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EDITORIAL

Improving Patient Outcomes: Revisiting the Process of Care

Dear esteemed readers and potential authors,

In this edition, let us turn our attention to the **Process of Care**, a vital step in the quality improvement cycle.

Donabedian's Quality-of-Care (QOC) model, a foundational framework for delivering high quality highlights three core elements required for effective care: **structure, process, and outcomes**[1]. "Structure" represents the environment and resources needed to deliver services, while "processes" describe the methods and practices used to provide care. "Outcomes" refers to the results achieved by the recipient. Donabedian emphasised that a strong structure is crucial to ensuring sound processes and good processes are essential to achieving optimal outcomes.

An essential component of improving patient outcomes is the process-of-care investigation; a systematic approach that assesses steps/actions that contribute to desired results, focusing on specific aspects of care delivery that can be enhanced or reinforced. This investigation targets areas within the team's control, identifies opportunities to improve patient care and ensures that often-limited resources are prioritised effectively.

Guide in Process-of-Care Investigation[2,3]:

1. **Selecting Target Outcomes:** Begin by setting a clear, specific goal to achieve. For example, if the goal is to reduce patient waiting time for treatment, relevant process steps such as patient registration, triage, and initial clinical assessment should be included in the investigation.
2. **Engaging the Interdisciplinary Team:** An interdisciplinary approach is critical. Clinical staff who work directly in the relevant processes, such as medical officers and paramedics for treatment outcomes, should be engaged. This ensures that those directly engaged with care delivery contribute to identifying issues and solutions.
3. **Sourcing Information and Setting Standards:** Effective process-of-care investigation draws on existing organisation protocols, clinical practice guidelines or standardised care plans. For the newly developed process of care, brainstorming sessions within the Quality Improvement (QI) team and consultation with the field experts will provide guidance.
4. **Identifying Critical Aspects of Care:** The goal of the investigation is to determine critical care practices that directly impact the target goal/outcome. For instance, if the focus is on reducing waiting time for treatment, the team should assess the critical points within the patient management where changes could enhance the clinic's efficiency.
5. **Defining the Model of Good Care:** Creating a Model of Good Care is a unique step in the investigation of the process of care following the Malaysian QI approach. Once critical steps are identified, criteria and standards for each critical step are determined, aiming to meet the desired outcomes. It is crucial to ensure these criteria are both measurable and objectively measured during the pre and post-intervention phases.
6. **Documenting Changes:** Formal documentation of any process changes is essential. This ensures that all staff are aware of and adhere to the updated practices, maintaining consistent quality across the team.

A structured, interdisciplinary approach to process-of-care investigation fosters continuous improvement in patient outcomes and strengthens the team's shared commitment to achieving high standards of care.

Enjoy your reading!

Dr Samsiah Awang
Editor-in-chief

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REDUCING ANTIBIOTICS USE IN ADULT PATIENTS WITH LOCALISED DENTOALVEOLAR ABSCESS IN ROMPIN DENTAL CLINIC

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Abstract

Antibiotics are generally not advised for patients with localised dentoalveolar abscesses (LDA) in outpatient dental clinics, as their overuse can lead to antibiotic resistance. A verification study conducted at Rompin Dental Clinic revealed that 50.1% of adult patients with LDA were prescribed antibiotics. This study aimed to reduce the rate of antibiotic prescriptions for adult patients with LDA to 30.0% within one year, which is in line with the established standard. This quality improvement study used universal sampling and measured the percentage of LDA prescription slips with antibiotics prescribed. The two main contributing factors identified were substandard practices by dental officers and external pressures to prescribe antibiotics. Additional factors included incorrect teachings from peers, lack of awareness of current guidelines and recommendations, lack of experience, inadequate knowledge of antibiotic use, misdiagnosis and management, and pressure from staff and patients. To address these issues, strategies were implemented in three phases: 1) enhancing dental officers' practices through a newly developed care process, displaying a prescribing guide, and conducting Continuous Dental Education sessions; 2) emphasising staff and public education through social media and an Antibiotics Awareness Week campaign; and 3) ensuring adherence to previous strategies. As a result, the percentage of antibiotic prescriptions for LDA decreased from 50.1% to 28.6 % in 2019, followed by 21.3% in 2020 and 22.9% in 2021. Continuous monitoring through regular education and enforcement can promote a healthy antibiotic-prescribing culture among dental officers, helping to curb antibiotic resistance.

KEYWORDS: Antibiotics, Localised dentoalveolar abscess, Over-prescription, Dental

Problem

In Malaysian primary care clinics, antibiotic prescriptions occur in at least one in five patient encounters (1). The Malaysian National Medicines Policy focused on the quality use of medicines by healthcare providers and consumers, recognising that misuse leads to antimicrobial resistance, which is challenging to treat and control (2). In response, the Ministry of Health Malaysia has implemented the Antimicrobial Stewardship Program in healthcare facilities, aiming to limit broad-spectrum antibiotic use unless specifically indicated in the National Antimicrobial Guidelines (3, 4). Although the program has shown a reduction in antimicrobial use, reports of antibiotic overprescription still exist.

In dental settings, toothaches are often attributed to localised infections such as pulpitis or a localised dental abscess (LDA), which typically require only local dental treatment (4-10). However, most dental patients received antibiotic prescriptions as the first treatment option (11-14). Indications for antibiotic prophylaxis include medically compromised patients, complex minor surgeries, dental implants and bone graft insertions, major maxillofacial procedures, and head and neck cancer surgeries (9, 15, 16).

Rompin Dental Clinic (KPR), located in Pahang, is a public primary dental clinic within the vicinity of a public primary care health clinic. It delivers a range of oral health services, including restorations, scaling, extractions, minor oral surgeries, and oral health promotion to the community across all age groups, covering a population of approximately 40,742 (17). The clinic employs 32 staff members, consisting of 11 dental officers, six dental therapists, one dental technologist, eight dental surgery assistants, three health attendants, and three drivers. This clinic is the main dental facility for oral health treatment in Rompin due to its location in a small suburban town, approximately 133 km from the nearest tertiary dental specialist referral facility for major oral surgeries.

A cost review by the pharmacy department in our primary care facility found that the dental clinic incurred the highest expenditure on antibiotics for LDA, with toothache being the most common cause of dental visits. Upon further investigation, it was found that amoxicillin was frequently prescribed for LDA. Therefore, this study aimed to improve the rate of antibiotic use among adult patients with LDA from 50.1% to 30.0% within one year.

Background

One in ten dentists administers antibiotics in outpatient dental clinics, making them one of the most common prescribers (18-20). Dental or dentoalveolar abscesses are common presentations in primary care outpatient dental settings, characterised by a localised collection of pus in the alveolar bone at the root apex of the tooth. The abscesses frequently result from dental caries, trauma, deep fillings, or failed root canal treatment (21). Systemic antibiotics are generally not advised for patients with LDA due to their limited efficacy (22, 23). However, globally, unnecessary antibiotic prescriptions in dentistry can reach up to 80%, even among dental specialists (24, 25).

Although antibiotics may be considered for those who are medically compromised (4, 10, 22, 26-30), dentists may make the common mistake of giving heavier consideration to non-clinical factors such as patient insistence, expenses, pressure from assistant staff, and time restrictions when prescribing antibiotics (31, 32). The intentions of dentists play a significant role in their antibiotic-prescribing practices (32). Both patients and dentists may hold beliefs about antibiotic use that can influence prescribing habits (32). Miscommunication between them may easily lead to antibiotic overprescription in primary care (19-21, 28, 31-33).

Overuse of antibiotics disrupts gastrointestinal function, causes organ toxicity, and contributes to the development of antimicrobial resistance (20). This is a significant issue as many microorganisms have developed resistance to conventional antibiotics due to alterations in the resistance genes (19, 20, 22, 27, 34-36). The presence of resistant strains in the oral microflora may also induce other systemic infections (37). Antibiotic resistance can be challenging to handle medically, with a higher risk of

side effects and severe infections, leading to frequent hospitalisations and higher mortality rates (20, 29, 34, 35).

To address this issue, strategies such as evidence-based prescribing guidelines, regular monitoring, and enforcement are essential (38). Adopting better prescribing practices can be achieved through brief educational interventions, audits, and the introduction of prescribing tools (27, 39-41). In the long run, these strategies are expected to enhance adherence to appropriate antibiotic use and reduce wastage (39-42).

Measurement

This quality improvement study utilised a universal sampling approach. The key indicator measured was the percentage of LDA prescription slips with antibiotics prescribed. Based on the diagnosis recorded by the dental officer, a tooth-related infection was later classified as either LDA or dentoalveolar abscess with systemic involvement. For this study, the LDA diagnosis was used to calculate the indicator, as this subset of diagnosis typically does not require antibiotics and is relevant to the issue of antibiotics overprescription. Antibiotics are classified as Group B drugs, which require a prescription from a licensed doctor or dentist (43, 44). Hence, a prescription slip (Perubatan 6A-Pin.3/96) indicating antibiotics prescribed for LDA was used in the numerator measurement.

Prescription slips identified with the diagnosis of LDA, with or without antibiotic prescriptions, among patients aged 18 years and above attending the KPR outpatient clinic were included in this study for the denominator measurement. This study excluded non-tooth-related infections and patients requiring prophylactic antibiotic coverage as recommended by the American Heart Association (45). The formula used to measure the indicator in this study was:

$$\textit{The percentage of LDA prescription slips with antibiotics prescribed.} = \frac{\textit{The number of LDA prescription slips with antibiotics prescribed}}{\textit{The total number of LDA prescription slips}} \times 100$$

The indicator was designed to measure the percentage of LDAs with antibiotic prescriptions, following the guidelines of the World Health Organisation (WHO) (46, 47). The WHO recommended that the percentage of antibiotic use should be below 30% to reflect an optimal pharmacological situation (48). Therefore, our study adopted this standard of 30%. This threshold accommodates post-operative dental procedures and special cases, such as medically compromised patients who are immunosuppressed or with congenital or acquired altered defence mechanisms (9, 22). Data collected from 698 prescription slips during a verification study from January 2018 to December 2018 revealed that 50.1% of LDA cases among adult patients at KPR were prescribed antibiotics. Following this verification study, strategies were implemented from January 2019 to June 2021, with re-evaluations conducted every six months to assess the effectiveness of these interventions.

Initial Assessment of the Problem

Based on discussion among the project group members, literature reviews, and an interview with an Oral and Maxillofacial surgeon, the factors contributing to the problem were mapped out as depicted in Figure 1. Two main categories of factors were identified: substandard practices among dental officers and negative external pressures on them.

A self-administered questionnaire was distributed to 29 dental officers in the Rompin district to quantify the potential factors influencing inappropriate antibiotic prescribing. The self-developed questionnaire included six potential contributing factors identified from the problem analysis chart. Respondents were asked to select the factor(s) they believed most contributed to the problem. The cumulative counts for each factor were totalled to establish a baseline for prioritisation. The four factors perceived as most prominent contributing factors were: 1) incorrect teachings passed down from peers (69.0%); 2) lack of experience (62.1%); 3) unawareness of current antibiotic guidelines and recommendations from updated literature (58.6%) and; 4) pressure from patients and assistant staff (55.2%). Two



Figure 1: Problem analysis chart for the inappropriate antibiotic prescriptions in LDA in KPR

other factors, each scoring 31.0%, were inadequate knowledge of antibiotic use and incorrect diagnosis and management. We focused on improving these factors due to their high scores, and there was control over these aspects when planning interventions.

Without a standardised operating procedure for LDA management, the care process at KPR was based on observations of daily practices by dental officers. The existing care process for LDA management included an additional step of administering antibiotics and reviewing them after one week, regardless of the patient's medically compromised status, before removing the source of the infection. The critical steps identified were guided by the quantified contributing factors.

Strategy

Several strategies were identified and implemented to address the abovementioned factors over three phases, from January 2019 to June 2021. In Phase 1, the strategies included developing a new process of care based on literature, displaying a prescribing guide for dentoalveolar abscesses in the clinic as a reminder, and Continuous Dental Education (CDE) sessions. These strategies aim to improve dental officer's practices. Phase 2 focused on public education and increasing awareness among assistant staff through social media promotions and an Antibiotic Awareness Week campaign. In the subsequent phase, no new strategies

were introduced; instead, the previously implemented strategies were continued. Compliance with the strategies was ensured through ongoing monitoring.

Phase 1: January – December 2019

Firstly, the process for managing LDA at KPR was newly developed based on a thorough review of guidelines and literature, as shown in Figure 2 (4, 10, 27, 28, 43, 45, 49). The practice of administering antibiotics for a week before removing the source of infection was removed from the standard process.

Secondly, to further strengthen the care process, a prescribing guide for managing dentoalveolar abscess (as shown in Figure 3) was introduced. This guide serves as a general guide for dental officers, designed to assist in the management of dentoalveolar abscess cases across various settings, including primary dental clinics, hospitals, and non-hospital-based dental specialist clinics.

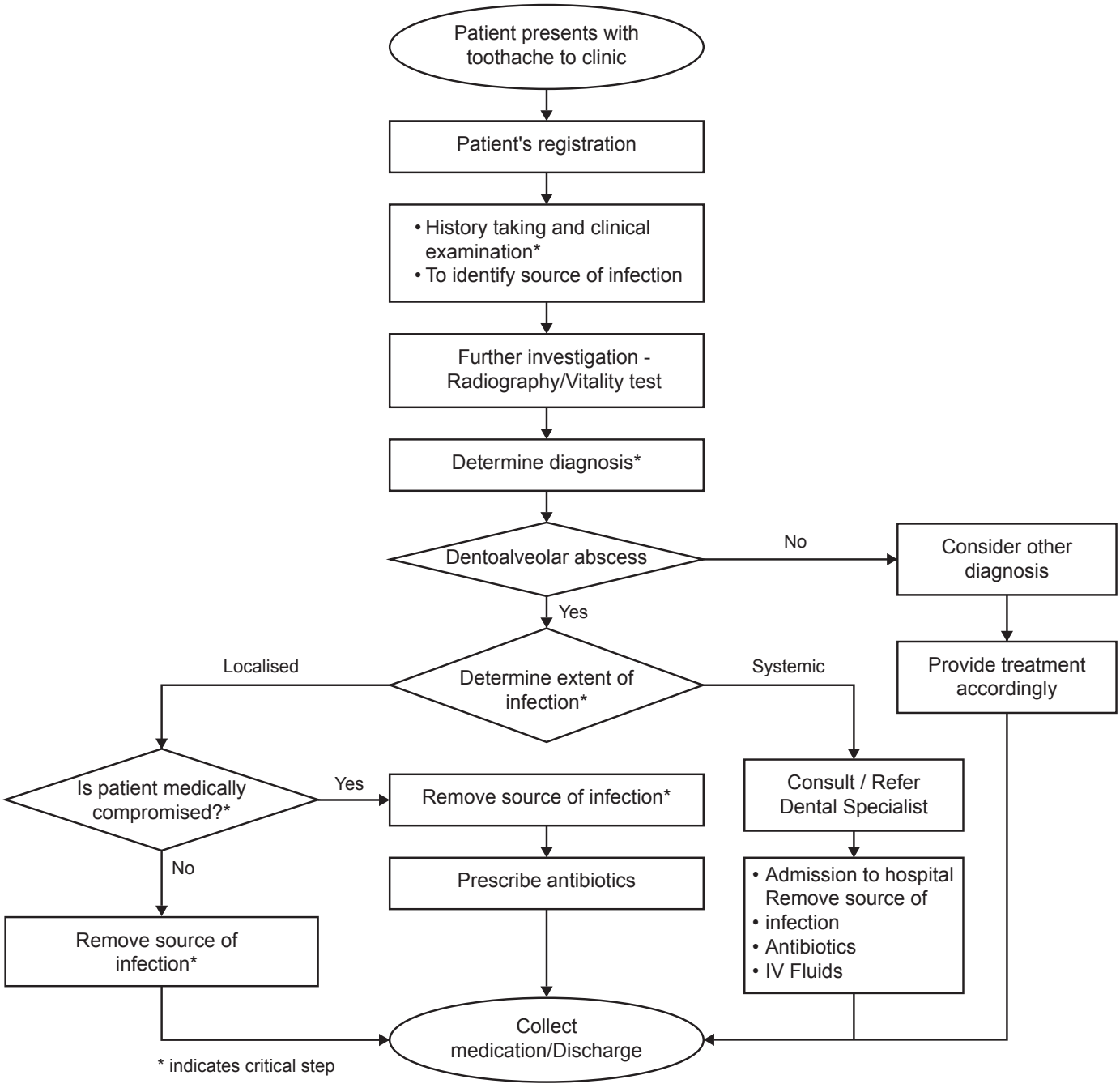


Figure 2 The newly developed process of care for LDA management in KPR as part of the strategy implementation.

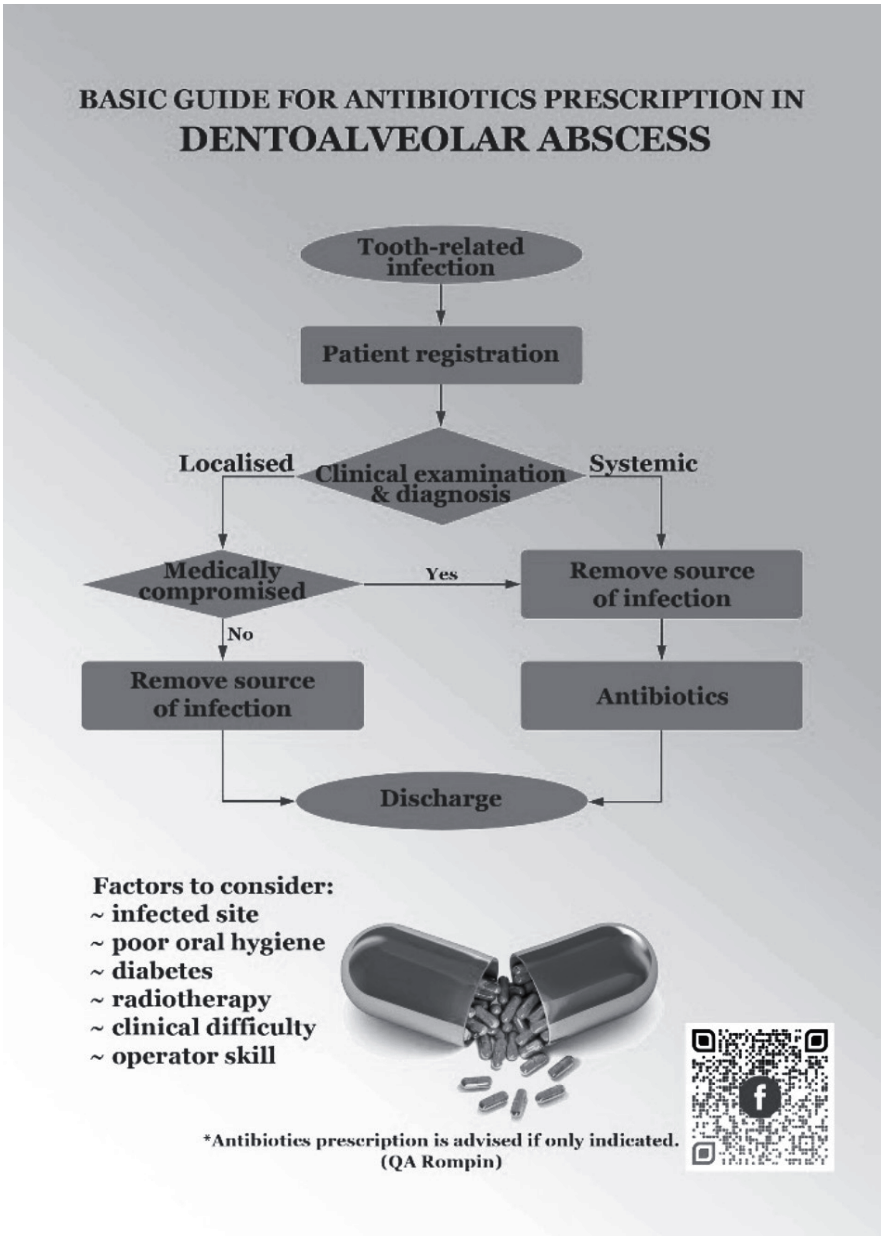


Figure 3: An antibiotic prescribing guide for dentoalveolar abscesses

This prescribing guide was developed in consultation with an Oral and Maxillofacial surgeon, chosen for their expertise in managing dentoalveolar infections and their deep understanding of the local context. This ensures that the guide is relevant and practical for local dental clinics. To validate the guide's content, an interview with the surgeon was conducted in June 2019. According to the surgeon's expert opinion:

- The prescribing guide addresses a comprehensive range of antibiotics indications, covering both local issues (such as periapical abscess and pulpitis) and systemic conditions (including space infections and cellulitis).
- Initial treatment involves removing the source of infection, followed by medical support such as antibiotics and medications for immunocompromised patients.
- When prescribing antibiotics after removing the source of infection, several factors should be considered: the condition of the infected site, poor oral hygiene, patient adherence to instructions, medical complications, uncontrolled diabetes, and a history of radiotherapy. Clinical difficulty, such as highly mobile teeth without bony sockets, and the operator's skill in performing extractions with minimal force and bleeding often negate the need for post-operative antibiotics.
- The benefits of this study include reducing over-prescription, lowering costs, and aligning with current guidelines.

Thirdly, dental officers received a one-hour CDE session focused on antibiotic use in dentistry, which covered the latest guidelines and LDA management strategies. This annual session aims to reinforce their knowledge and improve their prescribing practices. Prior to CDE, dental officers completed a quiz with five multiple-choice questions to assess their baseline knowledge on: 1) indications for antibiotic use in dentistry, 2) current antibiotic guidelines, and 3) diagnosing and managing LDA. A follow-up assessment was done one month after the CDE to evaluate knowledge retention. Dental officers who answered 4 out of 5 questions correctly were deemed to have a good understanding of LDA management and antibiotic use.

Phase 2: January – December 2020

The second phase of the initiative addressed a different perspective on contributing factors, specifically the patient's role and the behaviour of the assistant staff. This phase was attempted through simple education of LDAs, emphasising that antibiotics are often unnecessary, and raising awareness of antibiotic resistance to promote healthier oral health practices. To achieve this, we used various methods to educate staff and the public, including promotions on social media platforms such as the clinic and district health office's official Facebook pages, an infographic poster, a short educational film, and a Facebook Live session. During World Antibiotics Awareness Week in November, KPR organised an antibiotics awareness campaign to advocate for safe antibiotic use among our dental outpatients. This promotional campaign is planned to be conducted annually to ensure ongoing emphasis on this critical issue. The strategies implemented in the first phase were continued to maintain and further improve the outcomes.

Results

The percentage of LDA prescription slips with antibiotics prescribed among adult patients at KPR decreased significantly over the years, from 50.1% to 28.6%, 21.3%, and 22.9% (Figure 4). After three years of intervention, the Achievable Benefit Not Achieved (ABNA) reduced from 20.1% to -7.1%.

The implementation of CDE saw an increase in dental officers' knowledge of the management and antibiotics use in LDA, from 59.8% in 2018 to 90.9% in 2020. The emphasis on refresher courses enabled dental officers to gain better confidence and more working experience by applying their knowledge when treating patients with LDA. However, both factors require a prolonged duration of interventions. An indirect benefit observed in the pharmacy department was the reduced purchasing costs due to decreased antibiotic prescriptions for the dental clinic.

Lessons And Limitations

Although most dental officers are aware of proper antibiotic prescriptions, various factors influence their prescribing practices. Factors such as lack of experience in managing LDA and handling patient expectations fall within the dental officer's purview. However, factors such as insufficient monitoring, local control over antibiotic use, and antibiotic profit interests (18, 27, 50) may be beyond their control, which may limit the effectiveness of implemented strategies. In our study, dental officers had an acceptable level of knowledge regarding antibiotic use (59.8%) before the interventions. However, they still prescribed antibiotics for non-indicated cases, resulting in an ABNA of 20.1%. Good knowledge requires repeated reinforcements and audits to ensure consistent translation into positive habits (38, 41). Our strategies, including displaying the prescribing guide and conducting annual CDE sessions, serve as reminders to reinforce adherence to the new process of care for antibiotic prescriptions in LDA management.

Providing public health education is challenging as it requires competent healthcare personnel and multi-level policy interventions (50, 51). In Phase 2, we aimed to reduce negative external pressures on dental officers by educating the public and assisting healthcare staff. However, lack of working experience remains a challenge, affecting dental officers' confidence, especially with additional external factors influencing clinical decision-making. Therefore, more focus and interventions are needed to ensure that dental officers

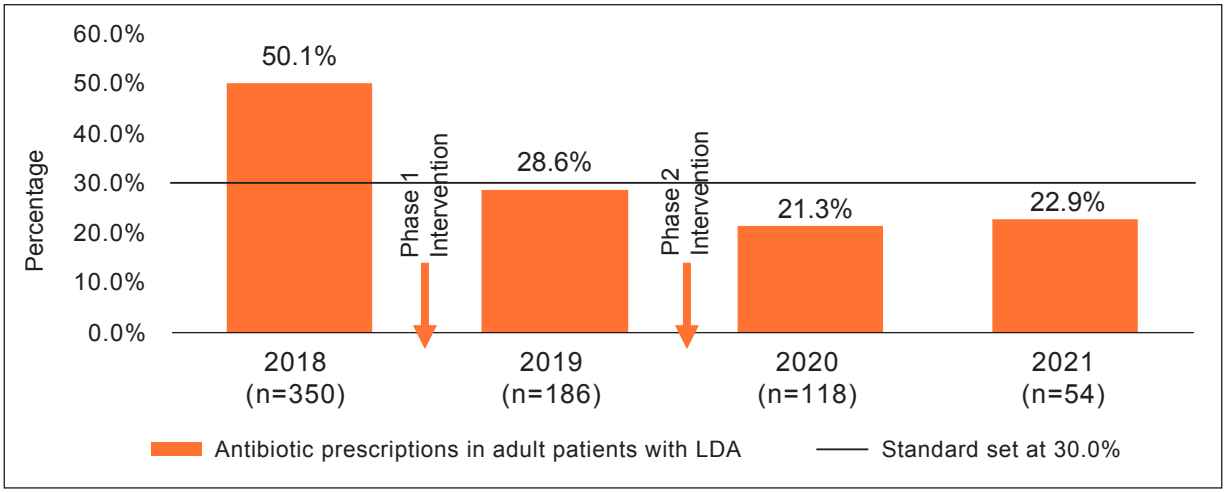


Figure 4: Antibiotic prescriptions in adult patients with LDA in KPR, 2018-2021

practice managing LDA based on clinical signs, as practice will eventually build their confidence. With increased confidence, dental officers would be less likely to be pressured by external factors when managing LDA. While we addressed patient insistence through public awareness programs, this factor involves public attitudes, which are challenging to change thoroughly.

Although the small sample size and geographic location limit data generalisation, the study provides insight into inappropriate antibiotic use from a dental perspective. No bias was evident as measurements were done using prescription slips and questionnaires. There is a possibility that LDA patients did not receive any prescriptions, possibly overestimating the percentage of LDA prescription slips with antibiotics prescribed. The clinical outcome and the cost saving were also not included as part of this study. Another study limitation is the role of unforeseen factors beyond the clinic's control, such as the turnover of dental officers to other districts and the COVID-19 pandemic, which affected both dental officers and the number of patients attending KPR (27, 50, 52).

Conclusion And The Next Steps

The percentage of LDA prescription slips with antibiotics prescribed in adult patients decreased within a year of implementing the interventions. Recognising the improvement and benefits of the study, we will continue monitoring the work process through regular education and enforcement to ensure dental officers develop a healthy antibiotic prescribing culture to prevent antibiotic resistance. The remedial actions are relatively simple and can be implemented in the long-term. We intend to share our findings with the Pahang State Dental Health Department and other platforms to promote replicability so that dental facilities encountering similar problems can adopt these strategies.

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Conflict Of Interest

The authors declared that there were no conflicts of interest.

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IMPROVING THE PERCENTAGE OF PRESCRIPTIONS REGISTERED THROUGH THE MYUBAT MOBILE APPLICATION FOR PHARMACY VALUE-ADDED SERVICE IN PORT DICKSON HOSPITAL

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Abstract

MyUBAT is a mobile and online application system developed and approved by the Ministry of Health Malaysia to simplify and speed up the pharmacy value added service (VAS) registration process and collection of subsequent patient medication supplies from health facilities. A verification study conducted in Port Dickson Hospital from July to November 2023 showed that the percentage of VAS prescriptions registered through the MyUBAT mobile application for subsequent medicine collection was merely 0.5%. This quality improvement study aimed to improve the percentage of prescriptions registered through the MyUBAT mobile application for pharmacy VAS to more than 15% over one year. Data on the indicator were retrieved from the Pharmacy MyUBAT Web Console Management database, while data on critical steps for improvement in the process of care were collected using a standardised data collection form. Self-administered survey forms were distributed to 50 patients/ caregivers and 22 pharmacy staff. The three main contributing factors were patient reluctance to use/accept the MyUBAT mobile application (65.8%), inexperienced staff on the MyUBAT mobile application (50.0%), and lack of technical support among patients (34.2%). Remedial measures were distributed in three cycles. Cycle 1: provided a dedicated VAS dispensing counter, assisted patients/caregivers register the MyUBAT mobile application, provided tutorial to patients in the pharmacy, created awareness via the Know Your Medicine campaign with ambassadors, provided continuous medical education (CME) for pharmacy staff, and offered workshops/hands-on tutorials for staff. Cycle 2: provided promotional leaflets at the screening counter, medication collection reminder notes with QR codes linked to the MyUBAT official website, stamped ‘MyUBAT’ at the queue numbers. Cycle 3: dispensed medicines with the promotional leaflet to patients/caregivers, and shared cellular internet data hotspots with patients/caregivers to download the mobile application. After three study cycles, the percentage improved from 0.5% to 80.8%. The strategies could be replicated and expanded to other hospitals with similar contributing factors.

KEYWORDS: Value-added services, Mobile health applications, Pharmacy

Problem

Malaysia Pharmaceutical Services Programme has introduced pharmacy Pharmacy Value-added Services (VAS) to improve the quality of refill medication deliveries to patients. It is a service that allows patients to choose a preferred method to obtain subsequent medication supplies more efficiently. Patients can decide their preferred VAS, such as an integrated drug dispensing system, appointment card service, drive-through pharmacy service, and mail pharmacy service (1).

On the other hand, MyUBAT is a mobile and online application system developed and approved by the Ministry of Health Malaysia (MOH) in 2020. The Pharmaceutical Services Programme, MOH, officially launched MyUBAT to simplify and speed up the VAS registration process and collection of subsequent patient medication supplies from the MOH facilities. MyUBAT mobile application allows patients to monitor their chosen pharmacy VAS appointments. This system also enables the pharmacy staff to manage the VAS registration process and provide subsequent medication supplies systematically through the Pharmacy MyUBAT Web Console Management database (2). MyUBAT is further supported by the Director General of Health, Malaysia, especially during COVID-19, as it enables patients to refill their medication via pharmacy VAS (3). This is in line with a recent study conducted in Perak, a state in Malaysia, which reported that the majority of the patients were delighted with the pharmacy VAS during the COVID-19 pandemic outbreak (4).

Port Dickson Hospital is one of the leading hospitals caring for an estimated 1.13 million population in Negeri Sembilan, Peninsular Malaysia (5). As one of the main departments in the hospital, the pharmacy department offers various services through six units: outpatient, inpatient, logistic, clinical, drug information service, and manufacturing. Notably, 22 outpatient pharmacy staff dispensed between 70,000 to 100,000 prescriptions annually through traditional counter service and VAS.

MyUBAT was officially launched in Port Dickson Hospital in July 2021, and the percentage of patients using the MyUBAT mobile application to register prescriptions for subsequent medication collection was merely 0.5% from July to November 2021 during the verification period. This indicated that the patients preferred to collect their subsequent medicines supply through traditional counter services instead of VAS. However, traditional counter services can increase patients' waiting time, affect patients' satisfaction with pharmacy service (6,7), and increase the risk of communicable disease transmission, especially in congested waiting areas (8–10).

Therefore, this study aimed to improve the percentage of prescriptions registered through the MyUBAT mobile application for pharmacy VAS to more than 15%, in line with the national key performance indicator (KPI), over one year.

Background

The digital revolution in health is expanding and consolidating quickly (11). In this context, mobile health (mHealth), defined by the World Health Organization, as the use of mobile and wireless technologies to achieve health objectives (12), plays an essential role in the digital transformation among patients. The digitalisation of healthcare encompasses the integration of the internet and digital technology and its correlation with novel therapies and optimal practices to enhance health management operations (13).

In general, there are 14 categories of mHealth services: health call centres, emergency, toll-free telephone services, managing emergencies and disasters, mobile telemedicine, appointment reminders, community mobilisation and health promotion, treatment compliance, mobile patient records, information access, patient monitoring, health surveys and data collection, surveillance, health awareness raising, and decision support systems (12).

Despite the global digital transformation trend, two recent international studies reported that the prevalence of using mHealth applications among the general population or patients was less than 50% (14,15). A recent study in China reported that only 17% of patients used web-based appointment systems (16). In Malaysia, more than half (77.1%) of patients used

online appointments in the healthcare system during the COVID-19 pandemic (17).

A study conducted by Peng and colleagues (2016) reported several factors impeding the use of mHealth applications: low awareness of health applications, lack of need for health applications because other tools were already available, lack of application literacy, lack of unique functions and features, lack of time and effort (especially if every information needs to be manually entered), lack of motivation, radiation from the cell phone, applications taking storage space of the phone or draining the battery, among others (18). More recently, Liu and colleagues (2019) reported that patients would decline to use mHealth applications if they did not have a smartphone, email or were not interested. In addition, the patients addressed their concerns regarding insufficient smartphone storage, unfamiliarity with downloading applications, forgotten passwords or email accounts, and slow or absent Wi-Fi connection (19). In Malaysia, a study reported that the main factors hindering public from using mHealth applications were inaccuracy of the applications, inconvenience and not being user-friendly (20).

Some factors may hinder patients from scheduling appointments using web-based or mobile applications. These included difficulty of use (21,22), lack of publicity (23), patients staying in rural areas (24), patients from low socioeconomic status (25,26), and patients with difficulty accessing the internet and computers (24,26–29).

One could implement a few strategies to increase the mHealth application usage. Providing monetary rewards or motivational messages is a strategy that some individuals prefer. Notably, an individual's commitment and drive will determine whether they will persist in using the mHealth application to improve their health (18). Hengst and colleagues (2023) outlined a few approaches aiming at low socioeconomic position populations, such as improving health and digital literacy, encouraging trust in the mHealth applications, securing the privacy and confidentiality of information, enlightening users on the importance of mHealth, providing technological support through digital training to the end users, family and friends by the healthcare professionals, equipping healthcare professionals with relevant knowledge, and increasing number of hotspots with access to free Wi-Fi (30).

On the other hand, researchers identified several potential solutions to encourage web-based or mobile applications for patient scheduling appointments: increasing patients' awareness of the service (26,28,31), addressing people's trust and interest (22), obtaining support from the government (16,26,32), improving impression of service quality (33), and improving proactiveness of the healthcare providers (34), among others.

Among all the strategies mentioned, studies showed that brochures were ineffective in raising awareness about web-based or mobile applications for patients scheduling (28,29,31). Zhao et al. (2017) reported that patients' poor experience with the internet and computers also hindered the patients from using the service (35). On the contrary, support from the government authority improves patients' satisfaction with web-based or mobile applications for patient scheduling appointments (32).

Measurement

This quality improvement study included all new VAS prescriptions from December 2021 to March 2023. The percentage of new VAS prescriptions registered through the MyUBAT mobile application was used as the indicator, and it was calculated as below:

$$\textit{Percentage of new VAS prescriptions registered through MyUBAT mobile application} = \frac{\textit{Number of new VAS prescriptions registered through MyUBAT mobile application}}{\textit{Total number of new VAS prescriptions registered}} \times 100$$

For example, if patients registered ten new prescriptions through MyUBAT mobile application while ten were registered manually by pharmacy staff in the database for January 2022, the total number of new VAS prescriptions registered in the database would be 20. Therefore, the percentage of prescriptions registered through the MyUBAT mobile application would be 50%.

However, if no new prescriptions were registered through the MyUBAT mobile application in February 2022 while 20 more were registered manually in the database in February 2022, the percentage would drop to 25% (10/40) due to the cumulative calculation. The Pharmacy MyUBAT database calculation would restart from the beginning of the new year. The standard was set at more than 15%, adapted from the 2022 MOH VAS Action Plan (1).

Data for the indicator was retrieved from the Pharmacy MyUBAT Web Console Management database. The database was developed by the Pharmaceutical Services Programme, MOH, as part of the MyUBAT system that facilitates staff in pharmacy facilities to manage the process of VAS registration and preparation of medicine at pharmacy counters more systematically (2). The data of the contributing factors was obtained from two different types of survey forms distributed to 22 pharmacy staff and 50 patients/caregivers at the outpatient pharmacy department at the beginning of the study. On the other hand, we collected data on critical steps of the process of care at the outpatient pharmacy department using a direct observation method and a standardised data collection form during office hours.

The data on the verification study (July to November 2021) was collected and analysed in December 2021, while remedial actions were implemented from January to February 2022 (cycle 1), April to May 2022 (cycle 2), and July to August 2022 (cycle 3). The achievement was analysed in March 2022 for Cycle 1, June 2022 for Cycle 2, and September 2022 for Cycle 3. The effects of change for cycles four and five were analysed in December 2022 and March 2023, respectively.

Data collected by the team members were compiled in Microsoft Excel before performing further analysis. During the verification study, the Pharmacy MyUBAT database showed that only 0.5% (3 out of 552) of VAS prescriptions were registered through the MyUBAT mobile application for subsequent medicine supplies. The achievable-benefit-not-achieved (ABNA) was 14.5%.

Initial Assessment of the Problem

The existing process of care was reviewed and revised as shown in Figure 1, starting from prescription screening by the pharmacist until medication collection by the patient at the pharmacy counter or through VAS offered. The critical steps were identified with asterisks. On the other hand, the Model of Good Care (MOGC) on the critical step is shown in Table 1.

The usual process of care starts with the pharmacist receiving a new prescription and screens for the correct medication regimen to be given to the correct patient. If the patient needs subsequent medication collection, the pharmacist will offer VAS according to patient preferences and check if the VAS suits the patient. For patients who opt for VAS for subsequent medication collection, he/she or the caregiver(s) need to register for their preferred VAS using the MyUBAT mobile application. Medication will then be filled, counterchecked, and dispensed. However, during the verification study, direct observation by the team members found that the MyUBAT mobile application was not offered during the prescription screening stage. At the same time, the Pharmacy MyUBAT database showed that only three patients used the MyUBAT mobile application to register for pharmacy VAS.

A brainstorming session was conducted to identify the potential contributing factors to this problem. It was presented using a problem analysis chart (Figure 2). Next, a survey was carried out using two different types of survey forms to further investigate the contributing factors. They were distributed to 22 pharmacy staff and 50 patients/caregivers at the outpatient pharmacy department. The results of this survey revealed the respondents' perceptions of the significant contributing factors that covered reasons on reluctance to use/accept the MyUBAT mobile application (65.8%) and the lack of technical support among patients (34.2%), while pharmacy staff expressed their main concern was on their inexperience on the use of MyUBAT mobile application (50.0%). Each strategy developed was targeted to address at least two or more contributing factors.

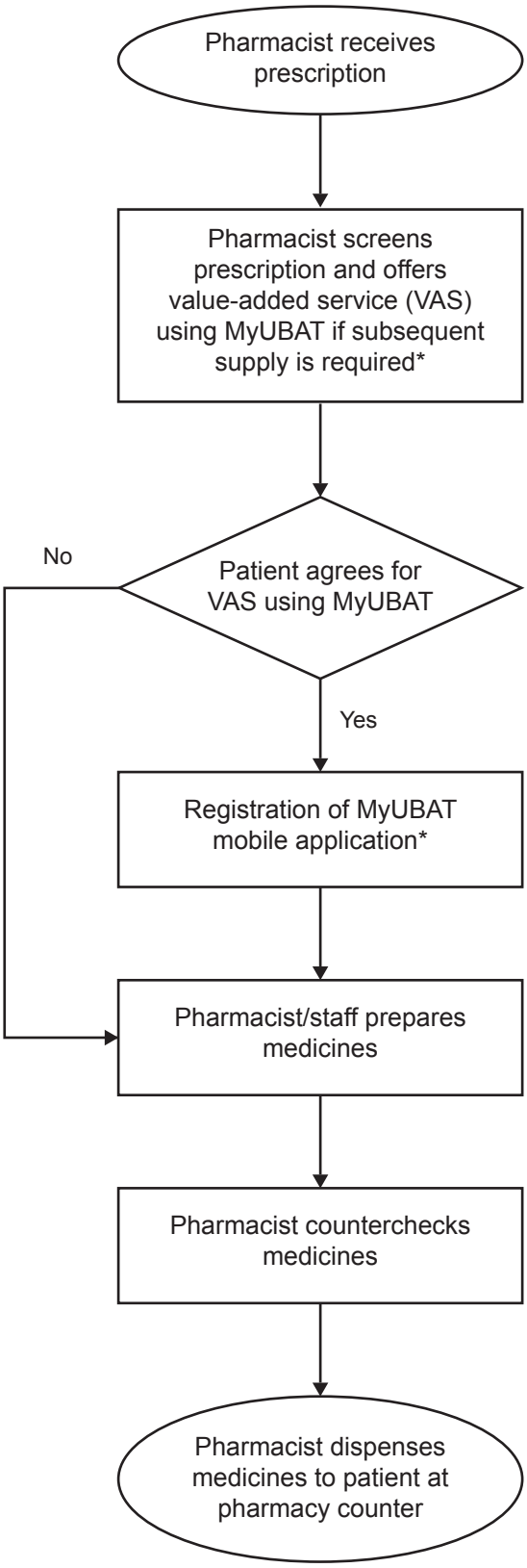


Figure 1: Process of care starting from new prescription screening by the pharmacist until medication collection by the patient at the pharmacy counter or through VAS offered

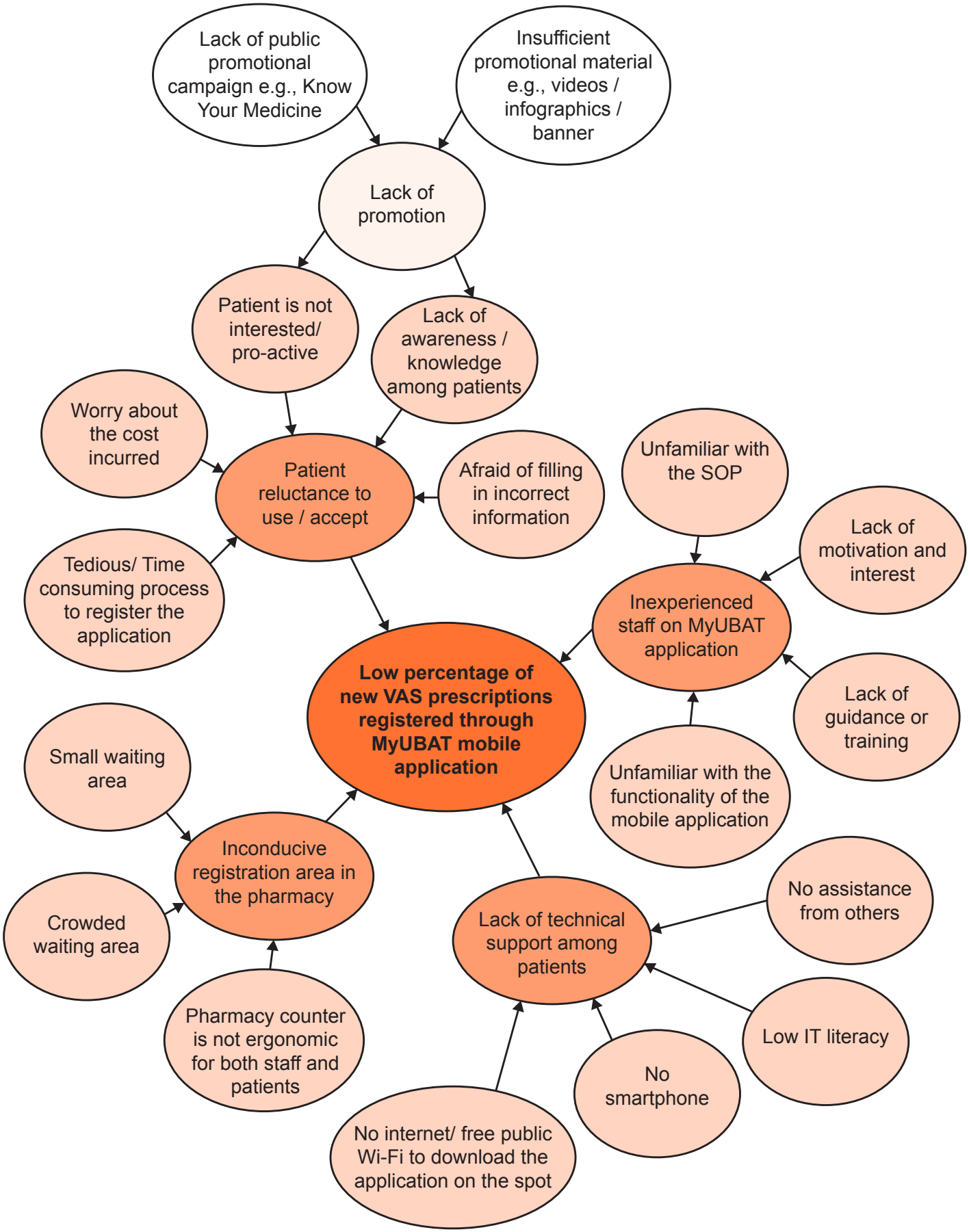


Figure 2: Problem analysis chart on the low percentage of prescriptions registered through the MyUBAT mobile application for Pharmacy VAS

Table 1: MOGC improving the percentage of prescriptions registered through the MyUBAT mobile application for pharmacy VAS

Process	Criteria	Standard (%)	Verification (%)	Cycle 1 (%)	Cycle 2 (%)	Cycle 3 (%)	Cycle 4 (%)	Cycle 5 (%)
Pharmacist screens the prescription and offers value-added service (VAS) using MyUBAT if subsequent supply is required	Ensure the prescription is for the right patient, with the right dose, frequency, duration, and route	100	100	100	100	100	100	100
	Provide a leaflet about the MyUBAT mobile application to patients/caretakers while waiting for medicine collection	100	0	0	85.5	89	93	90
	Stamp 'MyUBAT' on the prescription queue number for potential MyUBAT mobile application user	100	0	0	100	100	92.4	93.8
Registration of new VAS prescriptions	Ensure patients register new VAS prescriptions using MyUBAT mobile application on their own	15	0.54	14.5	15.9	27.2	35.6	80.8
	Ensure pharmacy staffs register VAS manually for those prescriptions that are not registered through MyUBAT mobile application	100	100	100	100	100	100	100

Strategy

A total of 11 strategies were implemented throughout the first three cycles: six in Cycle 1, three in Cycle 2 and two in Cycle 3. All the strategies were continued in both evaluation cycles 4 and 5 to evaluate the effectiveness of the strategies developed.

In Cycle 1, strategies were implemented to tackle all three main contributing factors. Firstly, a dedicated VAS dispensing counter was created at the outpatient pharmacy, and the MyUBAT promotional banner was displayed directly next to the counter. MyUBAT promotional leaflets were distributed to patients/caregivers coming to the VAS counter, and a timely introduction to this system was provided to them using a MyUBAT flipchart. Secondly, the pharmacy staff immediately assisted the patients/caregivers in downloading and registering the MyUBAT mobile application over the VAS dispensing counter. Thirdly, multiple tutorial sessions were conducted for patients/caregivers in the outpatient pharmacy waiting area to explain further about the benefits of using MyUBAT

mobile application. Fourthly, there were joint efforts between the MyUBAT & Know Your Medicine teams with the presence of Know Your Medicine ambassadors to promote MyUBAT mobile application at schools, mosques, and *madrasahs*, among others, to reach the community. These strategies allowed more opportunities to create awareness about the MyUBAT mobile application and create public interest in using this service. Fifthly, structured continuous medical education (CME) based on the 2021 Guidelines regarding Medicines Supply Management System for Pharmacy Value Added Services (MyUBAT) (3) was conducted regularly among 22 existing and ten new staff to remind them about the standard operating procedure (SOP). The sixth strategy involved the workshops and hands-on tutorials using the MyUBAT Training Mobile Application and MyUBAT Training Server for the pharmacy staff to simulate the actual scenario and ensure them to be well-equipped before attending to the patient's request. The remedial actions in Cycle 1 successfully reduced the achievable benefits not achieved (ABNA) gap, yet insufficient to attain the target. Therefore, more strategies were planned in Cycle 2.

In Cycle 2, the seventh strategy involved providing MyUBAT mobile application promotional leaflets directly at the outpatient pharmacy prescription screening station instead of only at the VAS dispensing counter. This gave patients or caregivers more time to understand MyUBAT mobile application while waiting for their medication collection. The eighth strategy involved designing the medication collection reminder note by incorporating a QR code directly linked to MyUBAT MOH's official website and attaching it to the patient's prescription. From there, patients or caregivers could choose their preferred mobile application platform, such as Apple Application Store, Google Playstore, or Huawei Application Gallery, to download MyUBAT mobile application. For the ninth strategy, a new stamp, 'MyUBAT' was designed and stamped on the queue number on the prescription during the prescription screening process to alert the staff that the patient was interested in using MyUBAT for their following medication collection.

In Cycle 3, the strategies were implemented to tackle limited technical support among the patients. As such, the tenth strategy involved inserting MyUBAT promotional leaflets into medication parcels for patients who signed up for VAS (i.e., appointment cards or postal medicines services), but have yet to register for the MyUBAT mobile application. The leaflets would be dispensed with medications to the patients/caregivers upon medication collection to create awareness among the patients' family members. This strategy focused on patients who are illiterate but interested in using the MyUBAT mobile application with assistance from their family members. For the eleventh strategy, pharmacy staff shared the free cellular internet data hotspots provided by the hospital with patients or caregivers without a cellular internet data plan on their smartphones to enable them to download the MyUBAT mobile application instantly and perform new registration/service application on the spot.

Results

The remedial actions implemented throughout this study improved the percentage of prescriptions registered through the MyUBAT mobile application: 14.5% (10 out of 69, Cycle 1), 15.9% (28 out of 176, Cycle 2), 27.2% (72 out of 265, Cycle 3), 35.6% (122 out of 343, Cycle 4), and 80.8% (122 out of 151, Cycle 5). The ABNA gap was -65.8% at the end of this study (Figure 3). The percentage of prescriptions registered through the MyUBAT mobile application for pharmacy VAS showed an increasing trend throughout the cycles.

Besides the improvement in the achievement of the standard, the critical steps showed encouraging accomplishment across the cycles (Table 1). The majority achieved more than 90% in the end, against the pre-set standard of 100% before the start of this study. The percentages of patients using the free internet data hotspots shared by the pharmacy staff provided by the hospital increased over Cycles 4 and 5 after the implementation of this strategy in Cycle 3, whereas the number of patients using their cellular internet data decreased as they started to opt for the internet data

hotspot shared by the pharmacy staff rather than using their own cellular internet data plan while registering for MyUBAT mobile application.

There were also some unexpected impacts attained from this study. For example, the percentage of prescriptions dispensed to all patients at the outpatient pharmacy counter within 30 minutes remained >95% despite the tedious MyUBAT mobile application registration process. This reflected good patient waiting time for medication collection at the outpatient pharmacy (>95%) achieved by pharmacy for this key performance indicator throughout the study. Moreover, the Pharmacy Department also indirectly managed to meet the key performance indicator for VAS, i.e., 15% out of all prescriptions received at the outpatient pharmacy requiring medication refills were registered for VAS. There was a 41.9% increment in the total percentage of prescriptions registered for VAS: 2966 in 2021 and 4208 in 2022. Only MYR 35 was involved to purchase the MyUBAT stamp, which was considerably negligible compared to the benefits obtained at the end of this study.

At the end of the study, a survey was conducted among 20 outpatient pharmacy staff to identify the interventions they perceived as responsible for improvement of the standard. Seventy-five percent (n=15) of them agreed that the most effective strategy was providing immediate assistance to patients/caregivers to download and register the MyUBAT mobile application, followed by inserting MyUBAT promotional leaflets into medication parcels for patients signed up for VAS (15%, n=3) and sharing free cellular internet data hotspots provided by hospital with patients/caregivers without a cellular internet data plan (10%, n=2).

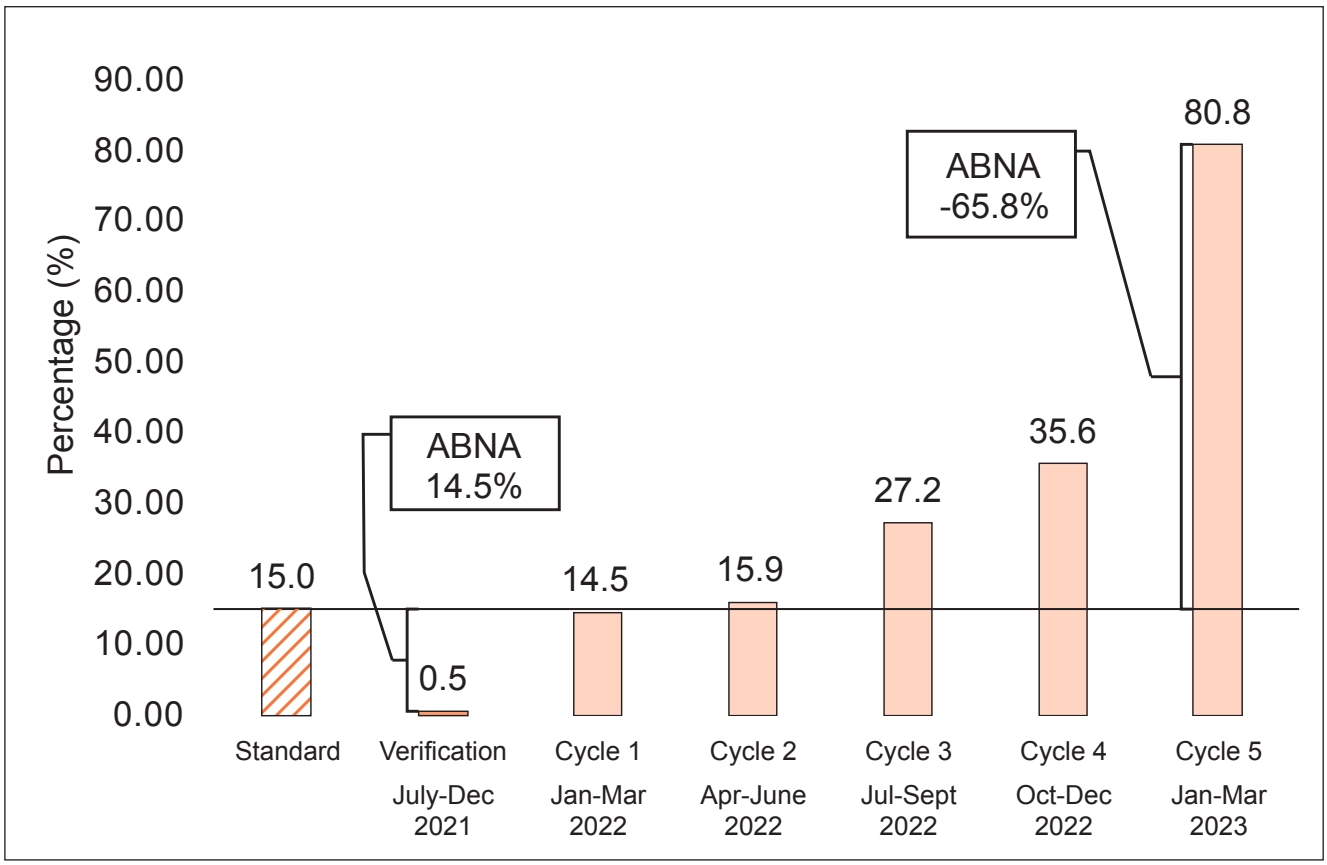


Figure 3: Achievement of the standard by cycles

Lessons and Limitations

This study highlights the importance of implementing multiple strategies to attain the standard set. Although the standard was met during the second cycle, our team members addressed patients' concerns by implementing two more strategies. These were important to ensure the study effects could be sustained or even superseded far beyond the early target. In addition, we learned that CME, workshops, and hands-on tutorials were vital to ensure that pharmacy staff were consistently equipped with the skills and knowledge to serve the patients/ caregivers right in front of the pharmacy counter. This is especially true for new or existing staff with less experience with the MyUBAT system and the need for them to update themselves regularly. A dedicated outpatient pharmacy team is also critical to continue all the strategies planned and implemented, not only during the study period but also on a daily working basis. Without their continuous commitment and dedication, the effects would not be sustained in the post-intervention phase.

Despite our team's achievements, we faced a few limitations. We identified that the steps of stamping the 'MyUBAT' stamp on the prescription queue number and attaching a medication collection reminder note with a QR Code link directly to the MyUBAT MOH's official website were not achieving the ideal 100% target. After interviewing the outpatient pharmacy staff, the reasons were due to peak hours and staff shortages, causing them not to be able to perform those two steps consistently. Persistent monitoring would be necessary to ensure the staff conducts the two steps. Importantly, we realised that patients/ caregivers without smartphones, illiterate patients, and patients without family support were among the obstacles we could not address throughout the study period. In the future, additional surveys could be conducted among patients/caregivers to identify the interventions they perceived as responsible for improvement of the standard. Perhaps these barriers could be addressed with social and financial assistance from the community.

Conclusion and the next steps

This study successfully improved the percentage of prescriptions registered through the MyUBAT mobile application for Pharmacy VAS from 0.5% in the pre-intervention phase to 80.8% post-implementation of strategies. The standard set was met, and the ABNA gap was eventually closed. The major contributing factors to these quality issues were identified and tackled. The strategies could be replicated in other healthcare facilities with similar background issues. We would expect more usage of the MyUBAT mobile application among the patients, except those without a smartphone, who are illiterate or without family support. The team members would continuously monitor the work process to ensure targets are achieved and maintained throughout the year in the hospital.

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Conflict Of Interest

The authors declare that there is no conflict of interest.

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Appendix 1: Strategies For Change



IMPROVING HbA1c CONTROL AMONG NEWLY INITIATED INSULIN TYPE II DIABETES MELLITUS PATIENTS IN *KLINIK KESIHATAN KELANA JAYA*

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Abstract

HbA1c is an important indicator of glycaemic control as it correlates with the risk of long-term diabetes complications. In 2017, only 17.4% of Type II Diabetes Mellitus (T2DM) patients at *Klinik Kesihatan Kelana Jaya* (KKKJ) newly initiated on insulin achieved at least a 1% reduction in HbA1c after six months. This contributed to 40.9% of patients developing diabetic nephropathy, 48.6% experiencing diabetic neuropathy, and 20.1% being diagnosed with diabetic retinopathy. Our study indicator is the percentage of T2DM patients who achieved at least a 1% reduction in HbA1c six months after insulin initiation. A target of 80% was set, based on consensus reached during 2018 Non-Communicable Disease (NCD) meeting at KKKJ. This quality improvement study employed a universal sampling method from July 2018 to July 2020. Data were collected using questionnaires distributed to healthcare professionals (HCPs), an audit checklist, and a patient assessment form completed during clinic visits. The data were analysed using Microsoft Excel. During the verification study, the achievement rate was 23.8%. The identified contributing factors to poor HbA1c control were poor patient adherence to insulin, lack of awareness among HCPs regarding the latest insulin guidelines, insufficient coordination among the multidisciplinary team, lack of self-monitoring of blood glucose and self-adjustment of insulin doses, and patient's non-adherence to lifestyle interventions. Several strategies were introduced, including the "One Sweet Centre," which involved a multidisciplinary team comprising a medical officer, pharmacist, dietitian, diabetes educator, and occupational therapist. Additionally, glucometers were loaned to patients with financial difficulties. Phone consultations and a drive-through service were offered during the Movement Control Order (MCO) period of the Covid-19 pandemic. Post-intervention results showed that the percentage of T2DM patients achieving at least a 1% reduction in HbA1C after six months of insulin initiation increased from 23.8% to 50% in cycle one, 70% in cycle two, and 83.3% in cycle three. Moving forward, we plan to share our remedial actions with other clinics and expand this initiative by setting up a peer support club and collaborating with Non-Governmental Organisations (NGOs) to empower the community.

KEYWORDS: HbA1c, Insulin initiation, Multidisciplinary team

Problem

KKKJ is one of the health clinics in the Petaling Jaya district in Selangor (1). This health clinic comprises various departments, including the Outpatient Department (OPD), Maternal and Child Health (MCH), pharmacy, laboratory, dental services, dietetic services, and physiotherapy. The OPD offers a wide range of services, which include managing NCDs, a quit smoking clinic, health screening, medical check-ups, mental health care, asthma clinic, diabetes clinic, tuberculosis clinic, HIV clinic, pre-exposure prophylaxis (PrEP) programme, methadone and hepatitis C clinic, PEKA B40 screening services, Influenza-Like Illness clinic (ILI) clinic, Covid-19 Centre and a virtual clinic. Health services in KKKJ are provided by multi professional team consists of a Family Medicine Specialist (FMS), medical officers (MO), medical assistant, pharmacist, pharmacist assistant, dietician, physiotherapist, nurses. The daily total attendance at the OPD ranges between 250 and 400 patients. Of these, NCD cases are the most frequently seen, with 50 – 65% being T2DM cases. According to the T2DM registry under the Petaling Jaya District Health Office, there were 3,504 active T2DM patients in KKKJ in 2017. Glycated haemoglobin (HbA1c) is used as one of the key monitoring tools to assess glycaemic control in these patients.

In 2017, almost 39% of T2DM patients in KKKJ were on insulin, either as a single agent or in combination with oral hypoglycaemic agents (OHA). However, only 17.4% of newly initiated insulin patients achieved at least a 1% reduction in HbA1c after six months. Among these patients, 40.9% had diabetic nephropathy, 48.6% had diabetic neuropathy, and 20.1% had diabetic retinopathy.

As a result, a quality improvement study was conducted to address the low percentage of T2DM patients achieving significant HbA1c reduction after insulin initiation. The primary aim of this study was to ensure that at least 80% of T2DM patients achieved a minimum of 1% reduction in HbA1c after six months of insulin initiation, with a target to reach this goal within 24 months.

Background

Insulin is widely used as one of the treatment options in managing T2DM to achieve target HbA1c levels (2). The Malaysia National Diabetes Registry report showed that insulin use in the treatment of T2DM increased from 11.7% in 2009 to 21.4% in 2012 (3). Selangor is one of the top five states in Malaysia with the highest percentage (30.4%) of T2DM patients receiving insulin (4) .

HbA1c is an important indicator of glycaemic control as it reflects the average blood glucose level over the past three months and correlates with the risk of long-term diabetes complications (5). Studies have shown that a 1.5% reduction in HbA1c is achievable with basal insulin plus OHA using a target-to-treat approach, especially in previously insulin naive patients (6,7). The mean HbA1c overall has decreased from 9.2% at baseline to 7.9% at a six-month follow up, with the largest mean reduction of 2.4% observed in patients with baseline HbA1c >9% when basal insulin was added to oral therapy (8).

The UK Prospective Diabetes Study (UKPDS) demonstrated that an early reduction in HbA1c of at least 1% is associated with a 21% reduction in diabetes-related deaths, a 37% reduction in microvascular complications (e.g., kidney disease, blindness), a 14% reduction in heart attacks, a 43% reduction in amputations or fatal peripheral blood vessel disease, and a 12% reduction in stroke (9).

Early insulin therapy initiation can help reduce blood glucose and HbA1c levels, therefore enabling patients to benefit from a favourable “legacy effect”. This phenomenon refers to the significant reduction of micro- and macrovascular complications through early intensive blood glucose control (10). As a result, the healthcare costs associated with managing T2DM complications can be markedly reduced (11).

Despite the fact that insulin is the most effective drug available for achieving glycaemic targets T2DM patients, a large study in the public healthcare system showed that only 26% of these patients had good glycaemic control (12). Several issues in clinical practice pose barriers to achieving

optimal glycaemic control with insulin therapy, such as poor patient acceptance, hypoglycaemia, weight gain after starting insulin, and suboptimal insulin regimen adjustments (13,14). Non-adherence to insulin regimens is another significant factor that delays the achievement of satisfactory glycaemic control. Multiple daily injections using syringes or insulin pens often cause discomfort and require a substantial commitment to self-management and daily living adjustments (15,16,17,18). Approximately 34.6% of diabetes patients reported missing insulin doses at least once a month (19).

To address poor glycaemic control despite insulin initiation, health care providers, both locally and internationally, have adopted several strategies. These include overcoming patient barriers by referring them for diabetes self-management education, providing medical nutrition therapy, offering ongoing self-management support, addressing emotional concerns related to insulin use, ensuring timely follow-up to promote adherence, and identifying and resolving potential challenges. Developing and implementing comprehensive algorithms for optimising and intensifying insulin therapy are also essential (20). It is crucial to involve patients in the decision-making process to ensure adherence and subsequently achieve glycaemic control. Education and empowerment through shared decision-making allow patients' preferences to be acknowledged and considered, leading to the creation of an individualised treatment plan for each patient (21). In addition, more frequent medical visits, coupled with treatment interventions including the use of insulin pens and self-monitoring, have improved glycaemic control in elderly patients with chronically decompensated diabetes (22). Effective interventions, including innovative medication delivery devices, improve the management of individuals with T2DM who are treated with insulin (23,24).

Measurement

The objective of this study was to increase the percentage of T2DM patients achieving at least 1% reduction in HbA1c after six months of insulin initiation at KKKJ. The percentage of patients meeting this target was used as the primary improvement indicator. This was calculated as the total number of T2DM patients achieving at least a 1% HbA1c reduction after six months of insulin initiation, divided by the total number of patients newly initiated on insulin. An 80% standard was set during the NCD meeting held at KKKJ in 2018.

This quality improvement study involved three cycles, conducted between October 2018 and June 2020. The verification study was conducted from July to September 2018, followed by post intervention cycles: Cycle One (October 2018 to May 2019), Cycle Two (June 2019 to December 2019), and Cycle Three (January 2020 to July 2020). The selected study population consisted of insulin naive T2DM patients at KKKJ, newly initiated on insulin during the study period. Patients with gestational diabetes mellitus were excluded. All newly initiated insulin patients were recruited at the start of each cycle, and followed up for six months. In Cycle One, 30 patients were included; in Cycle Two, 50 patients; and in Cycle Three, 42 patients.

A patient assessment form was used to track HbA1c readings six months after insulin initiation and to assess any new T2DM-related complications. An audit checklist was used to review the process of insulin initiation and optimisation for newly initiated patients. All data were compiled and analysed using Excel. Pareto analysis was used to determine the main factors contributing to the low percentage of T2DM patients achieving at least a 1% HbA1c reduction after insulin initiation.

The verification study found that only 23.8% of T2DM patients achieved the target 1% HbA1c reduction after six months, compared to the 80% standard, resulting in an Achievable Benefit Not Achieved (ABNA) rate of 56.2%.

Initial Assessment of the Problem

The process of care, as depicted in Figure 1, was reviewed at the beginning to identify critical steps contributing to the low percentage of T2DM patients achieving at least 1% reduction in HbA1c six months after insulin initiation. Appendix 1 (Before Quality

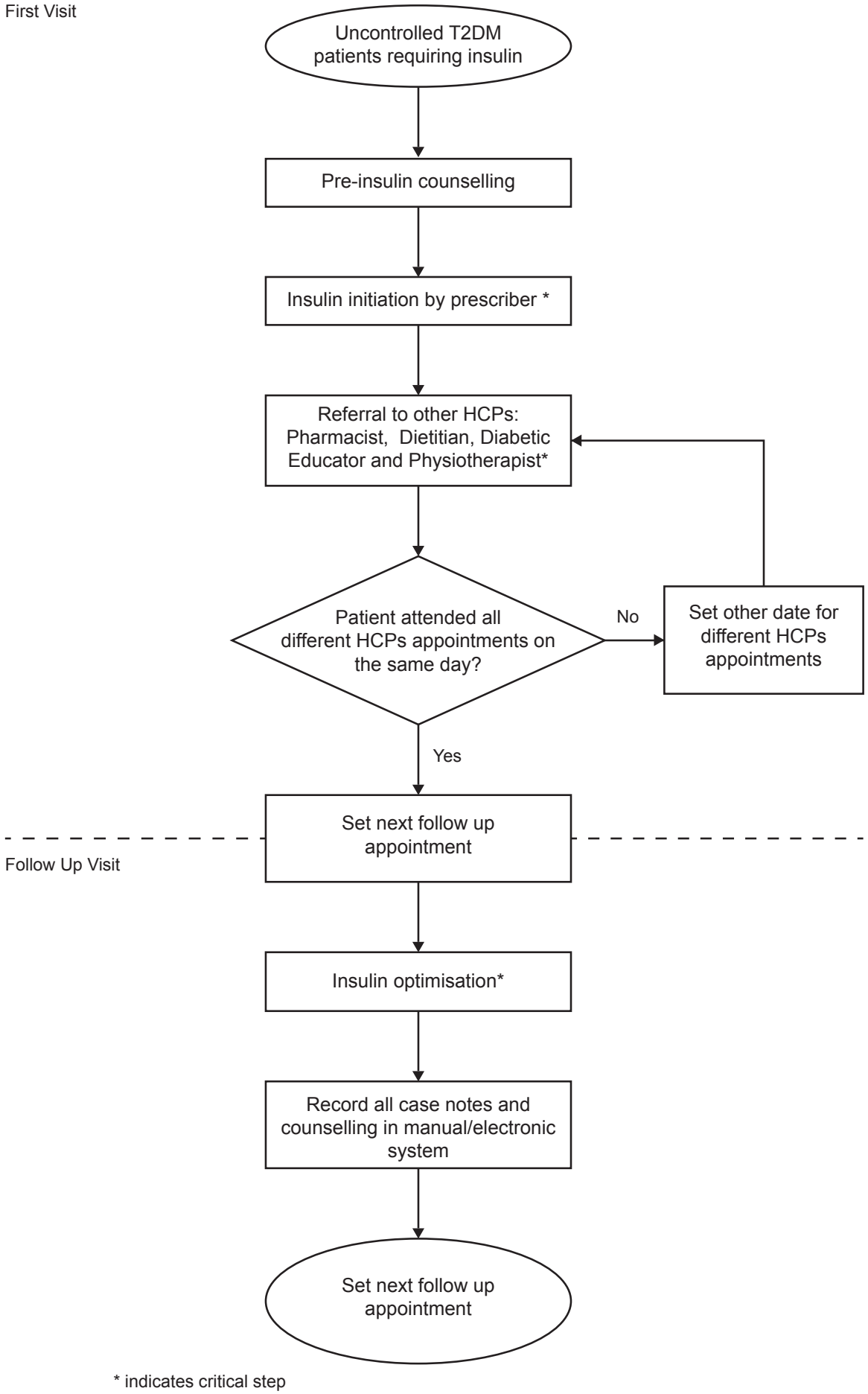


Figure 1: Process of care for uncontrolled T2DM patients requiring insulin (*indicates critical steps)

Study) outlines the 12-month appointment schedule for newly initiated insulin patients. The process involved the prescriber providing pre-insulin counselling, initiating appropriate insulin therapy (including type of insulin, starting dose, and insulin regimen), and referring patients to other HCPs such as pharmacists for insulin pen injection technique, diabetic educators for self-monitoring of blood glucose (SMBG), and dietitians for diabetes diet education. Once patient attended all counselling sessions provided, following two appointments were scheduled. However, some patients missed counselling sessions with HCPs and needed to be rescheduled. Frequent appointments during the first six months were essential, ensuring insulin dose titration could be performed to achieve optimal dosing and lowering HbA1c levels. The critical steps identified were insulin initiation by the prescriber, HCP involvement, and insulin optimisation.

A problem analysis chart, shown in Figure 2, was used to identify possible factors contributing to the low percentage of patients achieving the target HbA1c reduction. Data were collected through three methods – an HCP questionnaire, an audit checklist, and a patient assessment form during clinic visits. The questionnaire was distributed to 66 HCPs at KKKJ, including medical officers, pharmacists, dietitians, and diabetic educators. It aimed to identify factors contributing to low percentage of T2DM patients with HbA1c reduction following insulin initiation. Audit checklist was used to review the process of insulin initiation and optimisation while a patient assessment form was used to track HbA1c reading after 6 months of insulin initiation and occurrence of new T2DM-related complications.

Among the 66 participating HCPs (53% MOs, 47% other HCPs), 65.1% had over five years of working experience. Pareto chart analysis showed that the main contributing factors to low HbA1c reduction were poor patient adherence to insulin therapy (24.2%), lack of awareness among HCPs about the latest insulin therapy guidelines (22.7%), lack of multidisciplinary team coordination (16.7%), lack of SMBG and self-adjustment on insulin doses (10.6%), and patient non-adherence to lifestyle interventions (6.1%).

Table 1 depicts the Model of Good Care for the critical steps in the insulin initiation process. Among the three critical aspects identified, the lowest process scores were observed in the involvement of other HCPs including assessments by pharmacists or diabetic educators (DEs) post insulin initiation, individualised meal planning by dietitians, and insulin optimisation.

Specifically, there was no assessment by pharmacists or DEs post insulin initiation. This includes a complete absence of evaluations related to correct injection technique and handling of the insulin pen (0%), adherence to insulin therapy (0%), engagement in minimal exercise (0%), and weight loss of ≥1kg after six months for overweight or obese patients (0%). In terms of individualised meal planning by dietitians, only 7.1% of patients attended dietitian counselling within three months of insulin initiation, and 2.4% adhered to the diabetes plate method following dietetic counselling.

For the third critical step, insulin optimisation, involved both patients and prescribers, no patient (0%) managed to titrate their insulin dose at home, nor did any attend the second, third, or fourth review appointments as scheduled at the clinic. Furthermore, there was no (0%) insulin titration based on SMBG by prescribers during the second, third, or fourth clinic reviews.

Strategy

A holistic approach was used in formulating remedial actions, which involved all HCPs, patients, and a pharmaceutical company. The remedial actions implementation was divided into three phases across the study's cycle - two strategies in Cycle One, three strategies in Cycle Two and two strategies in Cycle Three.

Before the quality improvement study, patients newly initiated on insulin were given longer intervals between clinic appointments, which compromised insulin adherence and delayed insulin dose optimisation. Additionally, there was no structured monitoring by other HCPs after insulin initiation by the prescribers. During Cycle One (October 2018 – May 2019), a holistic program named "One Sweet Centre" (OSC) was introduced to address these

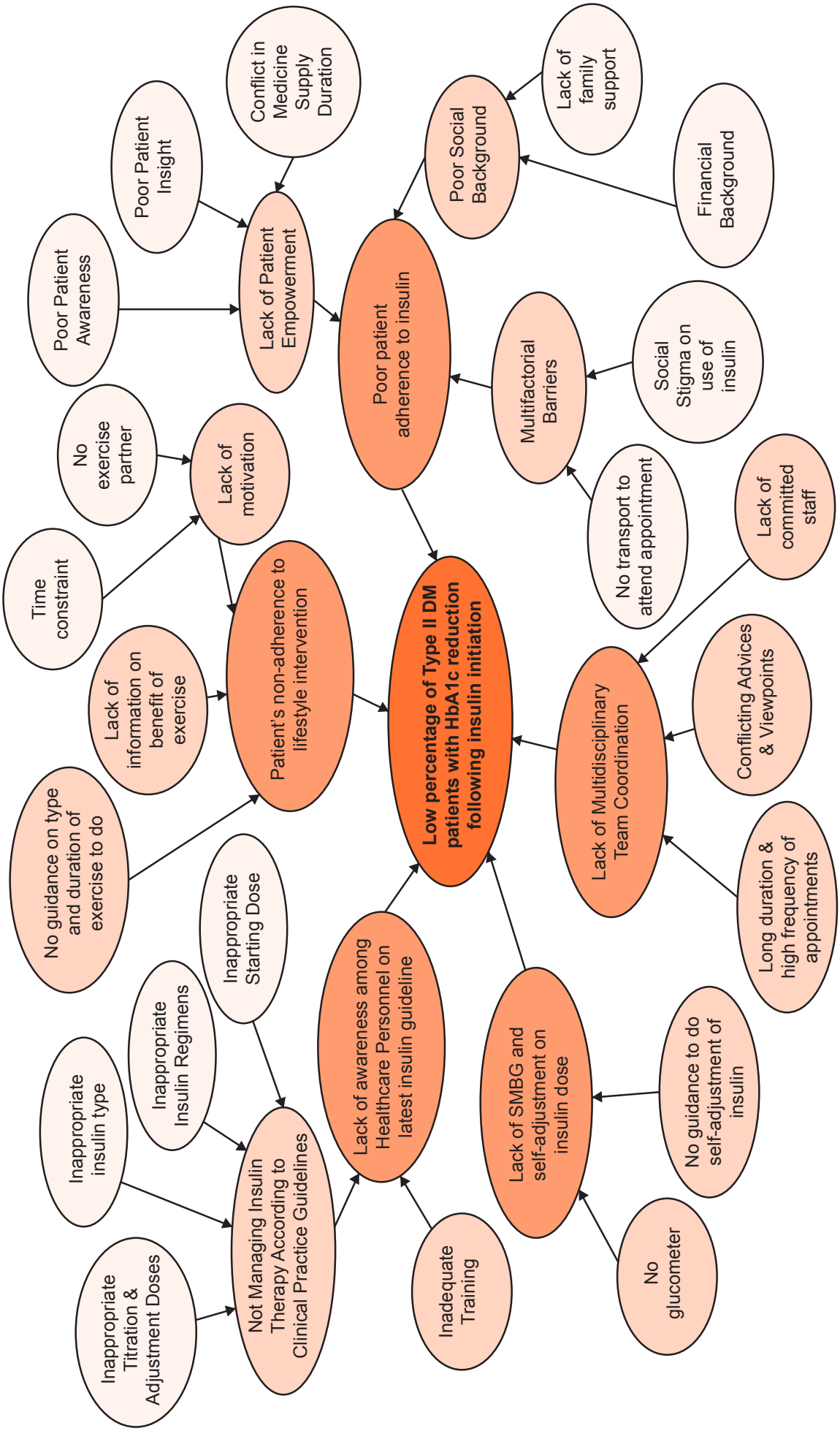


Figure 2: Problem analysis chart for low percentage of T2DM patients with HbA1c reduction following insulin initiation

gaps. It was a dedicated multidisciplinary clinic which emphasised patient education, self-empowerment, and individualised patient care, operating every Thursday and Friday from 8am to 1pm. The prescriber and Diabetes Medication Therapy Adherence Clinic (DMTAC) pharmacist were involved in the clinic. All T2DM patients newly initiated on insulin were reviewed in the OSC post insulin initiation, with follow up (visit two - four) appointments scheduled for insulin dose optimisation. OSC was set up with the aim to: 1) increase patient adherence to insulin by enhancing their understanding of insulin therapy; 2) provide individualised counselling on potential adverse effects, boosting confidence in insulin use; 3) educate patients on self-care devices like insulin pens and glucometers, and ensure proper technique and device handling; and 4) improve patient knowledge on SMBG and insulin dose titration through frequent monitoring and more regular clinic visits (Appendix 1).

In addition to patient focused interventions, a series of Continuous Medical Education (CME) were conducted to update HCPs as part of the knowledge empowerment and adherence to the latest insulin practical guidelines. A total of ten CME slots were delivered, with topics related to insulin initiation and optimisation, and incorporating Kahoot games to enhance engagement. Prizes such as goody bags and food vouchers were awarded to the top three HCPs, encouraging their interest in the insulin practical guidelines.

During the re-evaluation post Cycle One, it was found that T2DM patients were unable to perform exercise, follow a diabetic diet, or conduct SMBG due to not own a glucometer at home (Table 1). Hence, during Cycle Two (June 2019 – December 2019), patients without glucometers, experiencing financial challenges, or poor understanding were referred to the DE to obtain loaned glucometers for SMBG monitoring. These were provided free of charge by a pharmaceutical company with approval by the clinic FMS. Additional HCPs, including DEs, dietitians, and physiotherapists, were incorporated into the OSC team to offer a comprehensive care approach (Appendix 1). This strategy reduced patient burden by allowing patients to be reviewed by multiple HCPs in one visit and facilitated timely insulin dose titration by the prescribers. A detailed counselling and assessment checklist (Appendix 2), involving five HCPs in OSC, was introduced to streamline the process. The inclusion of a physiotherapist was particularly important, as they advised patients on appropriate types of exercises and durations according to patient capabilities. This intervention improved clinic attendance and insulin adherence.

Cycle Three (January – July 2020) coincided with the MCO during the COVID-19 pandemic. The pandemic presented additional challenges, including patients being unable to exercise outdoors, facing disruptions in their diets, and experiencing weight gain, worsening their T2DM management. Moreover, some patients feared attending clinic appointments and collecting medications due to the risk of infection, as T2DM patients are at greater risk for severe COVID-19 complications. In view of that, phone consultations were introduced for patients who missed appointments, covering SMBG, dose titration of insulin, and lifestyle advice. A value-added service, like drive through medication and insulin collection service was offered to ensure adherence while minimising the risk of exposure to COVID-19.

Results

Upon implementation of the above strategies, significant improvements were observed in the percentage of T2DM patients achieving at least a 1% reduction in HbA1c after six months of insulin initiation. Following the introduction of the OSC and multidisciplinary interventions in Cycle One, the percentage of patients with at least a 1% reduction in HbA1c increased from 23.8% during the verification cycle to 50%. However, this still fell short of the target of 80%.

In Cycle Two, the inclusion of the loaned glucometer programme and involvement of additional HCPs, such as physiotherapists and dietitians, further improved the outcome. The percentage of T2DM patients achieving the target HbA1c reduction increased from 50% (Cycle one) to 70%.

Despite the challenges posed by the COVID-19 pandemic and the MCO in Cycle Three, strategies such as phone consultations and drive-through services proved effective. The percentage of T2DM patients achieving the HbA1c reduction target rose from 70% (Cycle Two) to 83.3%, surpassing the 80% standard (Figure 3).

In addition to improvements in HbA1c control, this study also observed a reduction in the percentage of patients experiencing new onset T2DM complications, such as myocardial infarction, stroke, retinopathy, peripheral vascular disease requiring foot amputation, nephropathy requiring haemodialysis, cataracts, and heart failure. During the verification cycle, 23.8% (10/42) of patients experienced new complications due to failure to reduce HbA1c by at least a 1%. However, with the implementation of the strategies mentioned above, we successfully reduced the percentage of patients with new onset T2DM complications to 13.3% (4/30) in Cycle One, followed by 6.0% (3/50) in Cycle Two and lastly 2.4% (1/42) in Cycle Three.

Furthermore, the estimated direct cost of managing T2DM complications significantly decreased, from MYR 55,344 during the verification cycle to MYR 10,587 in Cycle One, MYR 10,103 in Cycle Two and lastly, MYR 479 in Cycle Three, owing to the improvement in HbA1c control post insulin initiation and optimisation. The cost estimates for managing T2DM complications were based on the journal published by Mustapa et al (25). Table 2 outlines the estimated direct cost of managing T2DM complications during this quality improvement study.

Overall, the ABNA was successfully reduced from 56.2% to -3.3%. The three critical aspects that were previously subpar all showed improvements following the implementations of the strategies.

Lessons and Limitations

This study imparted a crucial lesson: a dedicated multidisciplinary team involving FMS, MO, DMTAC pharmacist, DE, physiotherapist, and dietitians is important for improving HbA1c control in patients newly initiated on insulin. Proper diabetes education and guidance to empower patients to achieve target HbA1c levels earlier, thereby delaying or preventing both micro- and macrovascular complications. Through the various strategies implemented, T2DM patients learned to handle devices like insulin pens and glucometers properly, reducing medication wastage and disposal due to poor handling, which often leads to mechanical errors and non-adherence. Additionally, patients recruited during intervention Cycles One, Two and Three managed to perform SMBG as instructed, enabling prescribers to

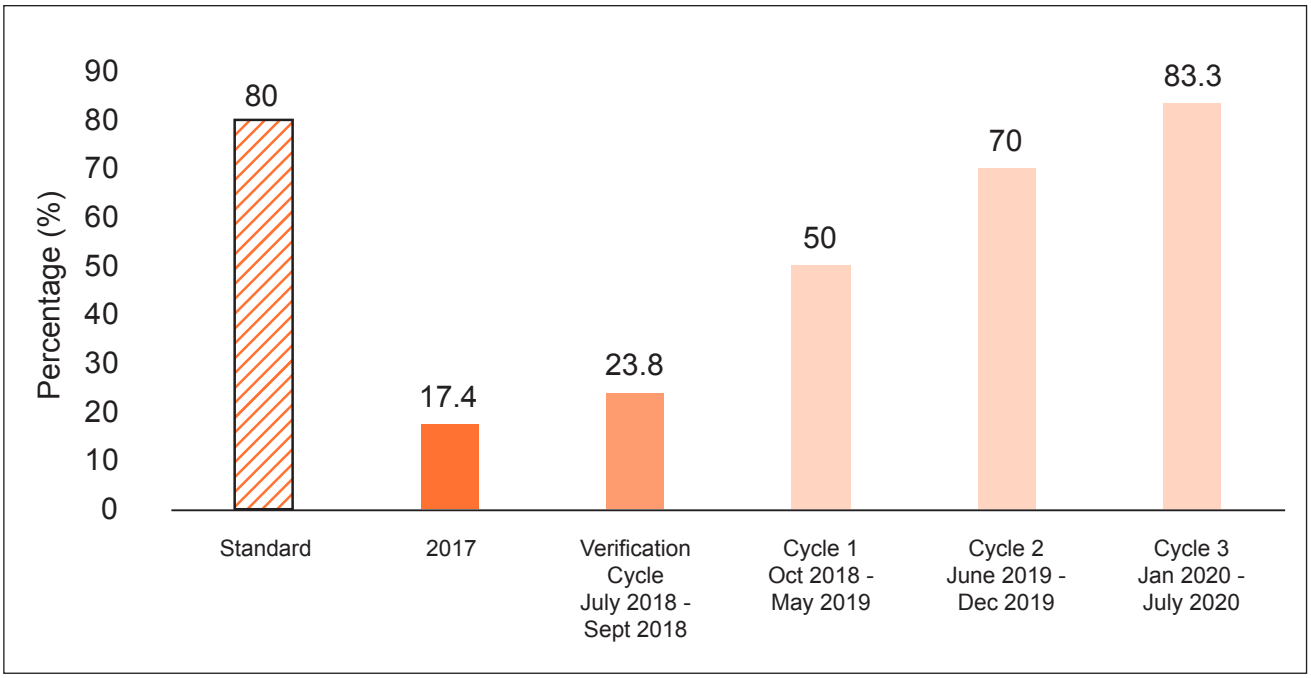


Figure 3: Percentage of T2DM patients who achieve at least 1% reduction HbA1c following insulin initiation

Table 1: Improvement in implementation of critical steps in Cycle One, Cycle Two and Cycle Three.

No	Process	Criteria	Standard	Verification (n=42)	Cycle One (n=30)	Cycle Two (n=30)	Cycle Three (n=30)
1	Insulin initiation by medical officer	• Select the correct insulin regimen as per guideline.	100%	83.3%	93.3%	98.0%	100.0%
		• Prescribe the correct type of insulin as per drug formulary.	100%	83.3%	93.3%	98.0%	100.0%
		• Prescribe the correct dose of insulin as per guideline.	100%	21.4%	70.0%	92.0%	97.6%
2	Referral to other HCPs: Pharmacist, dietitian, Diabetic Educator and Physiotherapist	(A) Diabetes education by pharmacist/DE upon insulin initiation					
		• Insulin pen injection technique	100%	95.2%	100%	100%	100%
		• SMBG counselling	100%	28.6%	100%	100%	100%
		(B) Assessment on patient by pharmacist/DE post insulin initiation					
		• Correct injection technique and handling of insulin pen	100%	0.0%	86.7%	92.0%	97.6%
		• Adherence to insulin therapy	100%	0.0%	86.7%	90.0%	97.6%
		• Perform minimal exercise of 150 mins/week	100%	0.0%	43.3%	72.0%	83.3%
		• Weight loss of ≥1kg after six months for overweight/obese	100%	0.0%	26.7%	28.0%	31.0%
		(C) Individualised meal planning by dietitian					
		• Patient has attended dietitian counselling within 3 month of insulin initiation	100%	7.1%	53.3%	64.0%	69.1%
		• Adherence to diabetes plate method by patient post counselling	100%	2.4%	53.3%	76.0%	78.6%

No	Process	Criteria	Standard	Verification (n=42)	Cycle One (n=30)	Cycle Two (n=30)	Cycle Three (n=30)
3	Insulin optimisation	(A) Patient					
		• Having glucometer for SMBG	100%	16.7%	40.0%	78.0%	85.7%
		• Able to perform SMBG	100%	14.3%	40.0%	78.0%	85.7%
		• Able to titrate insulin dose at home	100%	0.0%	30.0%	60.0%	69.1%
		• Attend clinic appointment as scheduled	100%				
		(i) 1st review: 1 month after initiation	100%	66.7%	100.0%	100.0%	100.0%
		(ii) 2nd review: 1 month after 1st review	100%	0.0%	100.0%	100.0%	100.0%
		(iii) 3rd review: 2 months after 2nd review	100%	0.0%	96.7%	96.0%	97.6%
		(iv) 4th review: 2 months after 3rd review	100%	0.0%	93.3%	96.0%	97.6%
		(B) Prescriber					
		• 1st review: titrate insulin dose based on SMBG 1 month after initiation	100%	45.2%	100.0%	100.0%	100.0%
		• 2nd review: titrate insulin dose based on SMBG 1 month after 1st review	100%	0.0%	100.0%	100.0%	100.0%
		• 3rd review: titrate insulin dose based on SMBG 2 months after 2nd review	100%	0.0%	100.0%	94.0%	97.6%
		• Order HbA1c test on 3rd review	100%	0.0%	93.3%	94.0%	97.6%
		• 4th review: review HbA1c reading 2 months after 3rd review	100%	0.0%	93.3%	94.0%	97.6%

Table 2: Estimated direct cost of management of complications due to T2DM.

Complication	Verification (n=42)		Cycle One (n=30)		Cycle Two (n=50)		Cycle Three (n=42)	
	Number of patients x direct cost	Total cost (MYR)	Number of patients x direct cost	Total cost (MYR)	Number of patients x direct cost	Total cost (MYR)	Number of patients x direct cost	Total cost (MYR)
Myocardial infarction	1 X MYR4,817	4,817	1 X MYR4,817	4,817	0	0	0	0
Stroke	0	0	0	0	0	0	0	0
Retinopathy	7 X MYR479	3,353	2 X MYR479	958	1X MYR479	479	1X MYR479	479
Peripheral vascular disease requiring foot amputation	0	0	0	0	0	0	0	0
Nephropathy (HD/CAPD)	1 X MYR42,362	42,362	0	0	0	0	0	0
Cataract	1 X MYR4,812	4,812	1 X MYR4,812	4,812	2 X MYR4,812	9,624	0	0
Heart Failure	0	0	0	0	0	0	0	0
TOTAL (MYR)		55,344	0	10,587	0	10,103	0	479

Note: The cost estimates for managing T2DM complications were calculated based on an article published by Mustapa et al (25).

accurately titrate and optimise insulin doses. This timely intervention contributed to the reduction in HbA1c levels, as reflected in the ABNA results.

Our dedicated multidisciplinary team also recognised the importance of fostering strong patient relationship with all HCPs. This connection encouraged patients to attend frequent follow up appointments, allowing prescribers to perform insulin dose titration and optimisation in a timely manner. Thus, achieving early reductions in HbA1c not only benefited the patients but also reduced healthcare costs associated with managing complications from poorly controlled T2DM.

Despite these positive outcomes, our team faced challenges during the MCO of COVID-19 pandemic. Cycle Three posed a great challenge as patients were unable to attend clinic appointments for proper counselling and guidance. In response, strategies such as virtual phone consultations to review SMBG results and discuss insulin dose adjustments was implemented. The pharmacy department also introduced an “instant drive through” service, enabling patients to refill insulin and medications during the pandemic, ensuring continuity of supply and adherence.

Conclusion and the Next Steps

In conclusion, our team is pleased to have observed a substantial improvement in HbA1c levels among patients newly initiated on insulin through holistic approach implemented in this study. We successfully improved the percentage of T2DM patients achieving at least a 1% reduction in HbA1c from 23.8% to 83.3% after six months of insulin initiation. As a dedicated multidisciplinary team, we are committed to continuously auditing and improving the work processes to ensure the highest quality of diabetic care for our patients. These strategies incurred minimal cost and are self-sustainable for future cycles. We plan to share these remedial actions with other government health clinics, aiming to improve national health outcomes and indirectly reduce healthcare costs by delaying or preventing both micro- and macrovascular complications of T2DM.

We would like to extend this service to all our diabetic patients. Expanding the program could involve setting up a peer support club between patients and HCPs, using platforms such as WhatsApp or WeChat to share experiences related to

insulin use. Additionally, we plan to create a QR code system providing information on topics such as insulin injection techniques, dose adjustment based on SMBG, complications of T2DM, and carbohydrate counting, based on the counselling given in the OSC.

On top of that, we aim to empower the community through social media platforms like Facebook, Instagram, and Twitter. These platforms could feature success stories of patients who have achieved their HbA1c targets post insulin initiation, using social media trends to influence and inspire others to follow good practices.

In collaboration with the National Diabetes Institute (NADI), non-government organisations (NGOs) and the *Kesihatan Pekerjaan dan Alam Sekitar* (KPAS) unit in our clinic, we also plan to provide affordable exercise classes, engaging physical activities, and diabetic-friendly cooking competitions. These initiatives will raise awareness about the importance of adhering to a healthy lifestyle, ultimately leading to improve diabetic control for our patients.

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Conflict of Interest

The authors declare that there was no conflict of interest.

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Appendix 1: Comparison between the frequency of clinic appointment, HbA1c blood test monitoring and involvement of number of HCPs before quality study and after quality study.

Month		1	2	3	4	5	6	7	8	9	10	11	12
Before Quality Study	OPD DM CLINIC	Initiation	1st review				2nd review			3rd review			4th review
	Order HbA1c test									HbA1c blood test			
	Involvement of HCPs	MO P	MO				MO			MO			MO
Cycle One	One Sweet Centre	Initiation	1st review	2nd review		3rd review		4th review					
	Order HbA1c test					HbA1c blood test							
	Involvement of HCPs	MO P	MO P	MO P		MO P		MO P					
Cycle Two and Three	One Sweet Centre	Initiation	1st review	2nd review		3rd review		4th review					
	Order HbA1c test					HbA1c blood test							
	Involvement of HCPs	MO P/DE	MO+P+ DE+ D+ OT	MO+P+ DE+ D+ OT		MO+P+ DE+ D+ OT		MO+P+ DE+ D+ OT					

Appendix 2: Counselling and assessment checklist involved five HCPs in OSC during cycle two.

NO	ASPECT	VISIT 1	VISIT 2	VISIT 3	VISIT 4
1	Introduction to ONE SWEET CENTRE.	MO/P			
2	Pathophysiology of diabetes.	MO/P			
3	Role of insulin in management of type II DM.	MO/P	MO/P	MO/P	MO/P
4	Therapeutic goals. • Glucose profile (HbA1c, FBG, RBG) • Lipid profile • BP • Renal profile • LFT	MO	MO	MO	MO
5	Assess adherence level towards oral medications and insulin	P	P	P	P
6	Assess understanding of medications and insulin – DFIT	P	P	P	P
7	Assess insulin injection issue: • Dose/timing/technique/site of injection/ needle use • Storage of insulin and insulin pen • Frequency to change needles/disposal of needles	P	P	P	P
8	Hypo and hyperglycaemia • Symptoms • Management	P/DE	P/DE	P/DE	P/DE

NO	ASPECT	VISIT 1	VISIT 2	VISIT 3	VISIT 4
9	Discuss side effect of oral medications and insulin.	P	P	P	P
10	Assess any adverse events experienced by patient due to medication/insulin.	P	P	P	P
11	Counsel on DM complications • Micro & macrovascular	MO	MO	MO	MO
12	Assess any complications experience by patient	MO	MO	MO	MO
13	Counsel about SMBG • How, when, where • Give booklet to record result of home SMBG • Dose titration based on SMBG • Emphasize the importance of SMBG	MO/P /DE	MO/P /DE	MO/P /DE	MO/P
14	Assess patient on knowledge regarding SMBG • Able to perform home SMBG • Able to titrate insulin dose based on SMBG	MO/P /DE	MO/P /DE	MO/P /DE	MO/P
15	Counsel about diet and lifestyle modification • Individualise meal planning • Carbohydrate counting • Exercise/smoking/alcohol • Weight management	MO/P /D/OT	MO/P /D/OT	MO/P /D/OT	MO/P
16	Assessment on lifestyle intervention: • Frequency of exercise • BW • Adherence to diabetic plate method • Quit smoking	MO/P /D	MO/P /D	MO/P /D	MO/P

NO	ASPECT	VISIT 1	VISIT 2	VISIT 3	VISIT 4
17	Sick day management	P/DE	P/DE	P/DE	P
18	Foot Care	DE	DE	DE	DE
19	Travelling • Insulin storage • Adequate supply/stock	P	P	P	P
20	At the end of each visit, plan for patient: • Set individualised targets	MO	MO	MO	MO
	• discuss on changes in medication/ insulin (if any) • discuss on insulin dose adjustment (if any)	P	P	P	P
	• Give new TCA for next appointment • Referral for other procedure (fundoscopy/physio) if any	MO	MO	MO	MO

REDUCING THE PERCENTAGE OF ADULT PATIENTS EXPERIENCING MODERATE OR SEVERE PAIN DURING LOCAL ANAESTHESIA ADMINISTRATION OF MAXILLARY DENTAL EXTRACTION PROCEDURE IN *KLINIK PERGIGIAN CHEMOR*

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Abstract

A survey conducted at *Klinik Pergigian (KP)* Chemor showed that 77.5% of adult patients experienced moderate or severe pain during local anaesthesia (LA) administration. Pain during a procedure may significantly impact patient satisfaction and delay patients seeking dental treatment, leading to poor oral health care. This study aimed to reduce the percentage of adult patients experiencing moderate or severe pain during LA administration of maxillary dental extraction in KP Chemor. The contributing factors identified were patients not receiving physical comfort prior to injection (100%), no clear standard operating procedure of LA administration (100%), speed of injection (83%), and fear of needles (92%). Remedial measures were implemented from 1st January 2020 to 30th March 2020, followed by two cycles of re-evaluation; 1st April to 30th June 2020 and 1st January 2022 to 30th March 2022. The remedial measures include introducing ice sticks, providing a clear standard operating procedure of LA administration, training sessions for dental officers performing LA guidelines, turning on the radio while treating the patient, and indiscreet instrument set-up. The post-intervention study showed a successful reduction from 77.5% to 18.3% in cycle 1 and 17.1% in cycle 2. This showed that the measures were effective and sustainable. All contributing factors had improved and the model of good care was up to standard.

KEYWORDS: Local anaesthesia, Painless dentistry, Quality improvement study

Problem

Local anaesthesia (LA) is an essential part of treatment in dentistry, and approximately 300 million cartridges of anaesthesia are used annually for dental treatment in the United States (1). LA is widely used in several dental treatments especially tooth extraction as it provides temporary loss of sensation in a specific part of the oral cavity without affecting the level of consciousness. Unfortunately, many patients perceive the LA procedure as the most painful and in some cases as the only painful part of the treatment (2).

Dental extraction is one of the most commonly performed procedures in primary dental clinics. Dentists administer LA via needle injection to prevent pain during dental extraction. However, some patients mentioned that they experienced intolerable pain during LA administration. This situation warrants serious attention as it can affect patients' satisfaction towards healthcare services.

Managing pain and anxiety in patients has always been an important part of dentistry, as 10% of the general population is affected by needle phobia (3). Although some patients are needle-tolerant, the LA injection itself is painful, which prevents most patients from receiving necessary dental treatment. Furthermore, avoidance of dental treatment due to dental fear may lead to severe deterioration of oral health, including oro-facial infections (4).

Klinik Pergigian (KP) Chemor is one of the primary dental clinics in the Kinta district of Perak, a state in the northwestern part of Peninsular Malaysia. It consists of four units of primary care dental chairs, six dental officers and 14 healthcare staff, serving a population of approximately 30,461 people. All dental officers in KP Chemor have the privilege to perform LA administration as well as dental extraction procedures. Based on the daily outpatient records, 42.0% of adult patients underwent dental extractions under LA in 2019. However, the biannual outpatient customer satisfaction survey found that patients reported experiencing moderate or severe pain during LA administration. A more detailed survey was conducted to verify the customer satisfaction survey findings and obtain feedback regarding LA administration among patients and among dental officers.

The verification study showed 77.5% of patients experienced moderate or severe pain during LA administration of maxillary dental extraction. The project then shifted it focus on dental extraction of maxillary region as local infiltration technique in maxillary region reported highest needle insertion discomfort. This problem could be due to inadequate pre-procedural step, variation of LA administration among dental officers, low pain threshold of patient and unconducive environment of dental clinic. The study aimed to reduce the percentage of adult patients who experienced moderate or severe pain during LA administration of maxillary dental extraction to less than 20%.

Background

Administration of LA is crucial in medical and dental settings, allowing for pain-free procedures and significantly enhancing patient comfort. According to Gaffen et al., the average dentist administers more than 1,500 cartridges of dental local anaesthetic annually, underscoring their extensive use in dental practice. This high frequency of usage highlights the essential role of LA in facilitating routine dental treatments and more complex procedures, ensuring patients experience minimal discomfort during their visits (5).

LA enables dental procedures such as root canal treatments, periodontal surgeries, and tooth extractions to be performed pain-free. However, failure of LA can cause severe pain to patients, hindering the completion of these treatments. Despite its critical role in dental care, the process of administering anaesthesia can trigger significant anxiety or fear, deferring patients from seeking necessary dental treatment. Patients who suffer from high levels of anxiety typically have lower pain thresholds, resulting in a decreased success rate of anaesthesia. Therefore, it is often necessary to employ complementary methods to enhance anaesthesia effectiveness. More importantly, the efforts of dentists to minimise patient pain is crucial in maintaining a calm and relaxed environment, which can significantly improve the overall experience and outcomes of dental treatments (6).

Around 10-20% of people experience dental anxiety, often triggered by fear of local anaesthetic injections (7). This fear can

lead to avoiding essential treatments like dental extractions, risking oral health and consequently causing deterioration of the disease leading to the need for more complex procedures under general anaesthesia. Addressing patient concerns and anxiety is crucial to encourage timely dental care and better oral health outcomes. As noted by Davoudi et al., local anaesthetic injections frequently evoke fear and anxiety across all age groups, often resulting in delayed dental visits or even refusal of treatment altogether. Thus, it is important to implement good strategies to alleviate anxiety surrounding dental procedures, ultimately promoting better oral health outcomes (8).

An effective LA administration depends on several factors which include having a good knowledge of anatomical structures, neuroanatomy, devices, and methods of delivering LA. According to Kulkarni et al, 2019, the most common cause of pain during LA administration was poor injection technique, technical errors and anatomical variability, infection and inflammation, pathological processes, and psychological causes, such as fear and anxiety (9). Previous studies also found some variables that might be involved in painful LA injections including tissue distensibility, speed of injection, patient characteristics and effects of temperature (10). Besides, environmental noise has also been associated with negative developmental outcomes and stress in clinics (11).

Pain experienced during LA administration for dental clinical procedures is almost a universal concern. Multiple studies reported clinicians have used various methods to prevent pain while administering LA such as using topical anaesthetics, using a smaller diameter needle for injection suggestion, slow infiltration, distraction, and vibration technique (12). Besides, the impact of cold application on injection pain in pain management during dental treatment, via application of an ice stick for 1 minute to the buccal mucosa before anaesthesia significantly reduced the pain associated with LA (13).

Measurement

In view of the alarmingly high percentage of moderate or severe pain during LA prior to dental extraction, up to 77.5% during the verification study from 1 November 2019 to 31 December 2019 in our setting, the urgency for intervention was identified. Assessment of pain was done by using a visual analogue scale (VAS) and a numerical rating scale (NRS) based on pain as the 5th vital sign guideline for doctors: Management of pain in adult patients by the Ministry of Health (MOH) (14). The primary outcome of this study was the percentage of patients with a pain score of 4 to 10 during LA administration. In this context, moderate pain referred to a score of 4 to 7, while severe pain referred to a score of 8 to 10. Following LA administration, each patient underwent a pain evaluation, which was documented by the treating dental officer. The patient was asked to point along a scale to indicate how much pain they were experiencing. The pain score is recorded as a number between 0 and 10 on the numerical scale.

Due to limited references regarding the appropriate percentage of patients who experienced pain during LA administration, we engaged an Oral Maxillofacial Surgeon (OMFS) from the Taiping Hospital for expert opinions and consensus. The standard was set at not more than (≤) 20% of patients experiencing moderate or severe pain during LA administration. The formula used to calculate the indicator is as follows:

$$\textit{Percentage of adult patients experiencing pain during local anaesthesia prior to maxillary dental extraction} = \frac{\textit{Number of adult patients subjected to maxillary dental extraction under LA who reported pain scores between 4 to 10}}{\textit{Number of adult patients subjected to maxillary dental extraction under LA}} \times 100$$

A quality improvement study was conducted using a purposive sampling technique. All adult patients above 18 years old who require LA injection for maxillary dental extraction and are willing to be enrolled were included, and consent was taken. Hypertensive patients with a blood pressure readings of more than 140/90 mm/hg were excluded from the study and tooth extraction procedure as there is a high risk of prolonged bleeding post-extraction procedure. The study also excluded patients with underlying Diabetes Mellitus with random blood sugar (RBS) of more than

10mmol/l due to risk of infection and poor socket healing process.

Pre-intervention data was collected from 1 November to 31 December 2019 among selected patients (n=151) and all dental officers (n=6). A self-administered questionnaire, as shown in Appendix 1, which consisted of seven questions, was distributed to all dental officers to determine the magnitude of the identified contributing factors. Apart from that, observation by a senior dental officer of every dental officer was also performed to assess the appropriateness of techniques and procedures during LA procedures (Appendix 2). For patient-related factors, a questionnaire (Appendix 3) on potential pain factors during LA administration was distributed to patients.

Remedial measures were implemented starting from 1 January 2020 until 30 March 2020. Data collection for Cycle 1 re-evaluation was performed from April 1 to June 30, 2020, involving 82 patients. Due to the COVID-19 pandemic, the study was postponed from July until December 2021. Subsequent data collection for Cycle 2 re-evaluation was carried out from January 1 to March 30, 2022, with a sample size of 76 patients. There were significant differences in sample size during the pre-intervention, Cycle 1 and 2 post-intervention studies due to the pandemic COVID-19, as majority of the dental officers were involved in the vaccination programme and the number of outpatients visiting dental clinics was restricted.

Initial Assessment of the Problem

The potential factors contributing to the high percentage of patients experiencing moderate to severe pain during LA in the maxillary region are shown in Figure 1. These include: i) inadequate pre-procedural steps, ii) variation of LA administration technique, iii) unconducive environment of the dental clinic, and iv) low pain threshold of the patient.

A dental examination was performed by dental officers. All patients indicated for maxillary tooth extraction were explained on the procedure and consent was taken to be included in the project. Upon observing the process of care, we identified two main contributing factors which were inadequate pre-procedural steps and variation of LA administration technique. The results showed that all dental officers (n=6) did not apply physical comfort before injection due to the high cost of topical LA; they also did not use any distraction technique, such as a black-out goggle. Additionally, 83% (n=5) did not apply slow injection technique. Upon theoretical assessment on pain relief, 83% (n=5) of them failed.

The self-administered questionnaire responded by 151 patients identified other contributing factors such as the unconducive environment of the dental clinic and the low pain threshold of the patient. These include not having instrumental music (sound therapy) (86%, n = 130), indiscreet instrument set-up (60%, n = 90), surrounding noise (79%, n = 119), and unpleasant smells (46%, n = 69). Ninety-two percent (n = 139) and 40% (n = 60) of patients were affected by fear of needles and traumatic experiences, respectively.

Strategy

After reviewing the current LA procedure, an additional critical step was included in the refined flowchart (Figure 2). The Model of Good Care (MOGC) (Table 1) elaborated on each critical step, emphasising the criteria that can aid in reducing pain during LA. A few strategies of change were implemented, aiming at improving the MOGC in the intervention period from January 1 to March 30, 2020.

The introduction of ice sticks (Appendix 4) before the LA procedure as a pre-local preparation was one of the strategies. This innovation help patients reduce pain during LA and having a better experience while doing dental treatment. The ice sticks requires only distilled water, straw, and heat sealer. It is practical to handle by direct application to the buccal mucosa for 10 seconds prior to injection. Each ice stick costs approximately MYR 0.045, produced in-house by team members and dental staff, making them a more economical option compared to topical LA which is limited in quantity and costs around MYR 46 per bottle. The topical LA, with its jelly-like consistency, costs about RM0.92 per patient, as one bottle can be used for up to 50 patients. The ice stick was also convenient to use as it

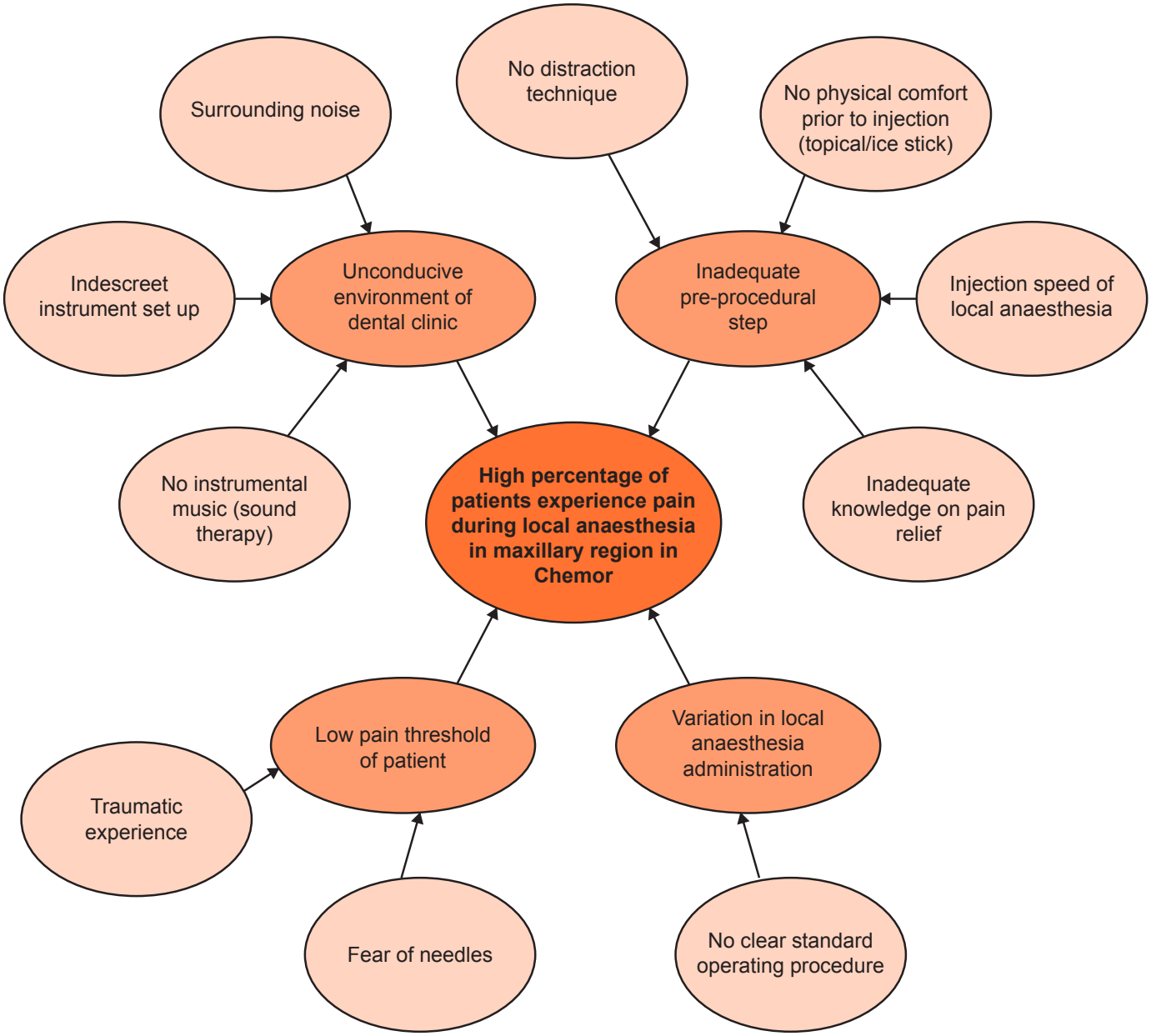
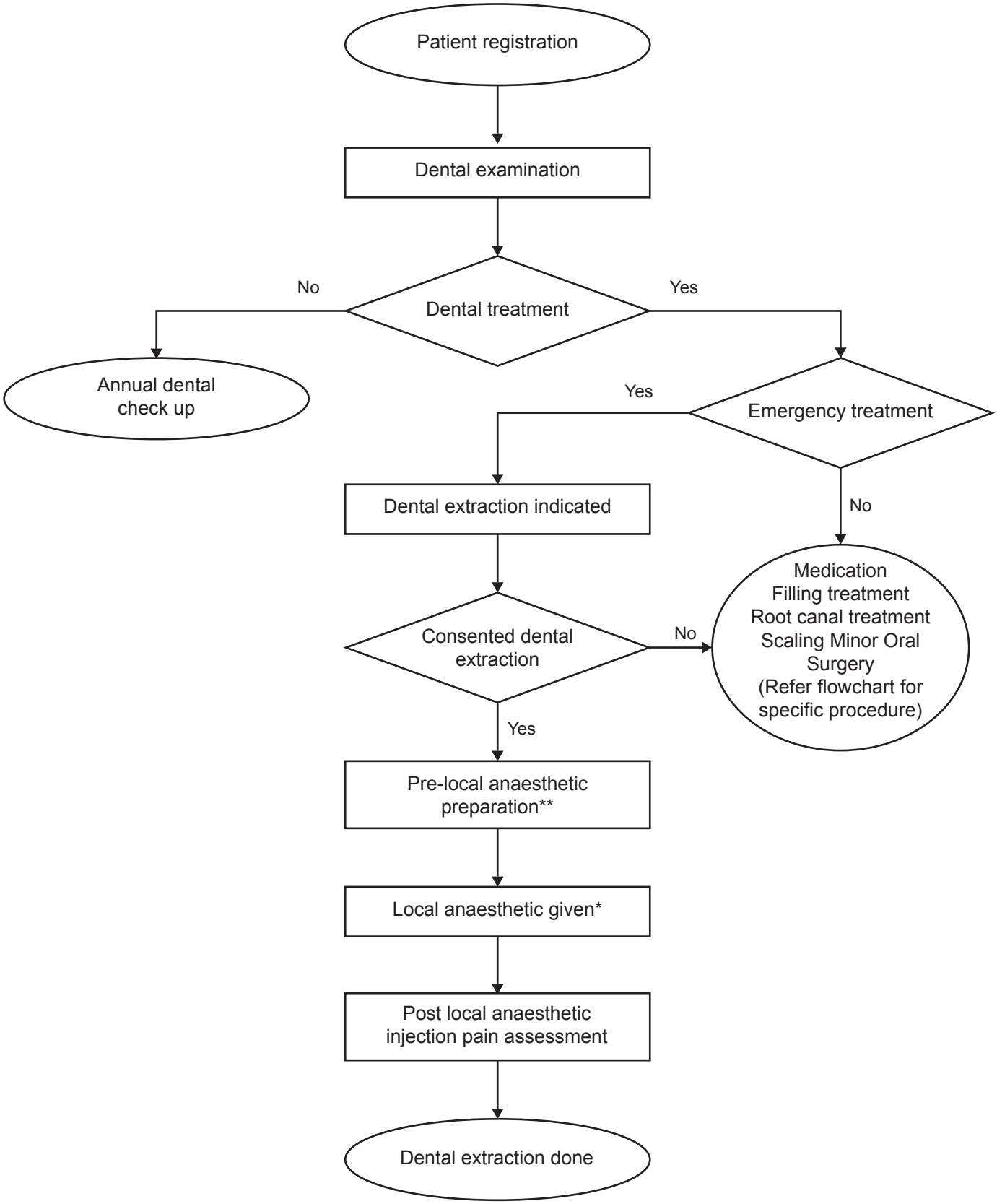


Figure 1: Problem analysis chart on potential factors contributing to high percentage of patients experience pain during local anaesthesia in maxillary region

did not require the drying of buccal mucosa as compared to topical LA. Hence, we saw better compliance and tolerance towards the pre-LA treatment using the ice stick.

A classical music was turned on while the patient was being treated to create a relaxing and comfortable atmosphere (15), and the instruments were discreetly arranged. A new standardise LA administration steps was introduced to address the clinical aspect. Once the patient was seated comfortably on the dental chair and the procedure was explained, mouthwash was given to disinfect the oral cavity. Next, the dental officer started pre-local anaesthetic preparation, the patient needed to wear a black-out goggle as a distraction technique from seeing the needle, and the ice stick was placed on the injection site for 10 seconds. Then, the dental officer applied local anaesthesia by placing the bevel of the needle towards the bone and the injection was given slowly at the rate of 30 seconds per cartridge. After that, the site of injection was gently massaged for 10 seconds. The patient was placed upright while waiting for the anaesthesia to take place. Pain assessment is taken for local



* indicates critical step
** additional critical step

Figure 2: Flowchart of workflow on dental extraction procedure.

anaesthetic injection procedure. Guidance and proper training on LA techniques were given under the supervision of the Oral Maxillofacial Surgeon (OMFS) from Taiping Hospital as well as training on distraction and hide-needle techniques. Continuous dental education (CDE) sessions were carried out for dental officers and dental assistants, which involved theoretical and practical lessons followed by an assessment. All CDEs were delivered by the senior dental officer and Oral Maxillofacial surgeon which focused on LA procedure updates, ice stick preparation and method.

The next strategy was theoretical and practical assessments for the personnel involved. Two assessments were administered; first, a questionnaire evaluated their understanding of LA for dental treatment and their knowledge of pain relief with the passing mark set at 80%. Second, a practical evaluation was conducted, led by an Oral Maxillofacial Surgeon (OMFS), to reinforce the topic covered. Upon successfully passing both the theoretical and practical assessments, with additional LA injection procedures performed under the supervision of senior dental officers and Oral Maxillofacial Surgeon, dental officers successfully performed a high-quality skilled and effective LA administration. Similar interventions were conducted in Cycle 2.

Results

The post-intervention analyses showed improvement in all MOGC criteria (Table 1). All operators complied with pre-local anaesthetic preparation, applied slow injection of infiltration of more than 30 seconds per cartridge, following the new standardised LA steps, and used the distraction technique named the hide-needle technique. All patients wore blackout google before the dental procedure. According to the post-test findings of the theoretical and practical assessment, all dental personnel (n=6) had passed with an achievement of over 80%.

The percentage of adult patients experiencing moderate or severe pain during LA administration of maxillary dental extraction was reduced from 77.5 % (n = 117) to 18.3% (n = 15) in Cycle 1, and further reduced to 17.1% (n = 13) in Cycle 2. Achievable Benefit Not Achieved (ABNA) has reduced from 58.0% (pre-intervention) to -1.8% in cycle 1 and -2.9% in cycle 2 as illustrated in Figure 3, showing that the measures were effective and sustainable.

Table 1: Model of good care for reducing the percentage of adult patients experiencing moderate to severe pain during LA administration.

No	Procedure	Criteria	Standard	Pre-remedial	Post-remedial (1st cycle)	Post-remedial (2nd cycle)
1	Pre-local anesthetic preparation	i. Patient wear black-out google prior to dental procedure ii. Application of ice stick on site of injection before LA procedure for 10 seconds.	100%	0%	100%	100%
2	LA administration technique	A new standard operating procedure are performed by a dental officer using a short needle ensuring: • hide-needle technique. • bevel facing bone slow injection • technique within 30s' per cartridge estimated by dental officer	100%	0%	100%	100%

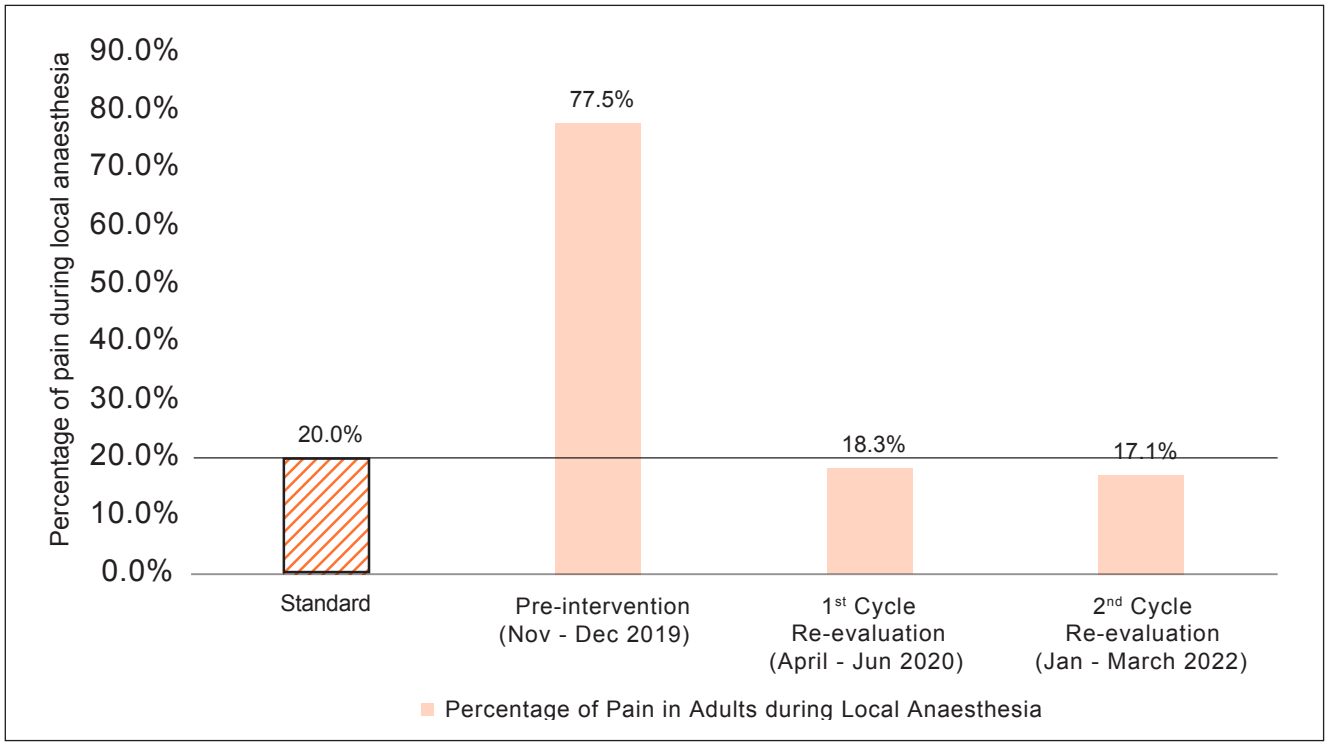


Figure 3: Percentage of adults experiencing moderate or severe pain during maxillary LA before dental extraction.

Lessons and limitations

This study was able to reduce the percentage of patients who experienced moderate or severe pain during LA injection, and sustained in the subsequent re-evaluation phase. Additionally, a comprehensive understanding and good skills regarding LA administration are very useful to the operator in delivering the best services to the patients.

Apart from that, this study proved that non-invasive and non-pharmacological methods significantly reduced pain for patients during LA. Improved communication skills between healthcare providers and patients were able to reduce anxiety symptoms related to unpleasant and painful experiences. Several techniques could be applied during the LA procedure including the use of ice sticks, hide-needles, and slow injection technique to improve the pain experience. A clear and effective standardised step of performing LA helps improve operators' skills and enhance rapport with patients, thus increasing their compliance with the treatment.

Despite all the success, several challenges emerged during the study. One of the most significant hurdles was the way to successfully comfort anxious and traumatic patients before the dental extraction procedure, dental officers were trained to tell the patients "I will count to 3. When I get to 2, take a nice deep breath. When I get to 3 try not to move when you might feel a little sting. If you move, the needle might come out and might have to sting you twice because I need to put it back in." Although the cost of ice sticks is low, the process requires cooperation from dental staff due to manpower limitations. Additionally, the project was unable to fully address the issue of unpleasant odours, as the source of these smells remained unidentified.

Moving forward, we aim to optimise workflow processes and improve task delegation to maximise the efficiency of ice stick productions. Despite these challenges, the interventions implemented in this study were deemed impactful to be adopted by primary clinic in Perak and potentially nationwide.

Conclusion and the Next Steps

The administration of LA in dental practice via needle injection causes fear and anxiety among patients as they perceived it is the most painful part of treatment. Adequate pain management before LA administration is very essential. In KP Chemor, percentage

of patient who experienced moderate or severe pain was very high (77.5%), thus effective interventions need to be carried out to achieve less than 20% adult patients experienced pain during LA.

Change begins with us; hence, we developed several strategies to overcome the contributing factors causing pain during LA administration. Using appropriate interventions, the incidence of moderate or severe pain was able to reach the standard set, with full responsibility at all departmental levels to practice all the intervention strategies.

Our interventions can be adopted by other healthcare facilities to improve the quality of care in the management of LA in dentistry. The training module for the new dental officers joining primary dental clinics could be expanded to involve the staff nurses. More regular training sessions should be organised to ensure continuous good practice and sustenance of knowledge and enforcement.

We aim to promote the use of standardised LA administration to ensure consistent and proper injection technique across practices. This initiative has been approved by the District Dental Office for Kinta District, allowing for districtwide implementation of all the strategies. The authors also aspire to expand this initiative to the national level, contributing to the delivery of more efficient and effective dental healthcare services.

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Conflict of Interest

The authors declare that there was no conflict of interest.

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Appendix 1

BORANG SOAL SELIDIK KAJIAN QA 2019-2020 (PEGAWAI PERGIGIAN)
TAJUK : TO REDUCE PAIN IN ADULT PATIENT DURING LA IN KP CHEMOR
CODE RESPONDEN :
KP :
TAHUN BERKHIDMAT :

1. Do you apply topical anaesthetic before LA injection?
   Yes / no

2. Do you feel you have sufficient knowledge concerning LA technique?
   Yes / no

3. Do you feel confident while giving local anaesthetic injection?
   Yes / no

4. Would you like more information or training on local anaesthetic injection technique?
   Yes / no

5. Do you having trouble while giving instruction or communicating with patient before LA injection?
   Yes / no

6. Do you give local anaesthetic more than 20 seconds at specific site (eg: buccal infiltration)?
   Yes / no

7. Do you use any distraction technique prior to dental injection? (hide needle technique)
   Yes / no

Thank you.

Appendix 2

ASSESSMENT FORM
QUALITY ASSURANCE PROJECT
PEJABAT KESIHATAN PERGIGIAN DAERAH KINTA
KP CHEMOR

Name:
A dental officer must pass all the steps.

	Steps of pain management in adults during local anesthetic injection	
1.	Patient is seated comfortably on the dental chair and the procedure is explained.	
2.	Mouthwash is given for disinfection of the oral cavity.	
3.	The mucosa is kept taut using the mouth mirror.	
4.	Ice stick is placed on the injection site for 10 seconds.	
5.	In distraction technique, the patient is asked to close his/her eyes while the operator prepares for the injection (black-out goggle).	
6.	The placement of bevel of the needle should be facing the bone.	
7.	An injection is given slowly at the rate of 30 seconds per cartridge.	
8.	After injection, recap the needle using a needle holder.	
9.	The site of injection is gently massage for 10 seconds.	

Appendix 3

BORANG SOAL SELIDIK PESAKIT KAJIAN QA 2019

Nama:
Umur:
Jantina:
Bangsa:
Berapa kali datang klinik:

Pernyataan	Ya	Tidak
Alatan dan bahan pergigian di klinik buat saya gementar ketika menerima rawatan pergigian.		
Saya rasa terganggu dengan bunyi bising ketika menerima rawatan		
Mendengar muzik membantu saya tenang ketika menerima rawatan pergigian.		
Saya pernah ada pengalaman buruk dengan rawatan pergigian sebelum ini		
Saya rasa takut dengan jarum suntik ubat kebas		
Saya faham dengan penerangan yang diberikan oleh doktor gigi berkenaan rawatan pergigian.		

Maklumbalas selepas mendapatkan rawatan anestesia setempat dan cabutan gigi :
……
……
…….

Tandatangan/ Cop Ibu Jari Kiri :……..
Nombor K/P :……..
Nama :……..
Tarikh :……..

Appendix 4



Innovative ice stick that is applied to buccal mucosa for 10 seconds prior to LA administration

IMPROVING UTILISATION OF PARENTERAL IRON THERAPY FOR TREATMENT OF IRON DEFICIENCY ANAEMIA IN MEDICAL WARDS OF *HOSPITAL KUALA LUMPUR*

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Abstract

Parenteral iron, despite being the recommended treatment for iron deficiency anaemia (IDA) in hospitalised patients, was underutilised in medical wards of *Hospital Kuala Lumpur* (HKL), where excessive use of blood transfusions for treating IDA was observed. A verification study in 2020, showed only 9.3% of IDA patients in HKL received parenteral iron. The indicator used was the percentage of IDA patients who received parenteral iron. The standard is 40% based on haematologist consensus and as practiced in tertiary hospitals abroad. This quality improvement study was conducted using universal sampling in selected medical wards from September 2020 until July 2022 in two consecutive phases. All IDA patients with traceable records were included, giving a total of 182 subjects throughout the study. A survey was conducted among healthcare providers to identify contributing factors to the underutilisation. Main contributing factors include a lack of confidence in using parenteral iron (52.8%), cost concerns (20.2%), lack of trained staff for monitoring (15.7%), and no protocol to guide its use (15.7%). Parenteral Iron Infusion Protocol (PREFER) was developed. Several continuous medical and nursing education sessions were conducted for training and to introduce PREFER. More strategies included were building a website with the feature of a smart dose calculator, poster displays in the wards, and adding iron derisomaltose to the hospital formulary. Implementation led to an increase in parenteral iron utilisation from 9.3% to 33.3%, conserving 100 pints of blood and saving MYR 8000.00 monthly. We plan to expand the study to other disciplines and promote PREFER at the state and national levels.

KEYWORDS: Iron deficiency anaemia, Parenteral iron, Quality improvement study

Problem

Iron deficiency anaemia (IDA) is a significant public health concern. Recent findings from the Global Burden of Disease project indicated that an estimated 1.24 billion individuals, comprising a substantial sixth of the global population, are affected by IDA (1). Beyond its well-known impact on specific cohorts such as paediatric and pregnant populations, IDA is increasingly acknowledged as a clinical concern in various medical specialities, particularly among individuals with chronic diseases and the elderly (2).

Hospital Kuala Lumpur (HKL) is the biggest government hospital under the Ministry of Health of Malaysia. It serves as the flagship hospital of the Malaysian public healthcare system and acts both as a tertiary and referral hospital, particularly for cases from government health clinics within the Wilayah Persekutuan Kuala Lumpur (WPKL) area where Kuala Lumpur, the capital of Malaysia is located. HKL has 83 wards and 2,300 beds, with 22 medical wards consisting of 495 beds. The medical wards at HKL are staffed by approximately 300 doctors including medical officers, specialists, and consultants, alongside 680 staff nurses, and 50 clinical pharmacists.

In WPKL, the anaemia prevalence was reported as high as 27.6% in 2015 (3). Although institutional data on the types of anaemia is not available, local data suggests IDA is predominant among patients in Malaysia (4). As HKL is the main government hospital within WPKL, most of the anaemia cases are likely to be referred to or treated here. At HKL, blood transfusions have been observed being used excessively for the treatment of IDA over the years. During several clinical ward rounds, a recently transferred haematologist in HKL raised this concern, which was then discussed with the pharmacists. Parenteral iron, which should be the primary choice for treating IDA among hospitalised patients, was not fully utilised by doctors practising in medical wards. Many IDA patients who were hemodynamically stable were still transfused instead of being administered parenteral iron.

A verification study conducted in five medical wards of HKL in September 2020 showed that only 9.3% of IDA patients were treated with parenteral iron. This figure contrasts sharply with findings from hospitals in New York and Mexico, where utilisation rates reach as high as 40% (5,6). The underutilisation of parenteral iron, paired with the use of blood transfusions to treat IDA, led to unnecessary consumption of the blood bank stock, which was already critical during the COVID-19 pandemic (7) and putting the patients at risk of getting transfusion-related adverse effects (8).

Therefore, this study aimed to improve the utilisation of parenteral iron for the treatment of IDA from 9.3% to 40% within two years.

Background

Anaemia is characterized by reduced levels of haemoglobin concentration, haematocrit, or red blood cell counts. Causes may include iron, folate or vitamin B12 deficiencies, chronic diseases, haemolysis, or bone marrow suppression (8). IDA is diagnosed when haemoglobin concentration falls below 12 g/dL in non-pregnant females or below 13 g/dL in males, mean corpuscular volume (MCV) is below 75 fL, and serum ferritin concentration is below 30 µg/L, or transferrin saturation (TSAT) is below 20% (9–11).

Patients with IDA should be treated with iron supplementation either orally or parenterally, while blood transfusions are reserved for severe cases. Oral iron is the preferred initial treatment (12), but many patients struggle with it due to intolerance and absorption issues (13,14). Parenteral iron, administered directly into the bloodstream, is more effective (15) and has shown comparable efficacy to blood transfusions in situations requiring rapid haemoglobin elevation (16,17). Furthermore, using parenteral iron also leads to cost savings as it preserves the blood bank stock. On average, 500 mg of parenteral iron, which costs MYR 82 (~USD 17) for iron dextran and MYR 44 (~USD 9) for iron sucrose, contains an equivalent amount of iron in two pints of blood, which costs MYR 240 (~USD 51) (18), making it a more cost-effective treatment option.

In Malaysia, three parenteral iron formulations are available: iron dextran, iron sucrose, and iron derisomaltose (19). Iron dextran and iron sucrose are available at HKL, while iron derisomaltose was

introduced during the study. In HKL, iron dextran can be prescribed by any physician, while iron sucrose requires authorisation by nephrologists or haematologists (20). Both iron dextran and iron derisomaltose allow total dose infusion, with the latter offering shorter infusion times and smaller fluid volume (21,22). Conversely, iron sucrose necessitates divided doses over several days (23). Due to convenience and accessibility, iron dextran is predominantly used at HKL.

Parenteral iron administration requires careful monitoring due to the rare but serious risk of allergic reactions, including life-threatening anaphylaxis (24). Healthcare personnel administering parenteral iron should be capable of monitoring and managing these adverse reactions (25). The recommended monitoring parameters include vital signs and signs of hypersensitivity reactions during the test dose, for one hour after the test dose, and during and after the infusion (21–23). Nurses, responsible for medication administration and patient monitoring in medical wards are best suited to oversee parenteral iron infusion, ensuring its safe administration (26).

Parenteral iron remains underutilised and less favoured by medical practitioners, as noted in various studies (27,28). Auerbach and Macdougall (28) attributed this trend to concerns about adverse effects and misinterpretation of minor infusion reactions. Mayson et al. (29) found that lack of knowledge, cost concerns, and fear of adverse reactions were key factors in parenteral iron's underuse. They also identified potential facilitators, such as trained staff, streamlined referral systems, and newer preparations with shorter infusion times.

Many promising methods appear to be under investigation, according to research on ways to enhance the usage of parenteral iron. A quality improvement study conducted at Sunnybrook Health Sciences Centre in Canada demonstrated that the implementation of the "Pumping Iron Bundle" comprised of an IDA screening tool, treatment algorithm, order set, and patient information handout significantly improved the utilization of parenteral iron from 17% to 90.3% among heart failure patients with IDA (30). Similarly, a study protocol published in BMC Pregnancy and Childbirth outlines a continuous quality improvement strategy to strengthen screening practices and facilitate the routine use of intravenous iron for treating anaemia in pregnant and postpartum women in Nigeria. The multifaceted intervention involves training healthcare providers, strengthening supply chains, and conducting evaluations to increase the uptake of IV iron and improve maternal-neonatal outcomes (31).

These studies highlight the potential of quality improvement methods to optimize the utilization of parenteral iron in various patient populations. By implementing targeted strategies tailored to the local context, healthcare institutions can work to ensure that patients with IDA receive appropriate and timely treatment, ultimately leading to improved clinical outcomes.

Measurement

A quality improvement study was initiated by a team comprising a haematologist who strongly advocated for improving Patient Blood Management (PBM) and five clinical pharmacists dedicated to optimising treatment options for patients with IDA. The study was conducted using universal sampling in five selected medical wards in HKL between September 2020 and December 2021 and expanded to two additional wards in Cycle 2 between January and July 2022. These wards were selected as they were non-COVID wards, and the ward consultants were not haematologists, removing any bias in prescribing preference. All patients diagnosed with IDA were included, except those without traceable medical records.

The indicator used was the percentage of IDA patients treated with parenteral iron. The standard was set at 40% based on haematologists consensus and as found practiced in tertiary hospitals in the United States and Mexico (5,6).

Indicator:

$$\textit{Percentage of IDA patients treated with parenteral iron} = \frac{\textit{Number of IDA patients treated with parenteral iron}}{\textit{Number of IDA patients}} \times 100$$

A verification study was carried out in September 2020 to measure the percentage of IDA patients treated with parenteral iron. All iron studies blood tests taken in the selected wards during the specified period were traced by five pharmacists in the team through the HKL online laboratory investigation system to identify IDA patients. Their medical records were retrieved with permission from the record department and reviewed by the same team members. A unique identifier was assigned to each reviewed record for data tracking and verification. A data collection form was used to document: (i) patients' socio-demographics, (ii) results of iron studies blood tests (including ferritin level and TSAT), (iii) any treatment given (parenteral or oral iron, blood transfusion, or no treatment), (iv) the dilution and administration rate of parenteral iron, and (v) the adherence to documentation of necessary monitoring parameters. Additionally, pharmacy records were cross-referenced for parenteral iron usage. All the collected data was entered and compiled into a Google Sheet.

Remedial measures for Cycle 1 were implemented from October 2020 to November 2021, with data collected in December 2021. Further remedial measures were implemented from January to June 2022, followed by data collection in July 2022. Using consistent sampling and data collection methods, the study included 43, 58, and 81 IDA cases in the verification study, Cycle 1, and Cycle 2, respectively.

Results from the verification study showed that out of 43 IDA patients, only four (9.3%) received parenteral iron. Additionally, it was also found that the monitoring of patients' parameters every 15 to 30 minutes during infusion was not recorded for all cases of parenteral iron therapy. This implied that monitoring for infusion-related reactions and other adverse events might not have been done.

Initial Assessment of the Problem

The contributing factors to this problem were analysed using a problem analysis chart as illustrated in Figure 1.

An online survey via Google Form (refer to Appendix 1) was conducted using purposive sampling among 102 healthcare providers (HCPs), which comprised of doctors and pharmacists working in all the medical wards in the hospital. Their confidence and awareness in using parenteral iron, as well as the perceived contributing factors to its underutilisation were assessed.

The main perceived contributing factors included lack of confidence in use (43.1%, n=44), concern about its cost (16.7%, n=17), no available facility or trained staff to do close monitoring (12.7%, n=13), and no local guideline or protocol to guide its use (12.7%, n=13) (Figure 2).

In the same survey, 15 questions to assess level of knowledge of IDA and parenteral iron were included. The questions and answers were reviewed by a haematologist for their relevance. A respondent is considered to have good knowledge when achieving a score of 60% or higher, as agreed by the haematologist and senior clinical pharmacists. Results from the survey showed that 79.7% of doctors and 96.8% of pharmacists were aware of parenteral iron as the treatment option for IDA. However, only 24.6% of doctors and 35% of pharmacists had good knowledge on the use of IDA and parenteral iron (Table 1).

The process of care for the treatment of IDA with parenteral iron therapy was reviewed, and the critical steps for improvement were identified, as shown in Figure 3. Four critical steps were identified; (i) Doctors prescribe parenteral iron, (ii) Pharmacists intervene (iii) Nurses administer parenteral iron therapy, and (iv) Nurses monitor the patient's parameters. During the pre-remedial study, 100% of parenteral iron was administered correctly by nurses, however, none of the cases had complete documentation, test dose monitoring and full dose monitoring. Due to the limitation of the study, the first two critical steps were not objectively measured.

Strategy

Firstly, a parenteral iron infusion protocol was developed to address the two main contributing factors, including a lack of confidence and knowledge among HCPs and the lack of standardised protocol. Before the protocol, there was inconsistency in parenteral iron prescription across specialties. The protocol, serving as both a reference and an educational tool, outlines



Figure 1: Problem analysis chart for underutilisation of parenteral iron therapy for the treatment of IDA in medical wards, HKL

indications, contraindications, precautions, dosage, and specially designed charts for dilution, administration, and monitoring. Reviewed by the only haematologist in HKL, the head of the national haematology service, and the chief clinical pharmacist for its content, the protocol led to more precise prescriptions and reduced the need for pharmacist clarification with prescribers.

The protocol was distributed in both printed and electronic forms to ensure accessibility among HCPs. However, during an observation conducted by two pharmacists in the team on a working day in January 2021, it was found that while physical copies were present in the wards, many staff were unaware of them. In contrast, HCPs provided positive feedback on the e-protocol to the team members. Yet, a survey conducted later revealed that only 50% of HCPs read the protocol, indicating a weakness in the strategy, though the reasons were not explored. Overall, while the electronic format proved to be more accessible, there was insufficient awareness and uptake among staff.

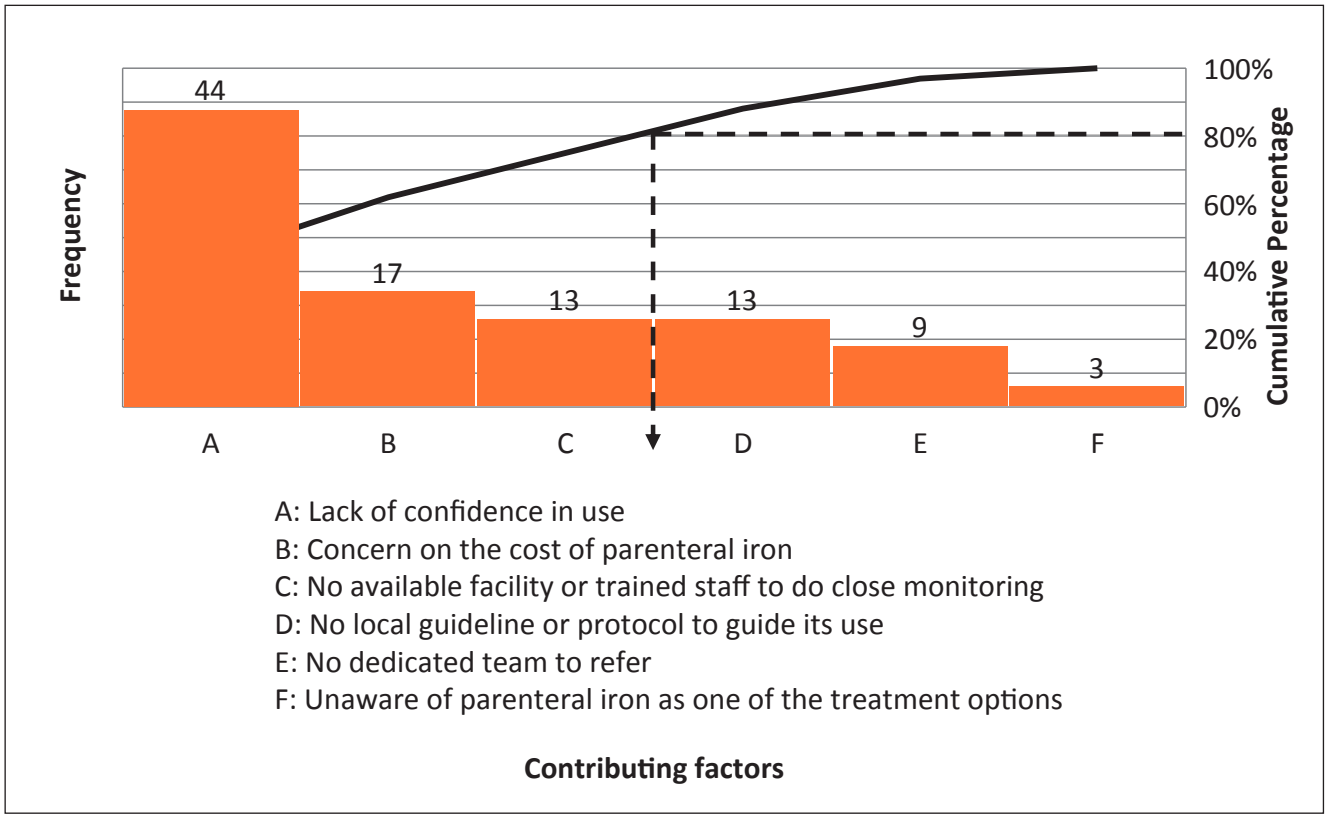


Figure 2: Pareto chart - Contributing factors to underutilisation of parenteral iron therapy based on a survey among doctors and pharmacists (n = 102)

Table 1: Results from the online survey among 102 HCPs and improvement from verification phase to Cycle 1 and Cycle 2

		Verification	Cycle 1	Cycle 2
Awareness	Doctors	79.7%	98.1%	100%
	Pharmacists	96.8%	100%	100%
Knowledge	Doctors	24.6%	67.9%	81.3%
	Pharmacists	35%	85%	81.8%

Thirdly, to enhance HCPs' confidence and knowledge as well as to correct misconceptions about the cost of parenteral iron, two virtual CME sessions were conducted by the haematologist and pharmacists via Zoom. Invitations to the CME sessions were shared through group chats with consultants, specialists, medical officers, and pharmacists. The response was positive, with consultants expressing strong support and assuring that their ward medical officers would attend the sessions. The CME had achieved 102 participants, constituting 29% of the targeted HCPs working in the related medical wards. Pre-tests and post-tests were performed to assess knowledge improvement, and participants achieving the highest score were recognized with tokens of appreciation at the end of the session to enhance participation. Comparison between pre-test and post-test results demonstrated improvement in HCPs' knowledge and confidence. Despite challenges posed by the COVID-19 pandemic, 29% of attendance at

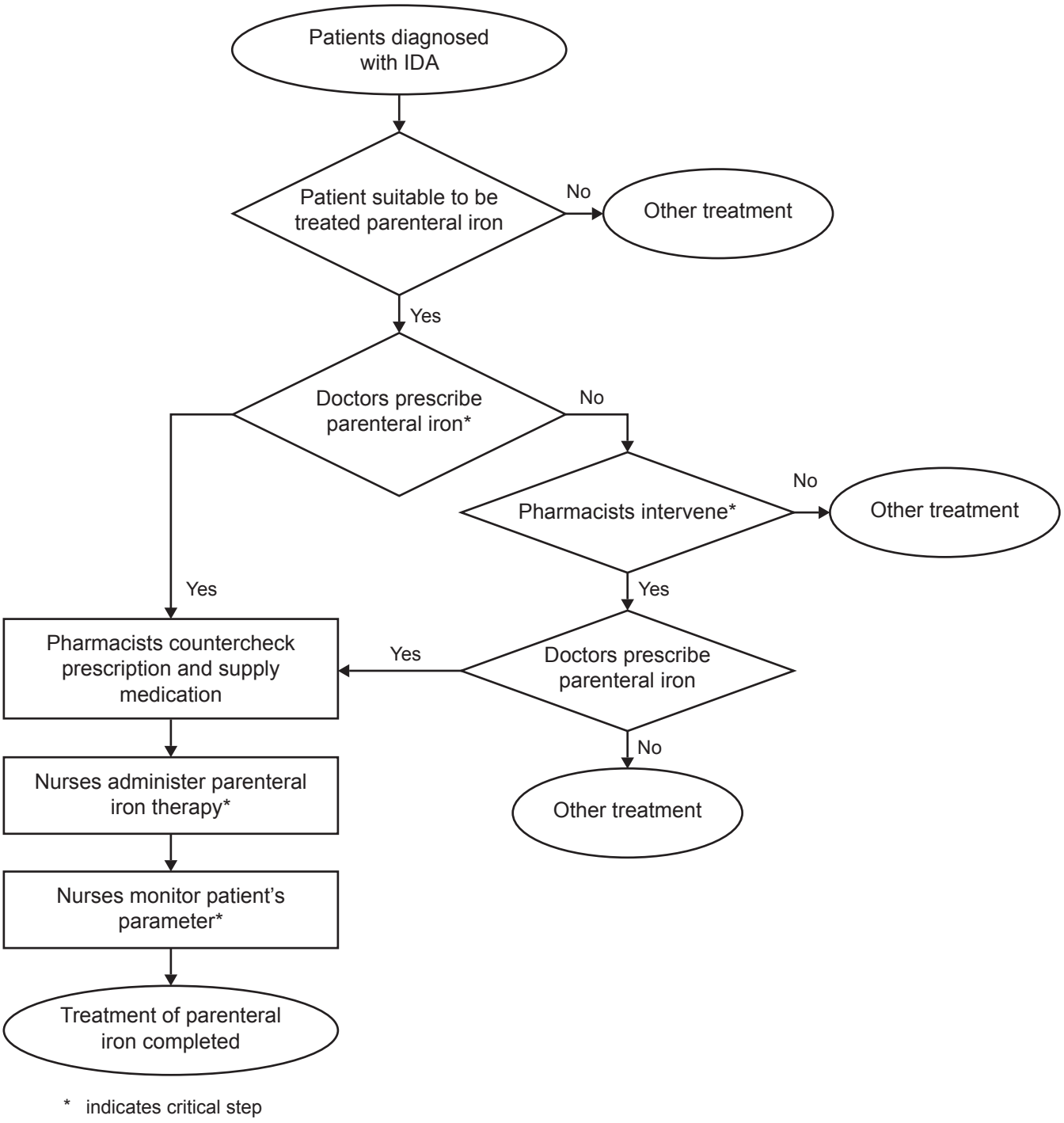


Figure 3: Process of care for the treatment of IDA with parenteral iron therapy in medical wards, HKL

the CME surpassed our expectations, which may be attributed to the virtual format and influential consultants involved. Additionally, the recognition of top scorers effectively encouraged participation and sustained engagement throughout the event.

The fourth remedial action targeted the lack of training and awareness for nurses to do close monitoring. Two sessions of continuous nurse education sessions (CNE) were conducted to educate nurses on the basic knowledge of IDA and parenteral iron, monitoring parameters, and to introduce the monitoring charts from the protocol. The charts are to be printed and used by the nurses for monitoring the vital signs of patients and to check for any signs of adverse reactions during the infusion. The CNE achieved 63 attendees, comprising about 10% of all medical ward nurses, with two to three nurses from each of the selected wards attending the CNE. Despite the limited attendance, the strategy improved compliance with monitoring requirements,

as evident in post-cycle 1. This highlights the value of training ward representatives and the practicality of the monitoring chart.

Cycle 2 implemented further strategies to bridge gaps identified in Cycle 1 results. After Cycle 1, only 67.9% of doctors had good knowledge. Additionally, the CME in Cycle 1 covered only 29% of the targeted HCPs. Hence, a hybrid CME session was conducted as the movement control order was lifted, reaching 145 additional attendees. In comparison to the previous CME, the hybrid mode achieved a higher attendance with a single session accommodating 145 attendees. The quiz questions in Cycle 2 included another three questions to assess the knowledge of the updated content of the protocol.

The sixth strategy was the rebranding and redesign of the protocol to gain more awareness and uptake among staff. Consultations to explore ways for protocol improvement took place with the quality assurance and improvement experts. The protocol was rebranded with the name PREFER and redesigned with a more attractive colour theme and layout. The content of PREFER was also revised based on users' feedback, particularly the recommendation to incorporate a summary table comparing different parenteral iron formulations. Additionally, the recent addition of iron derisomaltose to the hospital formulary necessitates the inclusion of its dosage, method of administration, and monitoring parameters in the protocol. The electronic version of PREFER was broadcasted to HCPs through messaging applications as this method had shown better uptake during Cycle 1. It was observed that PREFER had attracted greater attention than the preceding protocol, sparking discussions among HCPs since its introduction.

Taking a step further, the team members developed a website to publish PREFER online (Appendix 2) as the seventh strategy. The website was built using Google Sites which is free, does not require advanced technical skills, and is complemented with Google Analytics for visitor statistics. As the eighth strategy, a smart dose calculator (Appendix 3) was invented by using Google Sheets to ease calculation for different formulations of parenteral iron, embedded on the website. The ninth strategy involved promoting the website to HCPs through messaging applications and placing posters with QR codes (Appendix 4) linked to the website in the wards. The website attracts over 1300 visitors per annum, with the calculator section receiving 100 monthly visits. It was observed by team members that HCPs have been utilising the calculator in their daily practice, based on the alteration history recorded on the Google Sheet.

The tenth strategy aimed to improve nurses' compliance with the monitoring requirements by providing physical folders with monitoring chart copies in the wards. This was because Cycle 1 revealed an unsatisfactory level of compliance with the monitoring requirements: 66.7% for documentation, 66.7% for test dose monitoring, and 33.3% for full dose monitoring. The responsibilities of replenishing the monitoring chart copies were assigned to ward pharmacists and nurses. Positive feedback was received from ward pharmacists and nurses as the charts are readily available when needed, facilitating parenteral iron administration.

Following Cycle 1, team members received verbal feedback from HCPs about the challenge of treating IDA patients with heart failure or severe kidney impairment with fluid restriction. As 500mL of fluid needs to be given for the total dose infusion of iron dextran, this takes up the majority of the amount of fluid allowed daily for these patients. Hence, iron derisomaltose was added to the hospital formulary and introduced to HCPs during CME. Nevertheless, due to its high cost (approximately MYR 1218 (~USD 258) for 1 course of treatment), iron derisomaltose is listed as a controlled item and can only be prescribed by haematologists for selected patients. During cycle 2, no patient received it, resulting in minimal impact on parenteral iron usage.

Results

Upon implementation of the above strategies, the percentage of IDA patients treated with parenteral iron increased from 9.3% (n=4) to 20.6% (n=12) in Cycle 1. In Cycle 2, the result further increased to 33.3% (n=27). Achievable benefit not achieved (ABNA) improved from 30.7% to 19.4% and 6.7% in Cycle 1 and Cycle 2 respectively (Figure 4).

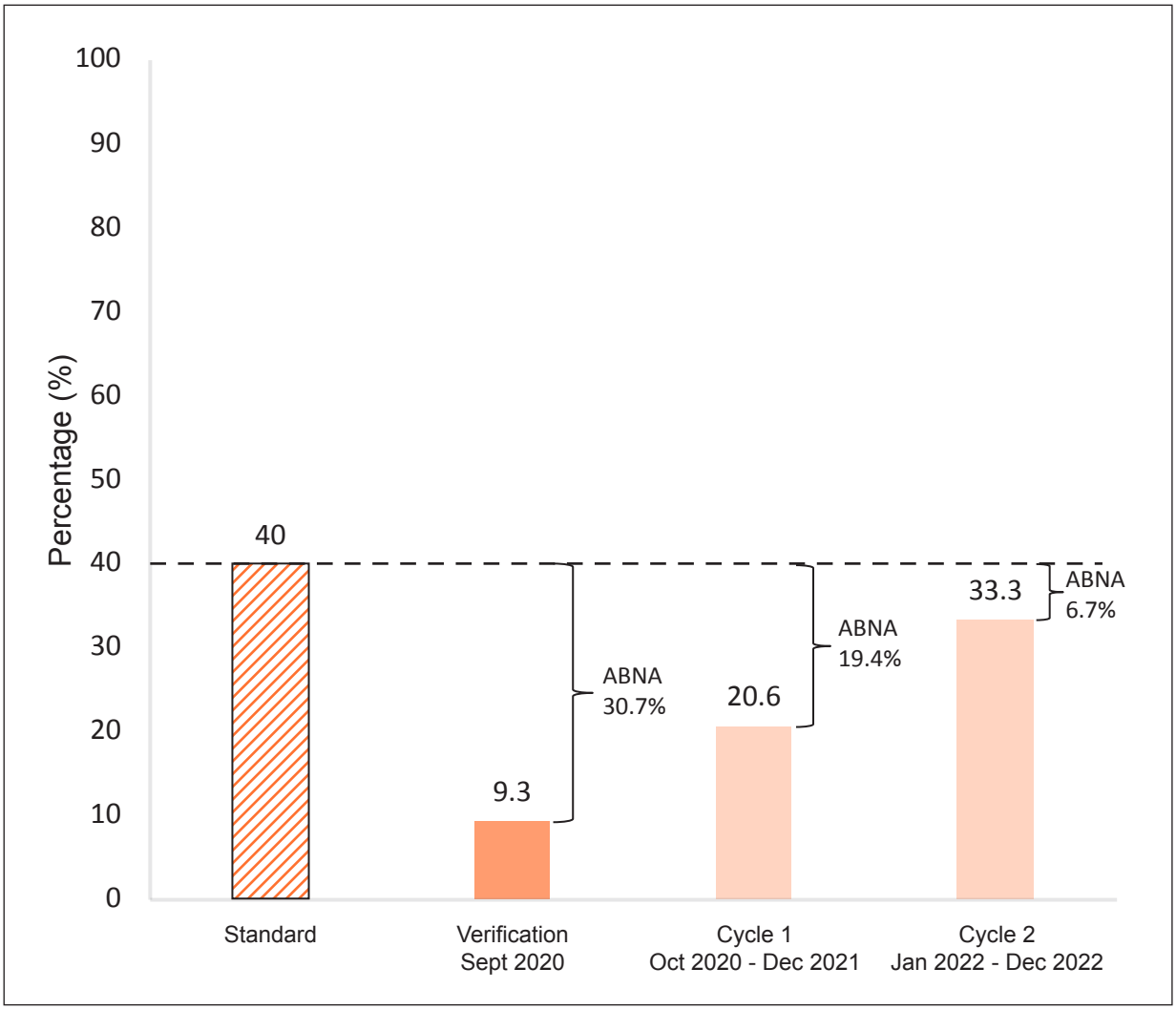


Figure 4: Percentage of IDA patients treated with parenteral iron from Sept 2020 - July 2022

A total of 10,000 mg (100 ampoules) of iron dextran, costing approximately MYR 1600 (~USD 338), was given over a month in Cycle 1, and 25,175 mg (252 ampoules) of iron dextran costing approximately MYR 4,000 (~USD 845) was given over a month during Cycle 2. As mentioned earlier, 500 mg of parenteral iron contains an equivalent amount of iron in two pints of blood as in transfusion therapy. Hence, we had successfully conserved 40 pints of blood costing MYR 4800 (~USD 1000) in Cycle 1, and 100 pints of blood costing MYR 12,000 (~USD 2537) in Cycle 2 and saved approximately MYR 3200 (~USD 700) per month in Cycle 1 and MYR 8000 (~USD 1700) per month in Cycle 2 after the implementation of our quality improvement project.

From this study, we managed to improve the knowledge among HCPs (247 doctors and pharmacists, 70% of medical ward staff) in using parenteral iron from 24.6% to 67.9% in Cycle 1 and 81.3% in Cycle 2 (doctors) and from 35% to 85% in Cycle 1 (pharmacists). The marked improvement in knowledge is proven to be sustainable albeit there is a slight drop in the pharmacist group from Cycle 1 (85%) to Cycle 2 (81.8%) due to a slight variation in the quiz questions for Cycle 2. The self-perceived level of confidence in using parenteral iron among the HCPs involved in the survey increased from 43.1% to 100% in Cycle 1 and 2. The awareness also improved from 79.7% (doctors) and 96.8% (pharmacists) to 100% for both parties (Table 1). We also successfully established a routine for nurses to do close monitoring during the administration of parenteral iron. The compliance with monitoring requirements improved from 0% to 100% on documentation, 0% to 88% on test dose monitoring, and 0% to 76% on

full dose monitoring. Increased compliance with monitoring requirements also implies improvement in patient safety as adverse drug reactions can be detected and managed early (32).

Lessons and limitations

The objective of promoting the usage of parenteral iron is in line with the aims of the first pillar of PBM, which is to optimise erythropoiesis (8), and to improve patient outcomes while conserving the blood bank reserves. This study is the first initiative done in HKL to assess the usage of parenteral iron among IDA patients in medical wards. The study's strength lies in its execution in wards where consultants lacked expertise in haematology. This approach eliminates potential biases related to specialist knowledge and prescribing preferences.

This study underscores the importance of thorough problem analysis in identifying contributing factors and practice gaps. Multidisciplinary collaboration between doctors, pharmacists, and nurses is crucial for safe and effective parenteral iron treatment. The strategies used are applicable in Malaysian specialist hospitals to optimize IDA treatment, potentially reducing blood transfusion needs and enhancing PBM practices nationwide.

Despite the success, this study has several limitations and challenges. Firstly, the first two criteria of MOGC (doctors prescribe parenteral iron and pharmacist intervene) were not developed, hence full assessment of MOGC was not conducted. Therefore, future cycles should identify criteria for the two critical steps and collect data to assess whether patients with IDA are prescribed the correct dosage of parenteral iron and to assess the interventions made by pharmacists in cases of inappropriate treatment or incorrect prescriptions. Additionally, data on the impact on patients' anaemia status and haemoglobin levels were not collected, which could provide further insights into the effectiveness of parenteral iron therapy. An overlooked factor affecting the prescription of parenteral iron is the presence of concomitant infections, as therapeutic iron doses may pose an increased risk due to bacteria utilising iron as a growth factor. Recommendations from experts suggest delaying parenteral iron administration during active infections (12). This is consistent with the findings from observations by the team members and feedback received from ward pharmacists, where most prescribers generally avoided parenteral iron when patients had acute infections, leading to its underutilisation. Therefore, the presence of active infections should be considered in the exclusion criteria of the study.

In Cycle 2, the introduction of iron derisomaltose enables the total dose infusion to be given in smaller amounts of fluid and is suitable for patients with fluid restriction. However, accessibility to the new drug was limited by its cost and prescribing restriction, hence, the effect of its addition could not be elucidated in this study.

Another limitation of this study is the potential need for refinement in the problem analysis chart and the data collection process. While the lack of a standardised protocol was identified as a primary contributing factor through the online survey and as illustrated in the Pareto Chart (Figure 2), it could also be viewed as a secondary factor related to lack of confidence in use. To remain aligned with the collected data, the results were presented based on the original categorisation. However, future studies may need to revisit this issue, improving the data collection form to allow for clearer distinctions between primary and secondary factors. This step could enhance the accuracy and reliability of the problem analysis process.

Conclusion and the Next Steps

In conclusion, the strategies employed have brought us closer to the study goals. The verification study revealed an underutilisation of parenteral iron, in which only 9.3% of IDA patients were treated with parenteral iron, compared to the standard of 40%. The main contributing factors were identified, which included the lack of confidence in using parenteral iron, concerns about its cost, lack of facilities and trained staff for monitoring, and absence of a standardised protocol. Strategies formulated include the development of PREFER protocol, website, and dose calculator, the use of standardised dilution worksheets and monitoring charts, the display of posters in wards, and the implementation of continuous staff training. After two cycles of

remedial measures, the percentage of IDA patients treated with parenteral iron therapy increased from 9.3% to 33.3%.

To address the challenge of administering parenteral iron to patients with acute infections, a daycare service for parenteral iron infusion was implemented at the Medical Admission Unit (MAU) after discussions between our team haematologist and the specialist in charge of MAU. Upon discharge from the ward, patients eligible for parenteral iron may receive a referral letter to be admitted to MAU later for administration.

To date, this study has already been expanded to all other medical wards. According to data from the pharmacy inventory system, the annual usage of iron dextran in HKL increased by 34% from 9,515 ampoules in 2022 to 12,780 ampoules in 2023. By applying this increment to the study indicator, the utilisation of parenteral iron is estimated to reach 44.6%, surpassing the standard of 40%. This suggests the positive impact of expanding the study to all medical wards and also the sustainability of our project outcomes. We also plan to expand the study to other disciplines to magnify its impact. In the future, we plan to promote the usage of the PREFER protocol and website at the national level so that beneficial outcomes in terms of patients' clinical improvement and saving on blood and the costs of treatment can be achieved nationwide.

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Conflict of Interest

The authors declare that there was no conflict of interest.

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Appendix 1: Questionnaires to assess awareness, perceived contributing factors, and knowledge among HCPs

Questionnaires: Management of IDA and Parenteral Iron Therapy

This set of quizzes consists of 15 multiple-choice questions to be answered by physicians and pharmacists. Please answer all the questions in 10 minutes and thanks for your participation.
* Indicates a required question

A. Email*

_____

B. Mobile number (to follow up on post-test)*

_____

C. Designation*
Mark only one oval.
- o Consultant
- o Specialist
- o Medical officer
- o House officer
- o Pharmacist

D. Current place of practice*
**Mark only one oval.*
- o Medical ward
- o Non-medical ward
- o Other:_____

E. Years of working in the current place of practice*
Mark only one oval.
- o < 1 year
- o 2-5 years
- o 6-10 years
- o 10 years

F. Are you aware of the availability of parenteral iron therapy as one of the treatment options for iron deficiency anaemia?*
Mark only one oval.
- o Yes
- o No

G. Which of the following parenteral iron formulations are currently available in HKL?
I. Iron Sucrose
II. Iron Polymaltose
III. Iron Dextran
IV. Sodium Ferric Gluconate

Choose the correct answer
**Mark only one oval.*
- o I and II
- o I and III
- o II and III
- o I and IV
- o Not sure

H. How often do you prescribe/recommend parenteral iron therapy for the treatment of iron deficiency anaemia in your daily practice?
Mark only one oval.
- o Always (100% of IDA cases)
- o Often (>70% of IDA cases)
- o Sometimes (30-70% of IDA cases)
- o Rarely (<30% of IDA cases)
- o Never prescribe/ recommend before

I. What is the main reason you choose not to prescribe/ recommend parenteral iron therapy for patients with IDA?
Mark only one oval.
- o Unaware of parenteral iron as one of the treatment options
- o Not confident to use (unsure dosage, doubt on efficacy or concern on side effects)
- o No dedicated team to refer
- o Concern about the cost of parenteral iron
- o No available facility or trained staff to do close monitoring
- o No local guideline or protocol to guide its use

Quiz Questions

1. Below are the indications of parenteral iron except:
*1 point
Mark only one oval.
- o Iron deficiency anaemia with intolerance of oral iron, especially in inflammatory bowel disease, or where oral iron is ineffective
- o As an alternative to blood transfusion when a rapid increase in haemoglobin is required for example perioperative anaemia
- o Non-ransfusion dependant thalassemia
- o To support the use of erythropoiesis-stimulating agents

2. Below are the contraindications to the use of parenteral iron except:
*1 point
Mark only one oval.
- o Anaemia with iron overload
- o Drug hypersensitivity including mono- or di-, saccharide complexes, and dextran
- o Macrocytic anaemia
- o Second and third trimester of pregnancy

3. Below are the differences between Iron Dextran (CosmoFer ®) and Iron Sucrose (Venofer ®) except:
*1 point
Mark only one oval.
- o Iron Sucrose (Venofer ®) is a vesicant agent while Iron Dextran (CosmoFer ®)is a non-vesicant agent
- o There has been less incidence of anaphylactic reactions with Iron Sucrose (Venofer ®) versus Iron Dextran (CosmoFer ®) in recent years
- o Iron Dextran (CosmoFer ®) can be given as a total dose infusion while Iron Sucrose (Venofer ®) cannot be given as a total dose infusion
- o The efficacy of both Iron Dextran (CosmoFer ®) and Iron Sucrose (Venofer ®)are similar

4. Which of the following are not the contraindications of parenteral iron preparation?
   I. Patient with a history of hypersensitivity to iron preparation
   II. Patient with underlying stage 3 CKD
   III. Patient with transfusion-dependent thalassemia
   IV. Patients with underlying hepatitis B

   Choose 2 options from the question above.
   *1 point
   Mark only one oval.
   - o I and IV
   - o II and IV
   - o III and IV
   - o I and II

5. Parenteral iron should be given cautiously in the following patients except:
   *1 point
   Mark only one oval.
   - o Patient with a history of drug allergies
   - o Patients with severe atopy or systemic inflammatory diseases
   - o A patient in her second trimester of pregnancy
   - o Patient with a history of blood transfusion in the past 1 year

6. What are the possible allergic reactions to parenteral iron preparation?
   I. Angioedema
   II. Kounis syndrome
   III. Bronchospasm
   IV. Dyspnea

   Choose the correct answer.
   *1 point
   Mark only one oval.
   - o All of the above
   - o II and III
   - o I and IV
   - o I, II, and III

Dosage calculation for parenteral iron based on the Ganzoni formula: (Body weight (kg) x 10 X (target Hb - actual Hb) (g/dL) x 0.24) + mg iron for iron stores

Body weight:
- Actual Weight if BMI < 30kg/m^2
- Ideal Body Weight if BMI > 30kg/m^2
- Pre-pregnant weight for pregnant women

Iron Stores:
- <35 kg body weight = 15 mg/kg body weight
- >35 kg body weight = 500 mg

7. A patient was admitted to the hospital with the chief complaint of dizziness for 2 days. Her Full Blood Count shows Hb of 8 g/dL, MCV 105(Ref range 80 - 96 femtoliters), MCHC of 35 (Ref range: 33-36 g/dL). She was diagnosed with symptomatic anaemia and her anaemic workout is still pending. What is the dose of IV Cosmofer that should be given to this patient to reach the target Hb of 12 g/dL? Patient's details: Body weight: 50kg, 158cm, BMI 20.0 kg/m^2

*1 point

Mark only one oval.

- o 975mg
- o 850mg
- o 775mg
- o Wait for an anaemic workout before giving IV iron

8. A female patient in her third trimester of pregnancy was admitted to the hospital and was diagnosed with severe iron deficiency anaemia. She has an Hb of 6.1g/dL and has yet to receive a blood transfusion. What is the ideal dose of IV Venofer that can be given to her to increase her Hb level to 11g/dL? Patient's details: Body weight: 60kg, height 160cm, BMI 23.4kg/m^2

*1 point

Mark only one oval.

- o 1230mg given as a total dose infusion over 4 hours
- o 2 doses of 600mg as total dose infusion given in 2 different days
- o 200mg 3 times a week for 6 doses
- o Do not give IV Venofer

9. A patient was admitted and diagnosed with Iron deficiency anaemia. Her Full Blood Count shows Hb of 6.6 g/dL, and an iron study shows Iron of 3.4 and Transferrin saturation of 12%. What is the ideal dose of IV Cosmofer that should be given to this patient to reach the desired target Hb level of 12 g/dL? Patient's details: Body weight: 70kg, 160cm, BMI 27 kg/m^2

*1 point

Mark only one oval.

- o A total dose infusion of 1500mg over 4 hours
- o 200mg EOD x 5 doses
- o Split doses of 700mg + 700mg as total dose infusion over 2 days
- o Do not give IV Cosmofer

10. Which of the following statements regarding parenteral iron is incorrect?

*1 point

Mark only one oval.

- o A test dose of parenteral iron is required continuation of iron therapy
- o Flushing with 3ml heparinised saline is not required parenteral iron infusion
- o Stop infusion of parenteral iron if the patient develops allergic / intolerance reactions
- o Parenteral iron to be diluted in Sodium Chloride 0.9% before infusion

11. Below is the recommended dilution & infusion time for IV Cosmofer except:
*1 point
Mark only one oval.
- o IV Cosmofer 25mg in 100ml Sodium Chloride 0.9%, run over 30 min
- o IV Cosmofer 25mg in 20ml Sodium Chloride 0.9%, run over 20 min
- o IV Cosmofer 600mg in 500ml Sodium Chloride 0.9%, run over 1 hour
- o IV Cosmofer 200mg in 100ml Sodium Chloride 0.9%, run over 1 hour

12. Which of the following parenteral iron preparations is/are vesicant?
*1 point
Mark only one oval.
- o Iron Dextran (CosmoFer ®)
- o Iron Sucrose (Venofer ®)
- o Both of them
- o None of them

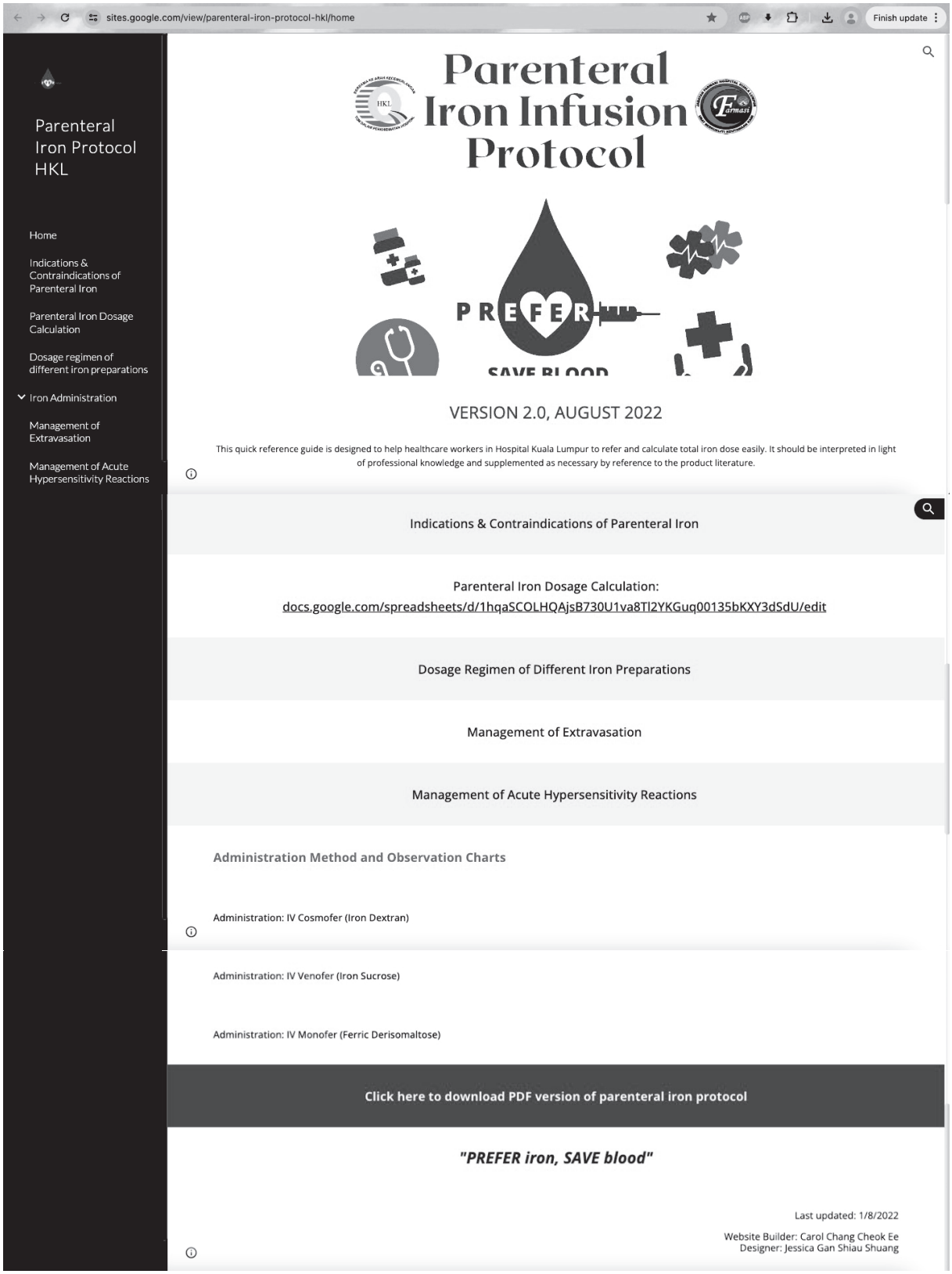
13. Which of the following regarding the management of extravasation of vesicant preparations is incorrect?
*1 point
Mark only one oval.
- o Stop and disconnect infusion immediately.
- o Remove the needle/ cannula immediately.
- o Aspirate as much extravasated solution as possible.
- o Apply dry cold compression.

14. Which of the following regarding the management of acute hypersensitivity reactions to parenteral iron infusions is incorrect?
*1 point
Mark only one oval.
- o If mild reactions such as itching, flushing, and slight chest tightness occur, an iron infusion can be withheld and then restarted at a reduced rate if the patient is well.
- o Patients who developed hypersensitivity reactions to Iron Dextran (CosmoFer ®) can be rechallenged with Iron Sucrose (Venofer ®) and vice versa.
- o If the patient does not develop any sign of hypersensitivity reactions after the test dose, the remaining dose can be safely given without the need for close monitoring.
- o For test dose monitoring, patients should be monitored every 15 minutes until 1 hour after the completion of infusion.

15. Which of the following are the monitoring parameters required for parenteral iron infusions?
I. BP
II. Body temperature
III. Signs and symptoms of allergy reaction such as itchiness, SOB, chest pain
IV. Infusion site reactions

Choose the correct answer.
* 1 point
Mark only one oval.
- o I, II, III
- o I, II, IV
- o I, III, IV
- o All of the above

Appendix 2: PREFER Website Interface via https://sites.google.com/view/parenteral-iron-protocol-hkl/home



Appendix 3: Smart dose calculator

Based on Ganzoni's formula: (Body weight (kg) x (target Hb - actual Hb) (g/dl) x 2.4) + mg iron for iron stores

	Kindly fill in:		Note:
	Body weight (kg)	50	Use Ideal Body weight if BMI > 30kg/m2; Use pre-pregnancy weight for pregnant women
	Current Hb or Initial Hb (g/dl)	9.3	
	Target Hb (g/dl)	12	12 for female, 13 for male
	Iron stores (mg)	**500**	< 35 kg body weight = 15 mg/kg body weight > 35 kg body weight = 500 mg
	Exact Iron dose Calculated (mg)	824	
	TOTAL IRON DOSE NEEDED (MG) (Rounded up/down to the nearest 100mg)	800	
	**Maximum Iron dose / day for this patient:	1000	(Maximum: 20mg/kg/day)

Iron preparations & dosage regimen (Choose 1)

a.	**IV Cosmofer**	**25**	mg test dose in 100ml NS over 30minutes infusion,then observe for 1 hour (200ml/H)				
	(Total Dose Infusion)	**775**	mg* in 1 pint Normal Saline infused over 4 hours (125ml/H)				
	*note: Maximum iron per DAY for this patient is	1000	mg/day (20mg/kg/DAY)				
	If total iron dose is > 20mg/kg, kindly split the dose and serve the remaining dose the next day.						
b.	**IV Cosmofer Split doses (Patient with ROF):**	**25**	mg test dose in 20cc NS over 20 minutes infusion (60ml/H) , then observe for 1 hour (for first dose only)				
		200mg	1 - 3 times per week for	**4**	doses	(First dose is 175mg after minus test dose 25mg)	
		Dilution: Withdraw 200mg & dilute in 100ml NS infused over 1 hour (100ml/H)					
c.	**IV Venofer**	**20**	mg test dose in 20cc NS over 15 minutes infusion (80ml/H), then observe for 1 hour (prior first dose only)				
	(JKUT Hematologi & Nephrologi)	**200mg**	1 - 3 times per week for	**4**	doses	(First dose is 180mg after minus test dose 20mg)	
		Dilution: withdraw 200mg & dilute in 100ml NS infused over 1 hour (100ml/H)					
	Maximum Venofer dose per week:	< 45kg: 7mg/kg/week > 45kg: 600mg/week					
d.	**IV Monofer**	**800**	mg (#) in 100 ml NS over 1 hour (100ml/H)				
	(JKUT Hematologi & Cardiology)						
	# note: Maximum iron PER WEEK for this patient is	1400	mg/Week (20mg/kg/WEEK)				
	If total iron dose is > 20mg/kg, kindly split dose and serve the remaining dose **after 1 week interval.**						

Note:

1. For details of various iron preparations and monitoring parameters, please refer to HKL PREFER protocol available at:
   https://sites.google.com/view/parenteral-iron-protocol-hkl/home
2. This iron calculation guide is designed to help healthcare workers in Hospital Kuala Lumpur to calculate total iron dose easily.
   It should be interpreted in light of professional knowledge and supplemented as necessary by reference to the product literature.
3. For any feedback or queries, kindly contact pharmacists in Parenteral Iron Team HKL (03-2615 5555 Ext: 5684)

"PREFER iron, save bloods"

Last updated: 20/7/2022

Appendix 4: Poster with QR code linked to PREFER website

Guidance on Prescribing Parenteral Iron Therapy

Indications

Iron deficiency anaemia

- Hb < 13g/dL (male), 12g/dL (female) with MCV < 75fL
- TSAT < 20% or < 30% (CKD)
- Serum ferritin < 30ng/mL (may be elevated in certain clinical conditions)

Support the use of **erythropoiesis-stimulating agents** (including patients on renal dialysis)

As an **alternative to blood transfusion** when a rapid increase in Hb is required

Formulations available

C — **Low molecular weight iron dextran (Cosmofer®)**
- Can be given as total dose infusion

V — **Iron sucrose (Venofer®)**
- To be given in divided doses

M — **Ferric derisomaltose (Monofer®)**
- Can be given as total dose infusion with smaller volume

Monitoring

- Vital signs
- Skin rashes
- Chest pain
- Angioedema
- O_2 Shortness of breath
- Infusion site reaction

Dosage

Calculate based on **Ganzoni formula**

(Body weight (kg) x (target Hb - actual Hb) (g/dL) x 2.4) + mg iron for iron stores

- Body weight: Actual Weight if BMI < 30kg/m2
- Ideal Body Weight if BMI > 30kg/m2
- Pre-pregnant weight for pregnant women

Iron Stores:
- <35 kg body weight = 15 mg/kg body weight
- >35 kg body weight = 500 mg

Target Hb level: 12g/dL (Female)

Body Weight (kg)	Actual hemoglobin (g/dL) 8	7	8	9	10	
35kg	1000	925	825	750	675	mg
40 kg	1075	975	875	800	700	mg
45 kg	1150	1050	925	825	725	mg
50 kg	1225	1100	975	875	750	mg
55 kg	1300	1150	1025	900	750	mg
60 kg	1375	1225	1075	925	775	mg
65 kg	1450	1275	1125	975	800	mg
70 kg	1500	1350	1175	1000	825	mg

Target Hb level: 13g/dL (Male)

Body Weight (kg)	Actual hemoglobin (g/dL) 6	7	8	9	10	
35kg	1100	1000	925	850	750	mg
40 kg	1175	1075	975	900	775	mg
45 kg	1250	1150	1050	950	825	mg
50 kg	1350	1225	1100	975	850	mg
55 kg	1425	1300	1150	1025	900	mg
60 kg	1500	1350	1225	1075	925	mg
65 kg	1600	1450	1275	1125	975	mg
70 kg	1675	1500	1350	1175	1000	mg

Kindly scan the **QR code** and refer to HKL **Parenteral Iron Infusion Protocol** for more information.

By HKL Parenteral Iron QA project team
(Pharmacy Department in collaboration with Hematology Unit of Medical Department)

Quality Improvement Report (QIR) for Q Bulletin Guideline for Authors

This guideline is the modified version of the BMJ Open Quality template for quality improvement project report. The original template can be accessed here: https://bmjopenquality.bmj.com/pages/authors/#editorial_policy

Your manuscript should include:

1. Abstract (up to 300 words)
2. Main text (up to 4000 words; excluding abstracts, tables and figures)
3. Maximum of 5 tables or figures.
4. Please use Font Arial, Size 12, double spacing.

Subheading	Description
Title	Indicate that the article concerns an initiative to improve healthcare.
Abstract	This is a summary of your work and is the most important section to attract a reader's attention. Please ensure you include: a) A brief background to the problem, b) The method for your quality improvement project, c) The overall results and d) The conclusion Keep it succinct and factual. Please include 3 – 5 appropriate keywords for your manuscript.
Problem	Summarise your problem and the focus of your project. Give some details about your local context including; a) The type of organisation you work in, b) The size of your organisation, c) Details about the staff members who work there and d) Perhaps a little bit about your local patient population. Include here the SMART aim of your project (for example; the aim was to reduce medication errors from 15% to 5% across six elderly care wards in three months).
Background	This section gives the reader background information about the problem and provides up-to-date, research and knowledge from the literature. Summarize the literature you have found on the background to your problem here. a) What existing evidence is there that this problem exists? b) What existing evidence is there on the factors contributing to the problem? c) What evidence is there that other people have tried to solve this problem in the past? d) Is there any evidence for what works and what doesn't to solve your problem?

Measurement	Describe which measures you selected for studying processes and the outcomes of the intervention(s), including: a) Rationale for choosing them, b) Their operational definitions, c) Inclusion and exclusion criteria, d) The standard and how you determine it Describe how you planned to collect this data throughout your project and how frequently. Include here the results of your baseline measurement (verification study).
Initial assessment of the problem	Describe what processes are involved in your problem including the critical that will contribute to the achievement of your final goal. Describe on the perceived factors that could contribute to the problem and how you quantify them. Include here the results of the study that you conducted to identify the contributing factors to the problem.
Strategy	In this section you should explain your strategy for improvement to the reader and discuss how you implemented your improvement cycles. In most cases you will have tried a number of progressive improvement cycles, some of which will not have been successful. It is important that you also share these to help others avoid similar difficulties. Remember that data should be collected continuously throughout your project. This is a difficult section to document and will contain a lot of information. For each PDSA cycle you should describe your aim, your change hypothesis and strategy for change. a) Describe how you implemented the change and the data you collected. b) Describe your key learning from each cycle of change, and discuss how this learning impacted on your change process. c) How well did your predictions of what change was needed match your outcomes? d) What worked more effectively than anticipated and what had less effect than predicted?
Results	Provide a summary of what your results using appropriate chart or diagram. a) Describe the variation in your data. b) Were the interventions you made responsible for any improvements? c) Describe how contextual elements interacted with the intervention(s) and affected your results. d) Compare your results to your baseline measurement. Comment on how you assessed whether the data was complete and accurate- was there any missing data? Please comment on whether there were any unintended consequences such as unexpected benefits, problems, failures or costs associated with the intervention(s).

Lessons and Limitations	In this section, discuss the lessons you learnt from the project and its limitations. Comment on the strengths of the project. Describe any problems you faced and how you navigated these. If you were to undertake this project again, what would you do differently? Reflect on your project's limitations. For example, did you realise as the project was implemented that your results would be affected by unforeseen factors such as a small sample size or the turnaround of patients or staff? Comment on the limits of generalize ability. Describe whether chance, bias, or confounding have affected your results and whether there was any imprecision in the design or analysis of the project. Are more data points required? Were efforts made to minimize/adjust for any limitations? Although we accept publications using different improvement approaches, we would expect you to have modified your intervention as it was implemented and undergone a process of continuous improvement, measurement and learning. If your project does not fit with this approach then we would like to see reflections and learning here about how you could have incorporated continuous improvement and measurement approaches in your project.
Conclusion and the next steps	You should reflect on your background research, noting what is already known on this topic and what your project adds. You should refer back to your aims statement – did your project achieve its aims? Did you adjust your aims as you went along? Was it a useful project? Were your measures appropriate and did you use balancing measures? Think about what your senior sponsor would like to see as an output of your work and what can help others to make the case for undertaking a similar piece of work – or for doing something differently if your project was not successful. Please describe your cost analysis here, were there any financial savings that your project made? Being able to demonstrate that your intervention delivered savings really helps to add value. Give an assessment of whether you think your project is sustainable – do you have enough data? What have you done to try to ensure that your work continues? Comment on how you would spread your project and whether it could be replicated elsewhere. Discuss what your next steps will be and whether further study in the field is required. The point of the conclusion is not to rewrite the whole project, but to give an overview of how the whole project was conducted, what it achieved, and some personal reflections.
References	In this section you should record any references to published material that you refer to elsewhere in your project. This is particularly likely to include material from background reading or from your conclusions.

	Use the Vancouver style for referencing.
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