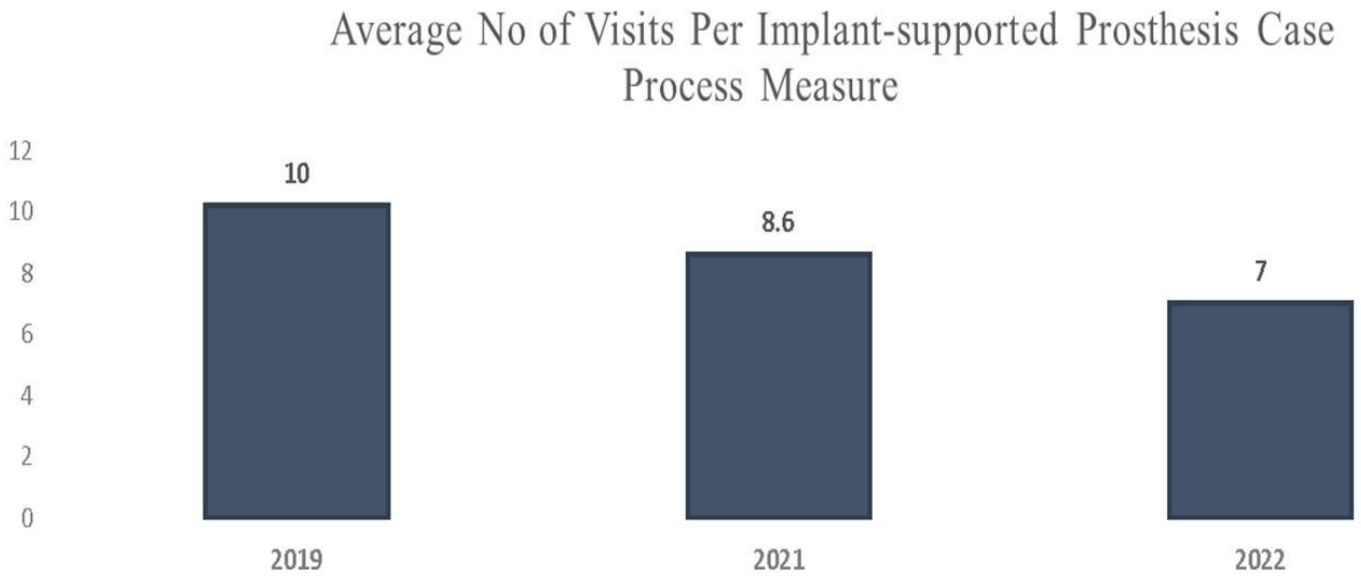


Figure 5C: Impact of IPU for Dental Implant Treatment on Accessibility

http://dx.doi.org/10.52533/JOHS.2025.50606

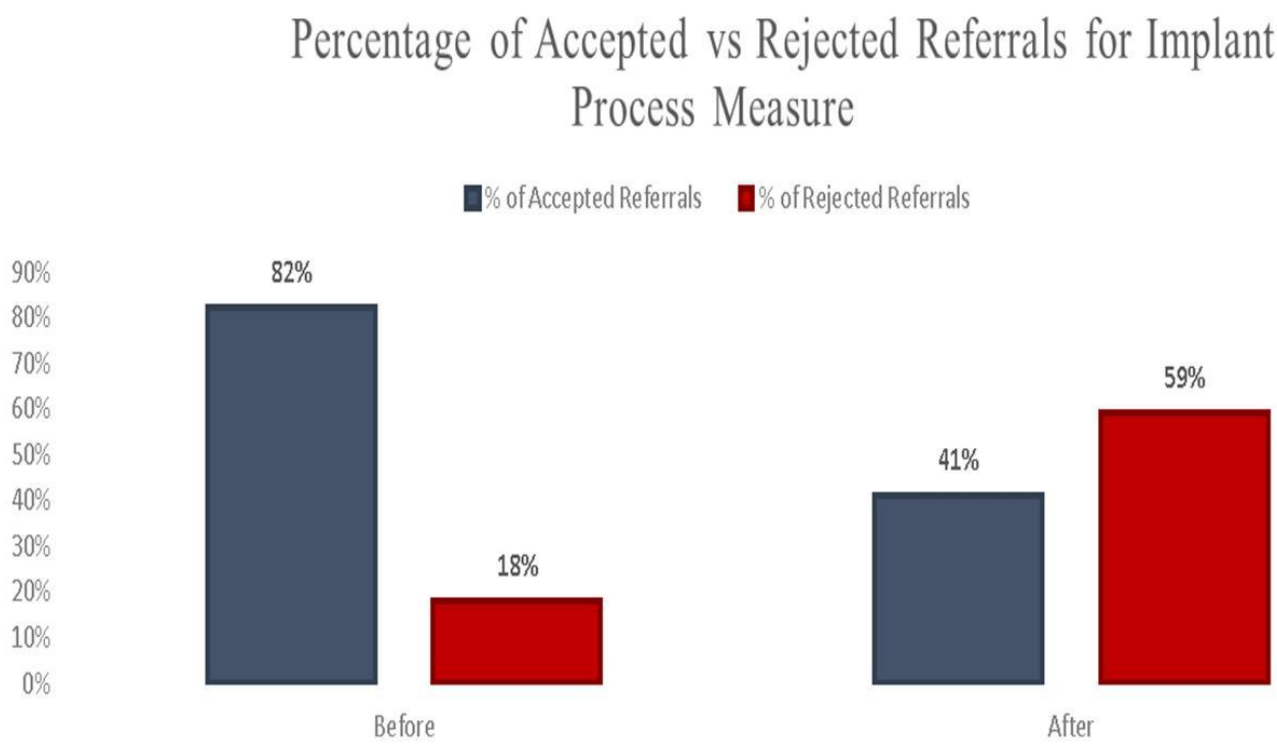


Figure 6A: Impact of IPU for Dental Implant Treatment on Efficiency

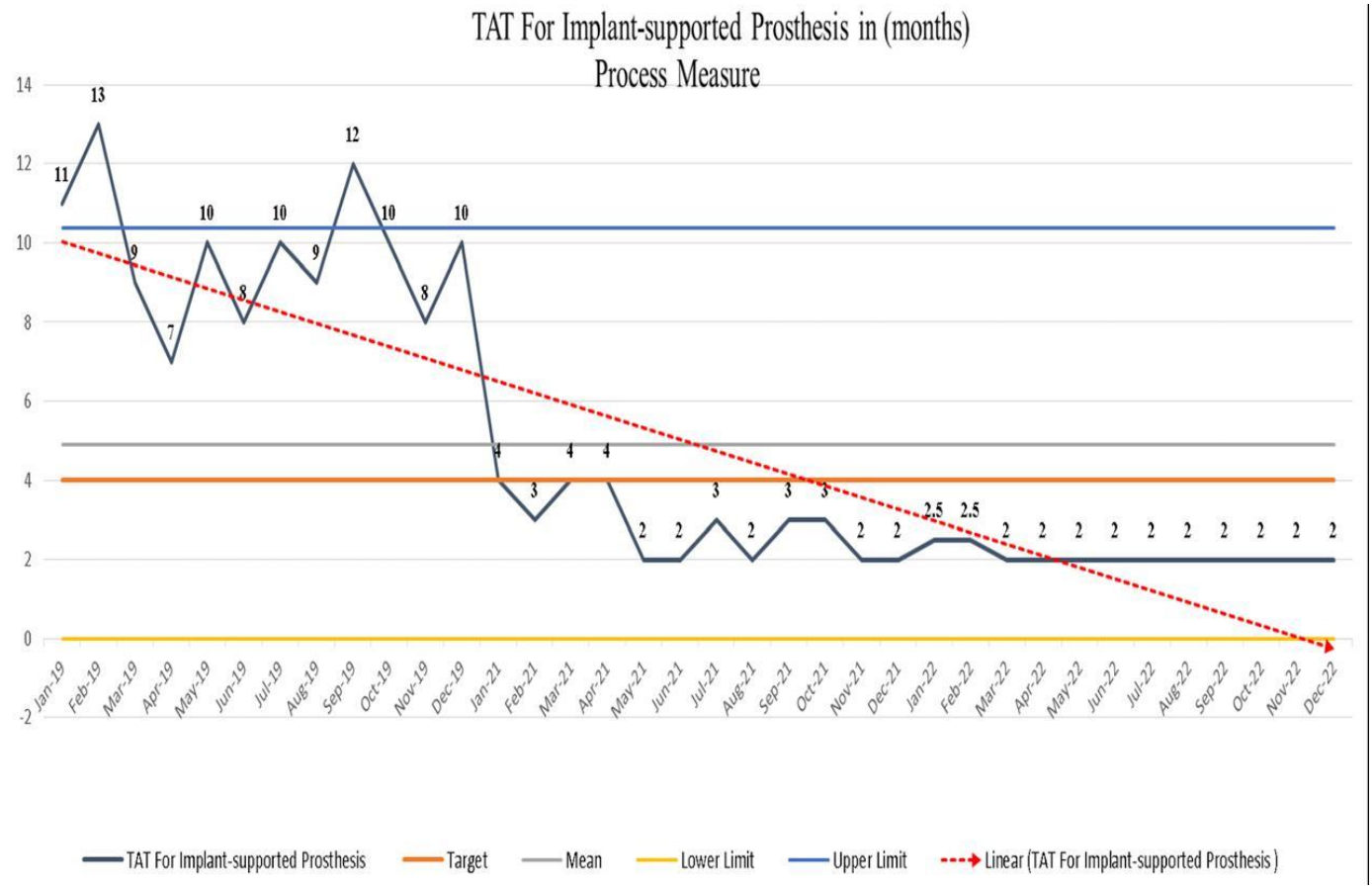


Figure 6B: Impact of IPU for Dental Implant Treatment on Efficiency

http://dx.doi.org/10.52533/JOHS.2025.50606

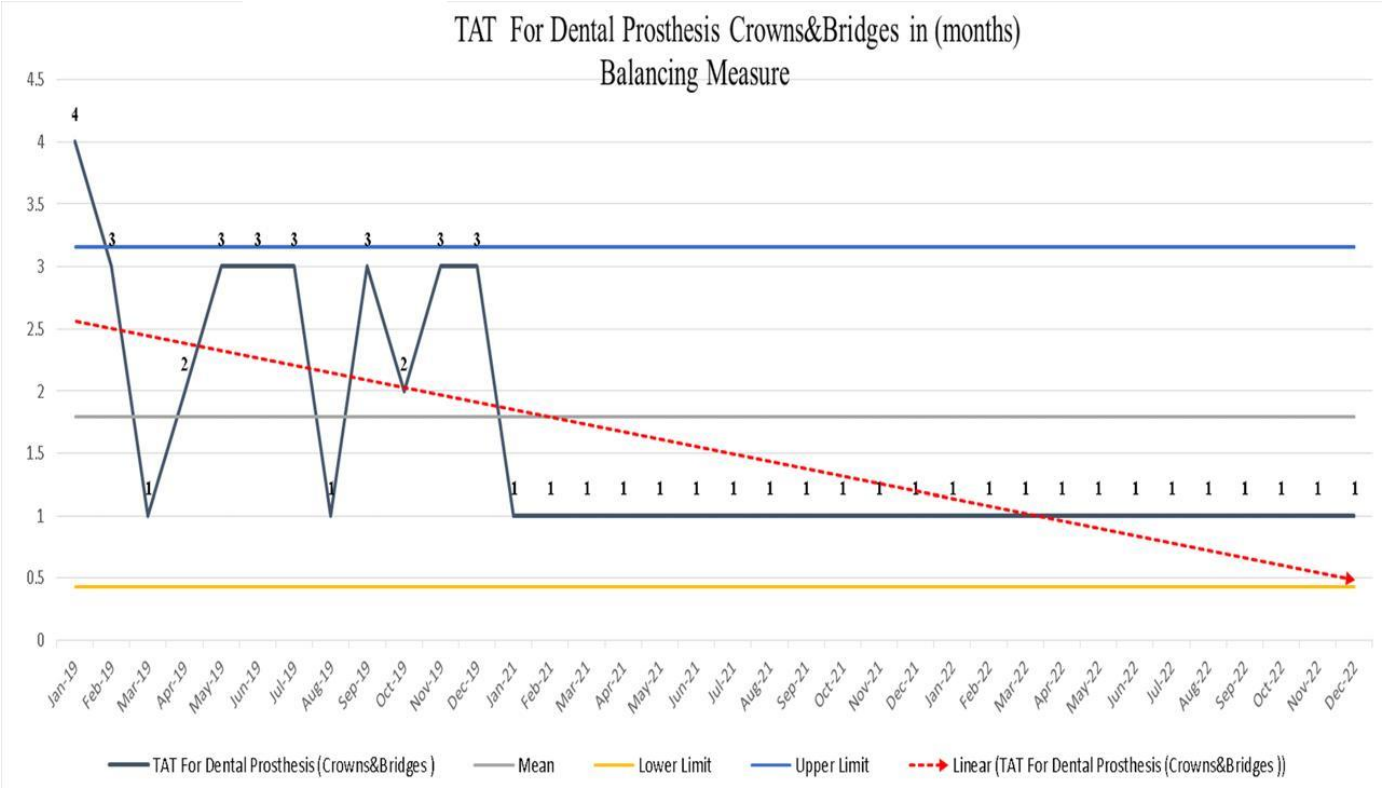


Figure 6C: Impact of IPU for Dental Implant Treatment on Efficiency

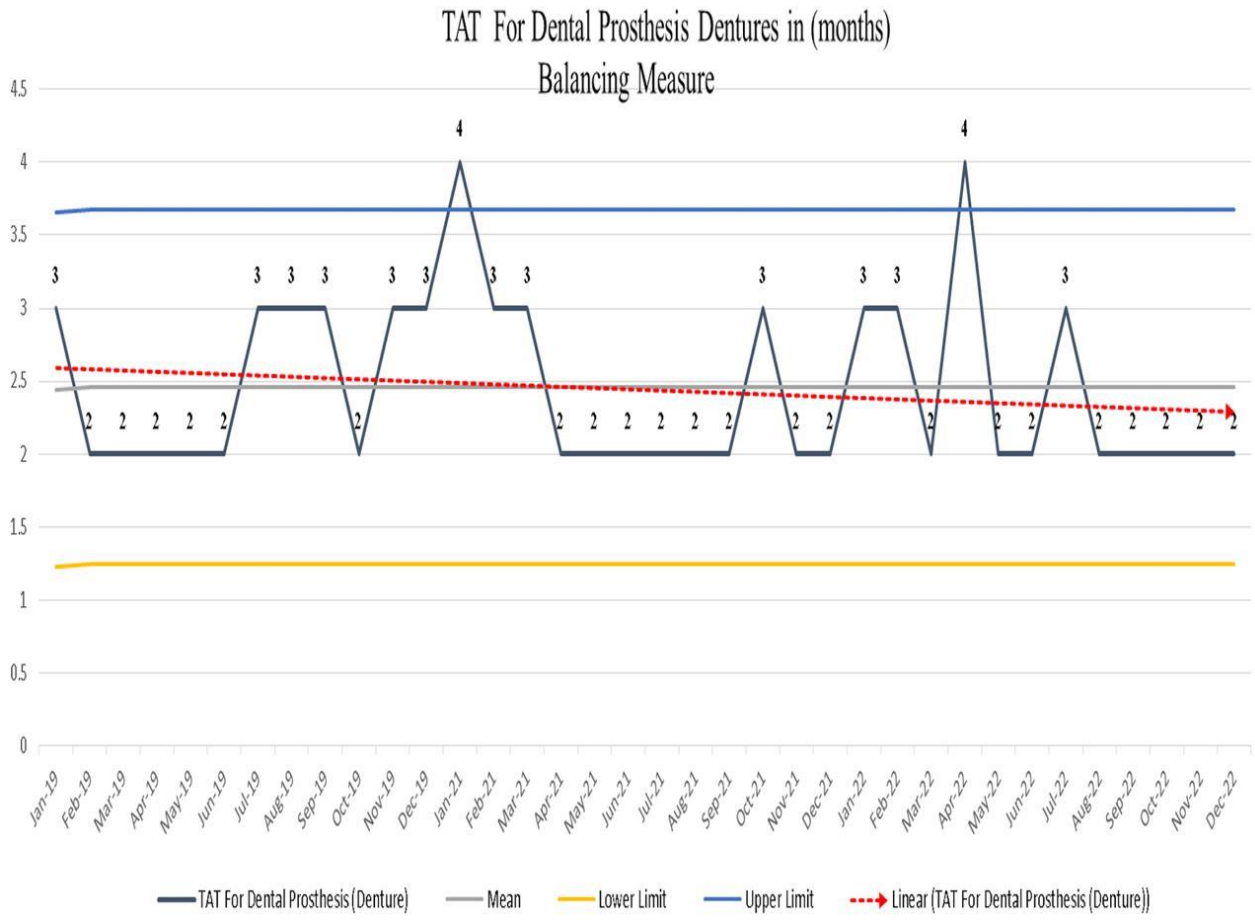


Figure 6D: Impact of IPU for Dental Implant Treatment on Efficiency

http://dx.doi.org/10.52533/JOHS.2025.50606

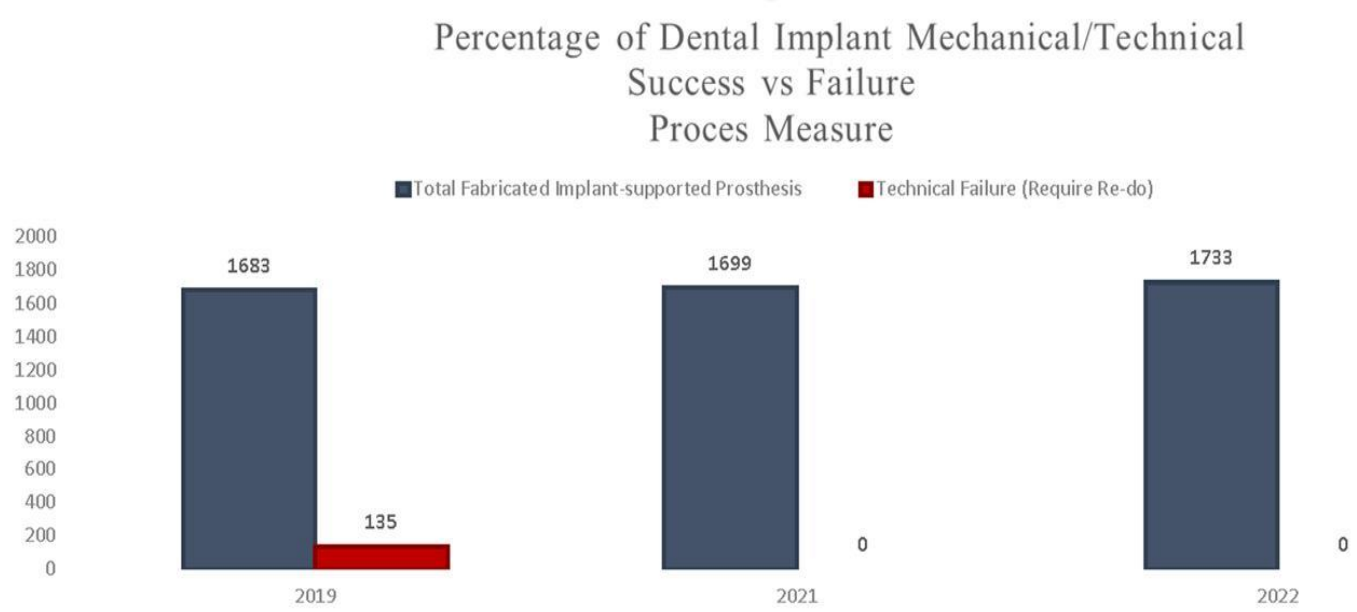
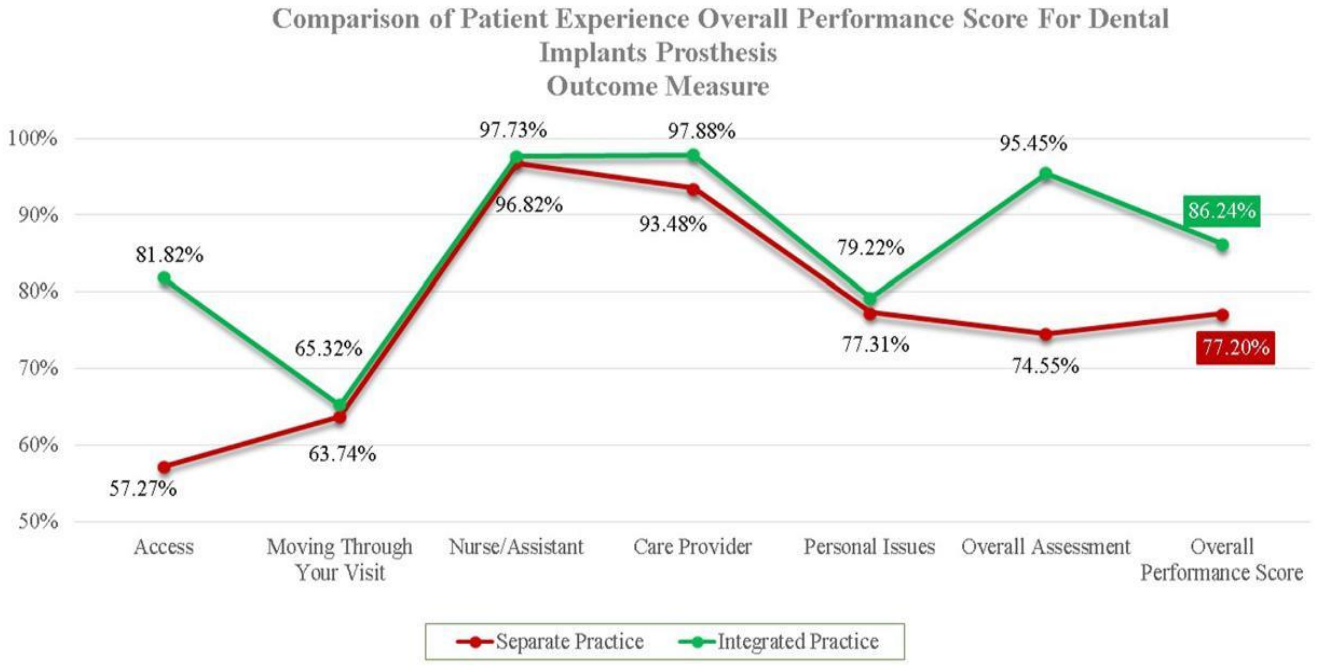


Figure 6E: Impact of IPU for Dental Implant Treatment on Efficiency

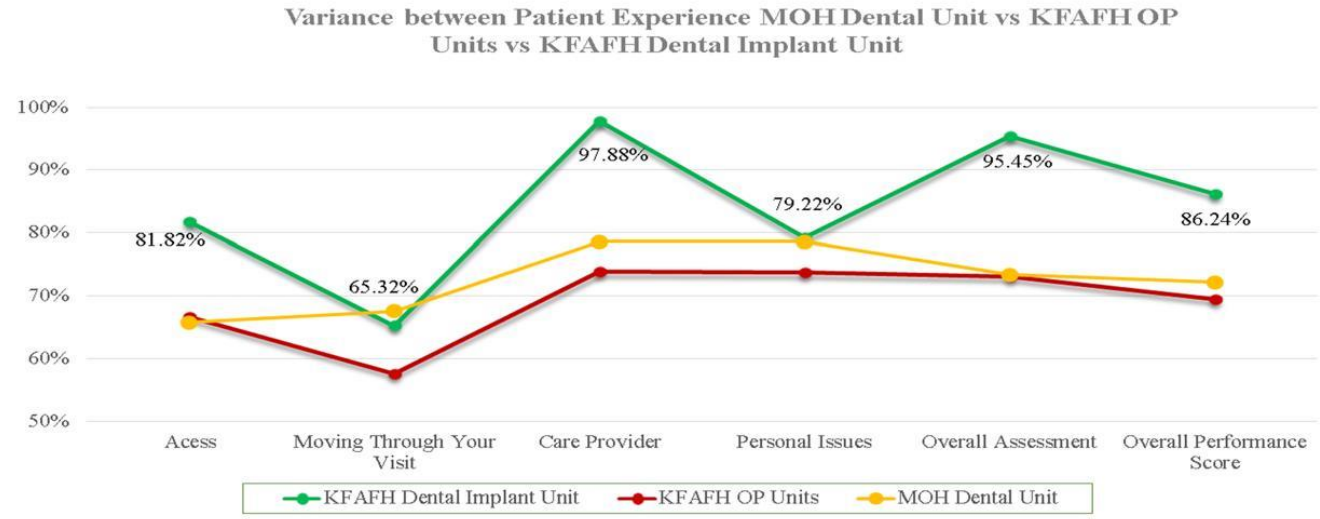


	Access	Moving Through Your Visit	Nurse/Assistant	Care Provider	Personal Issues	Overall Assessment	Overall Performance Score
Separate Practice 2019	57.27%	63.74%	96.82%	93.48%	77.31%	74.55%	77.20%
Integrated Practice 2022	81.82%	65.32%	97.73%	97.88%	79.22%	95.45%	86.24%

* Questions Type: Overall
* Survey: n-size 300
* Conducted to booked patients by Assigned dental staff

Figure 7A: Impact of IPU for Dental Implant Treatment on Patient Experience

http://dx.doi.org/10.52533/JOHS.2025.50606



	Access	Moving Through Your Visit	Care Provider	Personal Issues	Overall Assessment	Overall Performance Score
Dental Implant Unit	81.82%	65.32%	97.88%	79.22%	95.45%	86.24%
MOH Dental Unit	65.80%	67.60%	78.60%	78.60%	73.40%	72.20%
KFAFH OP Units	66.69%	57.62%	73.85%	73.73%	73.15%	69.55%

* Questions Type: Overall
* Year: 2022
* MOH / KFAFH Scores Source: Press Ganey Survey Ministry of Health [14]

Figure 7B: Impact of IPU for Dental Implant Treatment on Patient Experience

Figure 8: Percentage of implant-supported prosthesis survival rate vs biological failure Rate per Year Outcome Measure

http://dx.doi.org/10.52533/JOHS.2025.50606

Discussion

Our significant reductions in treatment time and laboratory turnaround closely align with findings from recent reviews on digital workflows in prosthodontics. Abdulkarim et al. (8) demonstrated that digital workflows involving intraoral scanners (IOS), computer-aided design (CAD), and computer-aided manufacturing (CAM) deliver superior precision and significantly shorten treatment time, especially in chairside-produced restorations.

In support of our findings, a 2023 systematic review by Bernauer et al. involving 440 patients and 658 restorations showed that complete digital workflows achieved similar or improved efficiency, accuracy, and patient satisfaction compared to traditional workflows (9). Furthermore, a 2023 randomized clinical trial by Goa et al. demonstrated that fully digital workflows significantly reduced both clinical time (approximately 46 minutes versus 55 minutes) and laboratory time, without compromising treatment outcomes (10).

The observed improvement in patient experience scores following implementation of the IPU reflects a broader trend in value-based healthcare. Listl et al. (1) highlighted the necessity of incorporating dental patient-reported outcome measures (PROMs) to ensure that oral healthcare delivery aligns with patients' values and experiences. Moreover, studies evaluating oral health–related quality of life (OHRQoL) using the OHIP-14 survey have confirmed that patients receiving implant-supported prostheses via digital workflows report significant improvements in function, aesthetics, and overall wellbeing (11, 12).

Our study's reduction in technical complications is further supported by recent work examining accuracy in digital implant workflows. A previous study by Gracis et al (13) emphasized that implant precision is highly dependent on proper selection of scan bodies, scanning strategies, and alignment software, which are critical variables in reducing deviations in implant positioning. This reinforces the benefits we observed after standardizing our digital processes and minimizing manual variability.

While not limited to implant dentistry, Listl et al. (1) conducted a multi-case analysis evaluating the implementation of value-based oral health models, concluding that multidisciplinary teams and systematic outcome measurement are essential to achieving improvements in care quality and resource utilization. These findings strongly support the framework and goals of our IPU strategy, affirming the relevance and scalability of value-based care models in dental services.

Dental care differs from medical care in several key areas: the treatment of oral diseases, how these diseases progress without treatment, and how the dental profession is structured compared to the medical field. These differences require dental services to be organized separately from the medical system for effective and efficient care. As a result, running dental outpatient clinics demands a different approach than medical outpatient departments. However, there is limited literature on evidence-based practices specific to dental outpatient settings (14, 15). Measuring the impact of the IPU is a crucial indicator of the quality of care. Our findings revealed high levels of satisfaction among implant patients across various components, especially in the accessibility and care provider's domains. In the accessibility domain of our survey, patients were primarily satisfied with the ease of getting an appointment (81.8%) for implant treatment compared with before the intervention and to other dental specialties access. In the dentist's domain, the highest improvements were reported when patients asked about explanations the physician gave them about their problem or condition.

Cost Impact analysis

Digital Transformation in the dental lab for Implant-supported Prosthesis and dental prosthesis through digital Computer-Aided Design and Computer-Aided Manufacturing vs manual techniques: The annual operational cost was calculated based on the actual consumption of both clinical and laboratory supplies, and budget allocated as provided by the

http://dx.doi.org/10.52533/JOHS.2025.50606

Supply Department in addition to dental lab fabrication manufacturing time and steps.

The Total number of Implant-supported Prosthesis cases completed in 2022 is 1733.

The estimated annual cost saving = 1733 x 1,225.19 = 2,123,254 SR

1. The Total number of Dental Prosthesis cases completed in 2022 is 3320.

The estimated annual cost saving = 3320 x 239.34 = 794,608 SR

2. The Total number of failed cases required redo in 2019 was 135 compared to zero in 2022 The estimated annual cost saving in 2022= 135 x 955.38= 128,976 SR

Estimated annual cost saving = 2,123,254 + 794,608 + 128,976 = 3,046,838 SR ***(Table 3).***

Table 3: Estimated annual cost savings from digital transformation in dental implant and prosthesis fabrication

	2019 Before		*2022 After*			
	Total cases	**Cost per case**	**Total cases**	**Cost Per case**	**Saving Per Patient**	**Percentage of saving**
Implant Supported Prosthesis	1680	2,180.57 SR	1733	955.38 SR	1,225.19 SR	56.19%
Dental Prosthesis	3288	452.4 SR	3320	213.06 SR	239.34 SR	52.90%

Drop in the average number of appointments to complete implant-supported prosthesis treatment from 10.2 to 7 visits

* The estimated average operational cost per dental clinic per day is 1,736 SR and per visit is 241 SR (16, 17)

Estimated Annual Cost saving based on the drop of total visits needed per case= 1,213,435 SR ***(Table 4).***

Table 4: Estimated annual cost savings due to reduction in total visits for implant-supported prosthesis treatment

	2019 Before				*2022 After*				
	Total Cases	**Average Visits Per Patient**	**Total Visits**	**Estimated Annual Cost**	**Total Cases**	**Average Visits Per Patient**	**Total Visits**	**Estimated Annual Cost**	**Annual Cost saving**
Implant Supported Prosthesis	1683	10.2	1683 x 10.2= 17,166	*17,166 x 241 =4,137,006	1733	7	1733 x 7=12,131	*12,131 x 241= 4,137,006	1,213,435

Drop in the implant-supported prosthesis Failure rate from 10.5% to 1.3% and Peri-Implantitis from 25% to 4.7%.

Estimated annual cost saving = 566,948 - 36,404 = 530,544 SR ***(Table 5)***.

Overall Cost saving:

Estimated annual cost saving = 3,046,838 SR + 1,213,435 SR + 530,544 SR = 4,790,817 SR

http://dx.doi.org/10.52533/JOHS.2025.50606

Table 5: Estimated annual cost savings from reduction in implant failure And peri-implantitis rates

	2019 Before				*2022 After*			
	Total Cases	Estimated Failed Cases	Cost Per Case	Estimated Annual Cost For Remake	Total Cases	Estimated Failed Cases	Cost Per Case	Estimated Annual Cost For Remake
Implant Supported Prosthesis	1683	1683 x 10.5% /100 = 176 + 20% of the 420 Peri Implantitis cases = 84 Total = 260	2,180.57	260 x 2,180.57 =566,948	1733	1733 x 1.3% /100 = 22 + 20% of the 81 Peri-Implantitis cases = 16 Total= 38	955.38	38 x 955.38 = 36,404

Limitations

The barriers to implementing this model come from the fragmentation of care delivery into specialties and, the lack of patient-centered outcome measures in dentistry when compared to other specialties. Another limitation is the technology challenges including communication and tracking software between the laboratory, clinics, and patients that could facilitate smooth scheduling of patients between the phases of treatment. Implementing clinical lab tracking software is very crucial in optimizing performance and improving communication between all parties, which will result in a further reduction in the time needed to complete the course of treatment.

Conclusions

Implants have emerged as the preferred solution in numerous, if not the majority of, cases necessitating the replacement of lost teeth. Research on the interaction between implant-supported restorations and the adjacent oral environment suggests that the human host response to oral implants is positive. The treatment planning for an implant restoration is distinctive due to the multitude of variables that may affect the therapy. It is essential to acknowledge that a comprehensive treatment strategy must be established sequentially to guarantee optimal service via IPU.

Disclosure

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Ethics Statement

This project was conducted as part of an internal quality improvement initiative. According to applicable guidelines, ethical approval was not required.

Consent for publications

Not applicable.

Data Availability

All data is provided within the manuscript.

Conflict of interest

The authors declare no competing interest.

Funding

All authors have declared that no financial support was received from any organization for the submitted work.

Acknowledgements

Not applicable.

References

1. Listl S. Value-based oral health care: moving forward with dental patient-reported outcomes.

http://dx.doi.org/10.52533/JOHS.2025.50606

Journal of Evidence Based Dental Practice. 2019;19(3):255-9.

2. Chowdhury S, Mok D, Leenen L. Transformation of health care and the new model of care in Saudi Arabia: Kingdom's Vision 2030. J Med Life. 2021;14(3):347-54.

3. Atchison KA, Weintraub JA, Rozier RG. Bridging the dental-medical divide: Case studies integrating oral health care and primary health care. The Journal of the American Dental Association. 2018;149(10):850-8.

4. El Bcheraoui C, Tuffaha M, Daoud F, Kravitz H, AlMazroa MA, Al Saeedi M, et al. Use of dental clinics and oral hygiene practices in the Kingdom of Saudi Arabia, 2013. International dental journal. 2016;66(2):99-104.

5. Katsoulis J, Takeichi T, Sol Gaviria A, Peter L, Katsoulis K. Misfit of implant prostheses and its impact on clinical outcomes. Definition, assessment and a systematic review of the literature. Eur J Oral Implantol. 2017;10(Suppl 1):121-38.

6. Soto-Penaloza D, Zaragozí-Alonso R, Penarrocha-Diago M, Penarrocha-Diago M. The all-on-four treatment concept: Systematic review. J Clin Exp Dent. 2017;9(3):e474-e88.

7. Phillips J, Simmonds L. Using fishbone analysis to investigate problems. Nursing Times. 2013;109(15):18-20.

8. Abdulkarim LI, Alharamlah FSS, Abubshait RM, Alotaibi DA, Abouonq AO. Impact of Digital Workflow Integration on Fixed Prosthodontics: A Review of Advances and Clinical Outcomes. Cureus. 2024;16(10):e72286.

9. Bernauer SA, Zitzmann NU, Joda T. The Complete Digital Workflow in Fixed Prosthodontics Updated: A Systematic Review. Healthcare (Basel). 2023;11(5).

10. Guo D, Mühlemann S, Pan S, Zhou Y, Jung RE. A double-blind randomized within-subject study to evaluate clinical applicability of four digital workflows for the fabrication of posterior single implant crown. Clin Oral Implants Res. 2023;34(12):1319-29.

11. Manfredini M, Pellegrini M, Rigoni M, Veronesi V, Beretta M, Maiorana C, et al. Oral health-related quality of life in implant-supported rehabilitations: a prospective single-center observational cohort study. BMC Oral Health. 2024;24(1):531.

12. Mora Rojas M, Chauca Bajaña L, Rodríguez Tates M, Poussin L, Velásquez Ron B. Oral Health-Related Quality of Life in Patients Rehabilitated with Dental Implants. Healthcare (Basel). 2025;13(7).

13. Gracis S, Appiani A, Noè G. Digital workflow in implant prosthodontics: The critical aspects for reliable accuracy. J Esthet Restor Dent. 2023;35(1):250-61.

14. Guay AH. The differences between dental and medical care: implications for dental benefit plan design. The Journal of the American Dental Association. 2006;137(6):801-6.

15. Gomaa AM, Mostafa AZH, El-Shaheed NH. Patient satisfaction and oral health-related quality of life for four implant-assisted mandibular overdentures fabricated with CAD/CAM milled poly methyl methacrylate, CAD/CAM-milled poly ether ether ketone, or conventional poly methyl methacrylate: A crossover clinical trial. J Oral Rehabil. 2023;50(7):566-79.

16. Misch CE. Dental implant prosthetics-E-book: Elsevier Health Sciences; 2004.

17. Resnik R. Misch's Contemporary Implant Dentistry E-Book: Misch's Contemporary Implant Dentistry E-Book: Elsevier Health Sciences; 2020.

http://dx.doi.org/10.52533/JOHS.2025.50606