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Ministry of Health Malaysia
Secretariat Address:
Institute for Health Systems Research
Block B2, National Institutes of Health Complex,
No. 1, Jalan Setia Murni U13/52,
Seksyen 13, Setia Alam,
40170 Shah Alam, Selangor
Tel: 03-3362 7500
Email: ihsrqa@moh.gov.my

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Mrs Adibah Murayadi
Pharmacist
Tuanku Ja'afar Hospital,
Seremban, Negeri Sembilan

Mr Lau Boon Tiang
Pharmacist
Port Dickson Hospital,
Negeri Sembilan

Dr Farizan Abdul Ghaffar
Pharmacist
Head of Branch Ambulatory Pharmacy
Hospital Kuala Lumpur

Dr Nur Wahida Zulkifli
Pharmacist, Lecturer
Department of Pharmacy Practice and Clinical Pharmacy,
Faculty of Pharmacy, Universiti Teknologi MARA,
Selangor Branch, Puncak Alam Campus, Selangor

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Mrs Devi Shantini Rata Mohan
Pharmacist
Institute for Health Systems Research (IHSR)

Dr Farhana Aminuddin
Research Officer
Institute for Health Systems Research (IHSR)

Mr Sivaraj Raman
Pharmacist
Institute for Health Systems Research (IHSR)

Dr Marhaini Mostapha
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Ms Nurul Salwana Abu Bakar
Research Officer
Institute for Health Systems Research (IHSR)

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EDITORIAL

Quality Improvement in Context: Shaping Better Care with Evidence

Dear readers,

Quality Improvement (QI) has always been more than a methodology—it is a commitment to strengthening healthcare in ways that are **contextual, meaningful, and achievable within resource-limited settings**. Of late, discussions on QI highlighted its effectiveness when data capturing issues for measurement are improved, alignment between the quality improvement studies and clinical operations happens, and interventions designed for the quality problem acknowledge the unique realities of healthcare settings, including resources, culture, and patient needs[1, 2]. After 7 years of its publication, it was evident that studies featured in this and the previous QBulletin edition reflect this principle. Each project demonstrates how contextualised QI translates evidence (the data on shortfall in quality) into practice (the interventions and improvement shown). From improving patient management to medication safety and treatment adherence, the projects showed us that meaningful change does not come from importing solutions wholesale, but from **adapting strategies to the realities of our clinics, hospitals, and communities**.

Current trends in healthcare quality emphasise **equity, patient partnership, workforce empowerment, and sustainability**. Yet, how do we speed up the process to achieve this? The **rise of Artificial Intelligence (AI)** opens new frontiers for QI. AI-powered predictive analytics, decision support systems, and automated data monitoring can accelerate improvement cycles, identify risks earlier, and personalise care[3]. Rather than replacing human judgment, AI offers an opportunity to **enhance decision-making, free up staff time, and provide real-time feedback**—enabling healthcare teams to focus on what matters most: PATIENTS. Thus, we truly encourage exploration of AI and its potential assistance.

As you read this volume, I encourage you to reflect on how each study represents more than a project—it is a story of learning, adaptation, and collaboration. Together, they remind us that **quality is not static, but a culture of continuous improvement**. In moving forward, with evidence, intervention, and AI as partners, we envisioned a better QI study that will achieve the 7 quality domains of health Malaysia – STEEEPA[4].

Enjoy your reading!

Dr Samsiah Awang
Editor-in-chief

References:

[1] Bradley SM and Das SR. The Next Era of Quality Improvement: Owning the Challenge. Circulation: Cardiovascular Quality and Outcomes. 2024; 17: e010010

[2] Rudi Nasib, Nelson Lean Boon Leong, Muhammad Mudassir Abdul Rahim, et al. The Utilization of Quality Improvements in Public Health Systems Across Asian Countries: A Systematic Review Malaysian Journal of Medicine and Health Sciences. 2023; 19: 186 - 95.

[3] Davenport T and Kalakota R. The potential for artificial intelligence in healthcare. Future healthcare journal. 2019; 6: 94-8.

[4] Malaysia. MoH. National Policy for Quality in Healthcare: Bridging Silos, Accelerating Improvements. Selangor: Institute for Health Systems Research, 2021.

IMPROVING APPROPRIATE OUTPATIENT REHABILITATION MANAGEMENT OF MODERATELY SEVERE COVID-19 SURVIVORS IN HOSPITAL SUNGAI BULOH

Akmal Hafizah Zamli[1], Nor Arisah Misnan[2], Raiha Hasni Mohd Hanaffi[1], Pamela Chia Shook Yen[1], Mohd Izuan Effendi Abd Wahab[1], Amitha Na Shern Lhung[1], Fatnin Faqiha Azmi Mahmud[1], Tan Bee Cher[1], Dayang Nur Atheerah Kamaruddin[1], Norfaezah Kamaluddin[1], Raagini Letchumanan[1], Syarifah Nur'aini Said Abdul Karim[1], Muhammad Shafaat So'af[1], Muhd Zulkifli Adnan[3], Nur Diana Absar[4], Zarina Zakaria[5]

[1] *Clinical Rehabilitation Unit, Rehabilitation Medicine Department, Hospital Sungai Buloh, Ministry of Health Malaysia*

[2] *Infectious Disease Department, Hospital Sungai Buloh, Ministry of Health Malaysia*

[3] *Physiotherapy Unit, Rehabilitation Medicine Department , Hospital Sungai Buloh, Ministry of Health Malaysia*

[4] *Occupational Therapy Unit, Rehabilitation Medicine Department, Hospital Sungai Buloh, Ministry of Health Malaysia*

[5] *Rehabilitation Nursing Unit, Rehabilitation Medicine Department, Hospital Sungai Buloh, Ministry of Health Malaysia*

Corresponding Author: Akmal Hafizah Zamli
Email: dr.akmal@moh.gov.my

Abstract

Rehabilitation management is essential for improving moderately severe COVID-19 survivors by reducing the risk of complications, enhancing quality of life, and optimising functional outcomes. A verification study conducted from July to December 2020 (n=165) involving moderately severe COVID-19 survivors referred for rehabilitation intervention showed that only 16.3% received appropriate outpatient rehabilitation programs. This study aimed to improve the percentage of appropriate outpatient rehabilitation management for patients with moderately severe COVID-19 to ≥80%, in alignment with established standards. This quality improvement study employed universal sampling methods and assessed the appropriateness of outpatient rehabilitation management for moderately severe COVID-19 survivors. The primary contributing factor to sub-optimal rehabilitation practices was a lack of awareness and knowledge among rehabilitation personnel. Additional contributing factors included the unavailability of guidelines and recommendations for outpatient rehabilitation management; lack of awareness and knowledge among COVID-19 survivors; sub-optimal education; and accessibility to resources towards rehabilitation self-management. To address these issues, a phased implementation of remedial measures was undertaken including, in-service and out-service training sessions; the establishment of a clinical framework for outpatient rehabilitation management; the provision of a dedicated, coordinated and structured multidisciplinary COVID-19 Rehabilitation Outpatient Specialised Services (CROSS); integration of the framework into the electronic Hospital Information System (e-HIS), and the development of collaborative educational resources on rehabilitation self-management. As a result, the percentage of patients who received appropriate outpatient rehabilitation management increased from 16.3% to 44.2% in Cycle 1, then improved to 87.8% in Cycle 2, and subsequently reached 89.4% in Cycle 3. Moving forward, we aim to explore the potential application of this clinical framework and multidisciplinary service for improving other rehabilitation services, such as an early rehabilitation program for post-intensive care syndrome.

KEYWORDS: COVID-19, Rehabilitation, Outpatient, Multidisciplinary, Quality improvement study

Problem

COVID-19 was officially declared a global pandemic in March 2020 due to its highly contagious nature with catastrophic health outcomes (1,2). The world has since recorded over 704 million infections, with more than 7 million deaths (3). Meanwhile, in Malaysia, over 5 million infections and more than 37,000 fatalities have been reported (4). Although the majority of patients recover from acute COVID-19 infection, it is now evident that survivors are at risk of experiencing long-term persistent symptoms (1,5-7), universally known as Long COVID and later clinically defined by the World Health Organization (WHO) as post-COVID-19 condition (PCC) in October 2021 (7).

PCC is a condition that occurs in individuals with a history of probable or confirmed SARS-CoV-2 infection, typically three months after the diagnosis of COVID-19, with symptoms lasting for at least two months that cannot be explained by an alternative diagnosis. Common symptoms include fatigue, shortness of breath, and cognitive dysfunction, which generally impact daily functioning. Symptoms may either emerge following initial recovery from an acute COVID-19 episode or persist from the initial illness. Additionally, symptoms may fluctuate or relapse over time (7). PCC can result in disabling symptoms that affect quality of life, return to work or school, financial stability, and the ability to care for oneself and families (1,5,6,8). Currently, there are no validated effective treatments for PCC (1,5,6,8). Rehabilitation management plays a crucial role in reducing the risk of complications, improving quality of life, and optimising functional outcomes (2,6,8,9).

The Rehabilitation Medicine Department is one of the healthcare service providers under the Medical Directorate of Hospital Sungai Buloh (HSgB). It offers a wide range of rehabilitation medicine services, including but not limited to spinal cord injuries, traumatic brain injuries, stroke, paediatric disabilities, amputees, prosthetics, and orthotics. The rehabilitation services span across all age groups, from paediatric to geriatric. Since the pandemic, the rehabilitation medicine department has also provided rehabilitation services for post-COVID-19 survivors. These services were provided through inpatient and outpatient rehabilitation programs, involving interventions by a multidisciplinary team consisting of three rehabilitation specialists, ten medical officers, fifteen physiotherapists, eleven occupational therapists, ten rehabilitation nurses, and other supporting professionals.

HSgB, a 1,037-bedded tertiary hospital, serves the districts of Gombak, Petaling, and Kuala Selangor, catering to a combined population of more than 2.18 million (10). Throughout the COVID-19 pandemic, HSgB, being the national referral centre for infectious diseases, was subsequently converted into the main referral and admission centre for moderately severe COVID-19 infections in Malaysia (11). From the time it was designated as the primary COVID-19 hospital on 10th March 2020, until its status changed to a hybrid hospital on 22nd April 2022 (11-13), HSgB recorded more than 92,874 acute COVID-19 admissions (11,13). Of these, 6,758 patients were referred for outpatient rehabilitation management (14).

A verification study conducted from July to December 2020 (n=165) involving moderately severe COVID-19 survivors referred for rehabilitation intervention showed that only 16.3% received an appropriate outpatient rehabilitation program upon discharge. This sub-optimal rehabilitation support affected their recovery process, leading to 67.5% of survivors experiencing persistent symptoms beyond 12 weeks, consistent with a diagnosis of PCC. This study aims to increase the percentage of moderately severe COVID-19 survivors receiving appropriate outpatient rehabilitation from 16.3% to ≥80% within two years.

Background

At least 65 million individuals worldwide are estimated to have PCC (1). Evidence suggests that the severity of COVID-19 infection is correlated with PCC consequences (1,2,5). The physical, cognitive, and mental health burden experienced by people recovering from COVID-19 who were hospitalised may be

considerable (1,2,5,7). A systematic review reported a median proportion of 72.5% of individuals (n=9,751) experiencing at least one persistent symptom (15). Studies on PCC involving the Southeast Asian population are limited. In the local context, the prevalence of PCC was reported to be 31.1% in a community-based survey of 732 Malaysians, with common symptoms including fatigue, brain fog, depression, anxiety, insomnia, arthralgia, and myalgia (16).

In another community-based study involving a total of 44,386 Malaysians who responded to the MySejahtera app platform, the PCC prevalence was reported at 3.4% (n=1,510) (17). Based on this study, the three most common symptoms experienced were cough, fatigue, and forgetfulness. Being females, having existing comorbidities, the presence of symptoms, and requiring hospital admission during the acute illness were associated with a higher likelihood of developing PCC. Another study in Thailand reported PCC in nearly half of the participants, with adolescents experiencing pulmonary symptoms, hair loss, muscle pain, and fatigue, while children exhibited rhinorrhoea, cough, and breathing difficulties (18).

The WHO regarded rehabilitation as an essential support in improving health outcomes, especially of patients with moderately severe COVID-19, and benefits health via optimising health and functional outcomes (19,20). Rehabilitation is defined as a set of interventions designed to optimise functioning and reduce disability in individuals with health conditions in interaction with their environment (20). Rehabilitation needs may exist in all care phases, including as part of acute care delivered in the Intensive Care Unit (ICU); during the subacute phase delivered in the ward or step-down facility, and during the long-term phase beyond hospital discharge within the community (19-21).

The multisystem characteristics of PCC and its high prevalence highlighted the need for continuity of care and multidisciplinary rehabilitation (8,9,19 – 22). However, comprehensive rehabilitation care faces multiple challenges, such as long waiting lists, difficulties in training clinicians, delivery of safe rehabilitation, barriers to access for patients with fatigue, absence of integrated rehabilitation, and funding sustainability (8,19 - 22).

Key components for outpatient PCC management may include but are not limited to multidisciplinary rehabilitation team engagement, coordination of care, personalised rehabilitation program, integration of patient education and self-management, and use of standardised outcome measures for monitoring of rehabilitation progress (2,6,8,9,19-23). Provision of hybrid rehabilitation delivery mode, including face-to-face and virtual mode, may be considered; however, the evidence concerning its safety, effectiveness, or non-inferiority to traditional delivery in an outpatient setting remains lacking (8,9, 19-23).

A meta-analysis involving 1,244 patients with PCC reported rehabilitation interventions were associated with improvements in functional exercise capacity, dyspnoea, and quality of life compared with the current standard of care (24). A randomised controlled trial recruited 39 PCC patients (the intervention group underwent an 8-week supervised aerobic and resistance exercise program at low to moderate intensity, whereas the control group undertook general physical activity in line with WHO guidelines, without supervised sessions), and reported significant between-group differences in changes of exercise capacity, strength, quality of life, dyspnoea, fatigue, and depression in favour of the intervention group (25).

Despite studies that have explored the prevalence, characteristics, risk factors, and effectiveness of multidisciplinary rehabilitation for PCC, there remains a scarcity of evidence specifically examining the appropriateness of outpatient rehabilitation management for PCC patients attending outpatient rehabilitation service facilities.

Measurement

The key indicator for improvement was measured using the percentage of moderately severe COVID-19 survivors provided with appropriate outpatient rehabilitation management. The indicator

was calculated from the total number of moderately severe COVID-19 survivors provided with appropriate rehabilitation management (numerator), divided by the total number of moderately severe COVID-19 survivors who attended for outpatient rehabilitation management (denominator). We chose the standard of ≥80% based on an adaptation from international literature (2,8,24-26).

Moderately severe COVID-19 survivors were those who endured acute category 4 & 5 infections based on the Ministry of Health (MOH) guideline (22). Every eligible moderately severe COVID-19 survivor who was considered to have received appropriate outpatient rehabilitation management will be required to fulfil all nine criteria as in Table 1.

This quality improvement study utilised a universal sampling approach. Malaysian citizens aged >12 years old with laboratory-confirmed COVID-19 who attended outpatient rehabilitation management during the study period were included. Prisoners, those with a pre-existing severe disability such as prolonged bedridden, severe stroke, or tetraplegia, and those clinically unstable to undergo rehabilitation physical evaluation and intervention were excluded.

Data from a verification study from July to December 2020 (n=165) involving moderately severe COVID-19 survivors referred for rehabilitation intervention showed that only 16.3% were provided with appropriate outpatient rehabilitation programs upon discharge. Following this verification study, remedial measures were implemented in phases from January 2021 through June 2024, with re-evaluations conducted on a 6-month interval to assess the effectiveness of these interventions.

Table 1: The nine criteria required for appropriate outpatient rehabilitation management of moderately severe COVID-19 survivors.

Criteria	Descriptions	Outcome measures
1	Comprehensive multisystem screening for PCC symptoms	Post-Covid-19 screening sheet (22)
2	Physical function assessment using standardised outcome measures	Hand dynamometer, 6-Minute Walk Test (6MWT) (21, 22)
3	Cognitive function assessment using standardised outcome measures	Mental State Examination (MSE) (21, 22)
4	Psychological function assessment using standardised outcome measures	Depression Anxiety Stress Scales (DASS) (21, 22)
5	Evaluation of PCC impact using standardised functional outcome measures	Post-Covid-19 Functional Status Scale (PCFS) (21, 22, 28)
6	Assessment of oxygen saturation at rest and during exertion	6-Minute Walk Test (6MWT) (21, 22)
7	Prescription of symptomatic treatment, order investigation, and make a referral as indicated	Not applicable
8	Provision of patient education and rehabilitation self-management resources	Not applicable
9	Prescription of a personalised exercise/therapy regime by the multidisciplinary rehabilitation team	Not applicable

Initial Assessment of the Problem

Based on discussions among the project group members and rehabilitation personnel, supported by literature reviews, the probable factors contributing to the problem were mapped out as depicted in Figure 1.



Figure 1 Problem analysis chart for the low percentage of appropriate outpatient rehabilitation management of moderately severe COVID-19 survivors.

A semi-structured survey was conducted to explore the knowledge and awareness of multidisciplinary rehabilitation personnel regarding outpatient management for moderately severe COVID-19 survivors. The survey questions were adapted from literature (2,9), and content validation was performed by a rehabilitation specialist. A total of 21 personnel were involved, consisting of two rehabilitation specialists, eight medical officers, four physiotherapists, three occupational therapists, and four rehabilitation nurses. The result of the survey showed that only nine (42.8%) respondents achieved passing marks of ≥80%. Notably, the multidisciplinary rehabilitation personnel opined on the need for regular training for improvement of their knowledge and skills in post-COVID-19 management.

Another semi-structured survey was conducted during outpatient rehabilitation sessions to evaluate the contributing factors from the patients' perspective. The survey questions were adapted from literature (2,9), and content validation was done by a rehabilitation specialist. A pre-test was done during the clinic consultation for the first three participants. A total of 28 moderately severe COVID-19 survivors attending the outpatient rehabilitation clinic were included in the survey. Demographically, the participants comprised 20 (71.4%) males; the mean age of 51.8 years; Malay, Chinese, and Indian ethnic distributions were 15 (53.5%), 4 (14.2%), and 9 (32.3%), respectively. The results found that only 13 (46.4%) of patients achieved the passing marks of ≥80%. All of the patients (100%) were not aware of any rehabilitation self-management techniques to enhance the improvement and recovery of the PCC symptoms they had, nor were they aware of the accessibility of any related educational resources to enhance their understanding of its application.

The existing process of care/ workflow was reviewed, and we identified the critical steps for improvement as shown in Figure 2.

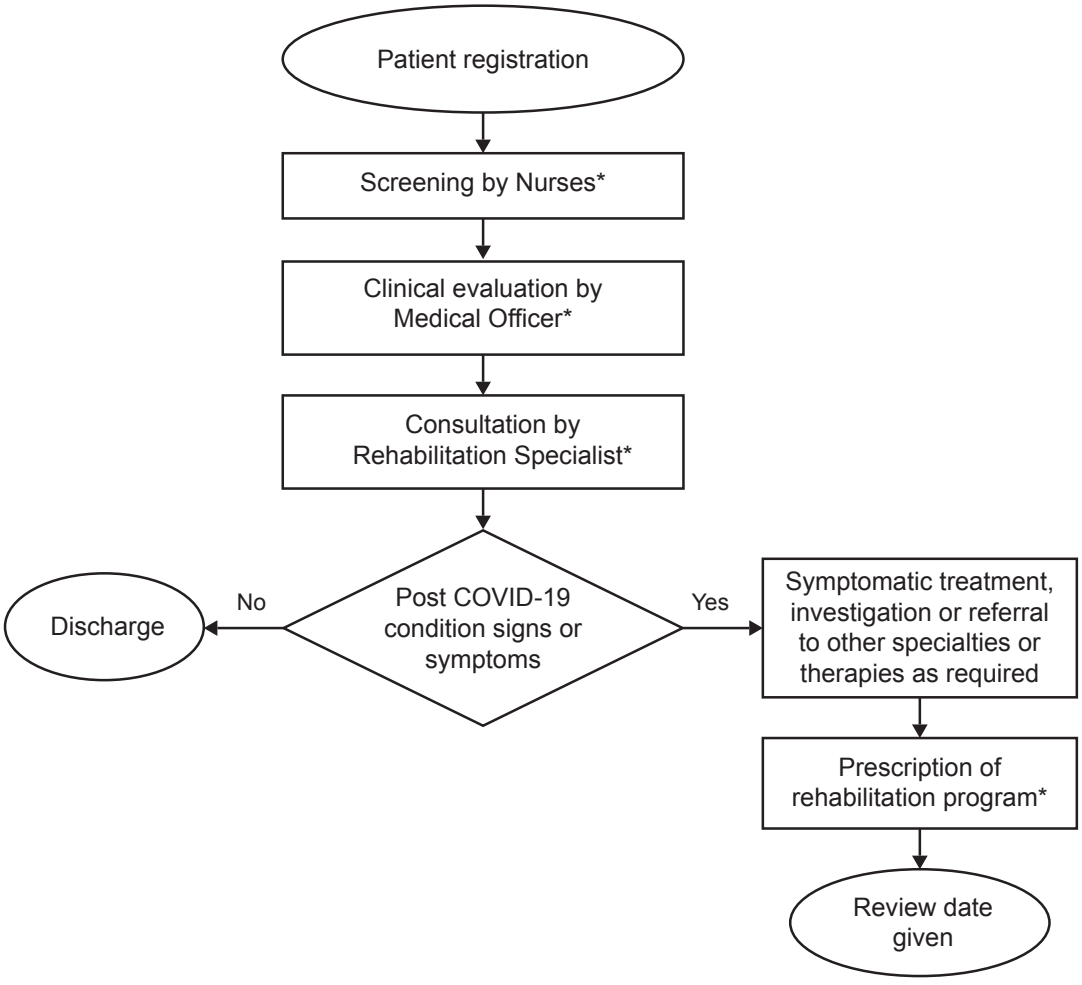


Figure 2 Process of care for moderately severe COVID-19 survivors attending an outpatient rehabilitation clinic.

The Model of Good Care (MOGC) parameters were established based on the critical steps in the process of care, adapted from international literature (2,8,24-27). A review of e-HIS medical records was conducted to assess compliance among rehabilitation personnel in providing appropriate outpatient rehabilitation management. Compliance was determined using an audit checklist that included all MOGC parameters.

In the verification study (n=165), we found full compliance (100%) on two of the MOGC parameters that included prescription of symptomatic treatment, order investigation, and make referral as indicated, and prescription of personalised exercise/ therapy by a multidisciplinary rehabilitation team. However, Shortfalls in Quality (SIQ) were detected across the other seven MOGC parameters. These include the assessment of multi-system screening for PCC symptoms (16.3%); physical function assessment using a standardised outcome measure (16.3%), cognitive assessment using a standardised outcome measure (16.3%), psychological function assessment using a standardised outcome measure (16.3%), evaluation of the impact of PCC on functional outcome measure (16.3%), assessment of oxygen saturation at rest and during exertion (32%) and provision of patient education and rehabilitation self-management resources (21%).

Strategies

Based on the study findings, structure-related and process-related remedial measures were formulated and implemented in four phases. A summary of structure-related and process-related remedial measures during the phased implementation is shown in Appendix 1.

a) Phase 1

Phase 1 remedial measures were conducted from January to June 2021 (6 months duration), focusing on structure-related (people) remedial measures, which involved serial training sessions for multidisciplinary rehabilitation personnel. Process-related remedial measures were then implemented through collaboration with other medical specialities to establish a one-stop, dedicated, structured, and coordinated outpatient rehabilitation service for COVID-19 survivors. The timeline for implementation of the remedial measures is as highlighted in Appendix 1.

- Serial training sessions were conducted and attended by the multidisciplinary rehabilitation personnel either physically or virtually. The training module included topics related to:
  - COVID-19 infection impact on multiorgan systems and the rationale for post-COVID-19 rehabilitation.
  - comprehensive multisystem screening for PCC using standardised outcome measures.
  - identification of red flag signs that require referral for further management by relevant medical specialties.
  - prescription of a personalised rehabilitation regimen/therapy tailored to the assessment findings.
  - provision of symptomatic treatment and, empowerment of patients with rehabilitation self-management.
- A requirement was made for all multidisciplinary rehabilitation personnel involved in post-COVID-19 management (N=43) to complete the OpenWHO online training on rehabilitation for COVID-19 (30). This online training comprised seven course modules addressing the diverse rehabilitation needs of patients recovering from COVID-19. The topics include management of cognitive, physical, respiratory, swallowing and communication impairments as well as addressing challenges in performing Activities of Daily Living (ADLs). Rehabilitation self-management methods to enhance symptoms recovery were also included. Certificates of participation were required for submission to the Head of Department to confirm training completion.
- Collaboration with other medical specialities involved in post-COVID-19 management was formalised, including General Medicine, Psychiatry, Geriatric Medicine, Endocrinology, Neurology, Respiratory Medicine, Rehabilitation Medicine, Physiotherapy, and Occupational Therapy to ensure comprehensive, structured, and coordinated care for COVID-19 survivors. This led to the establishment of a dedicated service known as COVID-19 Rehabilitation Outpatient Specialised

Services (CROSS) (14, 21). The service functions as a comprehensive, multidisciplinary centre where COVID-19 survivors undergo coordinated assessment by a rehabilitation nurse, occupational therapist, physiotherapist, medical officer, and rehabilitation specialist within a single setting. Standardised outcome measures, including the 6MWT, DASS, MSE, and PCFS scale, were employed to evaluate patient status (14, 21). Referrals to other medical specialities were initiated as clinically indicated by the attending rehabilitation specialist. In addition to clinical assessments, CROSS provides structured group and individual educational sessions focused on rehabilitation self-management. Personalised exercise and activity plans were developed and prescribed based on each patient's functional capacity and rehabilitation trajectory (14, 21).

b) Phase 2

Phase 2 remedial measures were conducted from January to June 2022 (6 months duration), focusing on process-related remedial measures through the establishment of teleconsultation and the integration of the CROSS framework into the HSgB e-HIS system. Additionally, structure-related (people) remedial measures for COVID-19 survivors were implemented by translating WHO online resources to improve patient education and enhance the empowerment process for COVID-19 survivors with rehabilitation self-management strategies (27).

- Teleconsultation was established predominantly through telephone calls. Video calls were initiated, when necessary, such as for reviewing pressure injury wounds, assessing general patient conditions, and evaluating home environments for COVID-19 survivors requiring short or long-term home oxygen therapy and monitoring. The primary aim of teleconsultation is to monitor the progress of COVID-19 survivors' recovery within the community. Medical advice was provided accordingly to enhance the recovery process, and dates for rehabilitation clinic in-person reviews were confirmed. In cases where red-flag conditions were a concern, patients and caregivers were advised to seek immediate medical consultation at the nearest healthcare facility.
- Collaboration with the Information Technology Department (ITD) of HSgB enabled the integration of the CROSS framework into the HSgB e-HIS system. All nine required MOGC criteria were incorporated into the e-HIS clinical documentation template, as required for appropriate outpatient rehabilitation management of moderately severe COVID-19 survivors. This section is subtitled in the e-HIS system as CROSS clerking and progress notes.
- The Malay language translation of post-COVID-19 rehabilitation self-management educational resources, consisting of six animated videos, was initiated and made available on the WHO website (https://who.canto.global/b/NTTVB) for public reference. The video topics are summarised in List 1 of Appendix 2. The videos were routinely broadcast in the clinic waiting area, and information regarding access to these online educational resources was provided to COVID-19 survivors attending the CROSS clinic.
- The Malay language translation of post-COVID-19 rehabilitation self-management educational resources, consisting of thirteen posters, was subsequently initiated and made available on the WHO website (https://who.canto.global/b/U076U) for public reference. The translated poster topics are summarised in List 2 of Appendix 2. Information on accessibility of these online educational resources was provided to COVID-19 survivors attending the CROSS clinic.

c) Phase 3

Phase 3 remedial measures were conducted from January to June 2023 (six months duration), addressing structure-related remedial measures for moderately severe COVID-19 survivors.

- Due to the challenges faced by COVID-19 survivors in understanding Western-style animated videos and poster resources, we took the initiative to collaborate with the Health Education Division, MOH Malaysia, to produce Malay language, live-action, locally adapted educational videos for social media circulation. This initiative aims to enhance understanding,

thereby improving the education and empowerment of local COVID-19 survivors with rehabilitation self-management strategies. Eight live-action, three-minute Malay-language videos were produced through this collaboration and made accessible on the MyHEALTH Portal's TikTok and YouTube channels (29). By October 2024, the TikTok videos had at least 47,792 collective views, while the YouTube versions garnered more than 6,500 views. View counts and topics are detailed in List 3 of Appendix 2. The video series has also been routinely played in clinic waiting areas, and information on accessing these social media educational resources has been provided to the COVID-19 survivors.

- To further enhance patient empowerment in rehabilitation self-management within the community, we initiated the publication of a free digital e-book based on WHO recommendations for rehabilitation self-management (27). The e-book, entitled "OPTIMUM: Panduan, Sokongan serta Inspirasi Bagi Pengurusan Kendiri Rehabilitasi Individu Pasca Jangkitan COVID-19" (29), comprises a total of 13 chapters on rehabilitation self-management post-COVID-19 as summarised in List 4 of Appendix 2. This e-book has since been made accessible to all patients through the Health Education Division, MOH (29). A link to the e-book is displayed in the clinic waiting area, and information on accessing these online educational resources was provided to COVID-19 survivors attending the CROSS clinic. By October 2024, the e-book had been downloaded 445 times by COVID-19 survivors (32.4%), healthcare personnel (56.9%), and others (10.7%).

Results

These comprehensive, multifaceted remedial measures have led to an increasing percentage of moderately severe COVID-19 survivors receiving appropriate outpatient rehabilitation management.

Results following Phase 1 remedial measures that focused on serial trainings of the multidisciplinary rehabilitation personnel and establishment of a one-stop dedicated, structured, and coordinated outpatient rehabilitation service for post-COVID-19 survivors (CROSS) have shown outcome improvement in Cycle 1 to 44.2% (153/346). We observed sustained 100% compliance in MOGC parameters, including symptomatic treatment, investigations and referrals, and personalised exercise prescriptions by the multidisciplinary rehabilitation team. An additional 100% compliance was observed in the MOGC parameter on comprehensive multi-system screening for PCC symptoms.

The other five MOGC parameters also showed a favourable increase to 68.5% (237/346), including standardised assessments of physical, cognitive, and psychological function, evaluation of PCC impact using functional measures, and oxygen saturation assessment at rest and during exertion. However, the MOGC parameter result on the provision of patient education and rehabilitation self-management resources still showed marginal improvement (44.2%, 153/346).

Results following Phase 2 remedial measures that focused on sustenance of Phase 1 remedial measures, with additional initiation of teleconsultation, integration of the CROSS framework into the HSgB e-HIS system, Malay language translation of WHO online resources on rehabilitation self-management strategies (27); showed further improvement in Cycle 2 to 87.8% (58/66).

We observed a sustainable outcome with 100% compliance on the MOGC parameters that included prescription of symptomatic treatment, order investigation, and make referral as indicated, prescription of personalised exercise/therapy by a multidisciplinary rehabilitation team, and assessment of multi-system screening for PCC symptoms. Additionally, we observed 100% compliance with another two MOGC parameters that included the assessment of oxygen saturation at rest and during exertion, and provision of patient education and rehabilitation self-management resources.

We observed further increments across the other four MOGC parameters to 92.4% (61/66), including standardised assessments of physical, cognitive, and psychological function, and evaluation of PCC impact using functional measures.

Results from Phase 3 remedial measures, which focused on sustaining efforts from Phases 1 and 2 and included the production of Malay-language live-action educational video series and an e-book on

rehabilitation self-management of common post-COVID-19 symptoms, showed a further increase in outcomes in Cycle 3 to 89.4% (42/47).

We observed sustainable outcome with 100% compliance on the MOGC parameters that included prescription of symptomatic treatment, order investigation and make referral as indicated; prescription of personalised exercise/therapy by multidisciplinary rehabilitation team; assessment of multi-system screening for PCC symptoms; assessment of oxygen saturation at rest and during exertion; and provision of patient education and rehabilitation self-management resources.

We observed further increments across the other MOGC parameters to (95.7%, 45/47). These included physical, cognitive and psychological function

Table 2: Improvement across the study cycle on the MOGC parameters following Phase 1 through Phase 3 remedial measures.

No	Critical Steps	Criteria	Std	Ver	Cycle 1	Cycle 2	Cycle 3
1	Screening by nurses	Comprehensive multi-system screening for PCC symptoms	100%	16.3%	100%	100%	100%
2	Clinical examination by a medical officer	Physical function assessment using a standardised outcome measure	100%	16.3%	68.5%	92.4%	95.7%
		Cognitive function assessment using a standardised outcome measure	100%	16.3%	68.5%	92.4%	95.7%
		Psychological function assessment using a standardised outcome measure	100%	16.3%	68.5%	92.4%	95.7%
		Evaluation of PCC impact on standardised functional outcome measure	100%	16.3%	68.5%	92.4%	95.7%
		Assessment of oxygen saturation at rest and during exertion	100%	32%	68.5%	100%	100%
3	Consultation by Rehabilitation Specialist	Prescription of symptomatic treatment, order investigation, and make referral as indicated	100%	100%	100%	100%	100%
4	Prescription of rehabilitation program	Provision of patient education and rehabilitation self-management resources	100%	21%	44.2%	100%	100%
		Prescription of personalised exercise / therapy by multidisciplinary rehabilitation team	100%	100%	100%	100%	100%

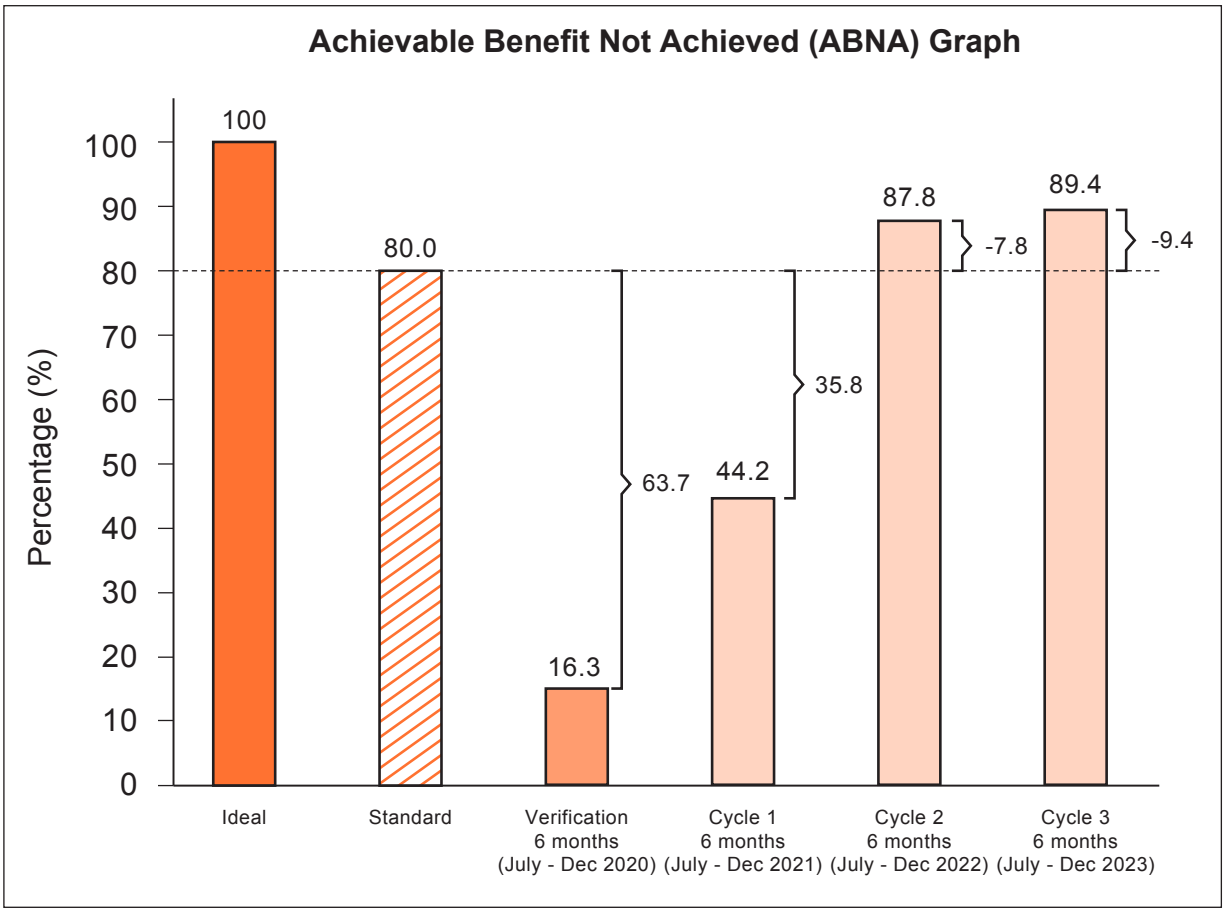


Figure 3: Information on ABNA and the percentage of moderately severe COVID-19 survivors provided with appropriate outpatient rehabilitation management from verification through Cycle 3 study analysis.

assessment using a standardised outcome measure, and evaluation of the effect of PCC using a functional outcome measure.

The details of each study cycle MOGC parameter achievement post Phase 1 through Phase 3 remedial measures implementation are summarised in Table 2.

Improvement of the Achievable Benefits Not Achieved (ABNA) was observed from 63.7% pre-intervention, reduced to 35.8% following Phase 1 remedial measures. Subsequently, following Phase 2 remedial measures, the ABNA has further improved to -7.8% post-intervention. We observed sustainability of the ABNA achievement to -9.4% following Phase 3 remedial measures.

Lessons and Limitations

The phased implementation of multi-faceted remedial measures has led to the improvement in the percentage of moderately severe COVID-19 survivors receiving appropriate outpatient rehabilitation management in our facility, with evidence of sustainability observed during the re-evaluation cycles.

This study highlights the importance of effective teamwork, commitment, and dedication among multidisciplinary rehabilitation personnel in completing the project. Collaboration across all levels, including interdisciplinary units within the Rehabilitation Medicine Department, other medical speciality units and departments involved in post-COVID-19 management, the Information Technology Department, hospital administration, the State Health Department, and the Ministry of Health Malaysia has facilitated the phased implementation of remedial measures. This collaborative effort has ultimately contributed to the successful completion of this study.

Continuous professional development activities involving multidisciplinary rehabilitation personnel caring for moderately severe COVID-19 survivors are of pivotal importance. The establishment of a dedicated, structured, and

coordinated service (CROSS), along with the provision of a clear clinical framework for comprehensive outpatient rehabilitation management, has enabled a more focused intervention. The integration of this comprehensive framework into the hospital e-HIS system documentation provides clear guidance for multidisciplinary rehabilitation personnel on the required assessments, management, and interventions.

From the patients' perspectives, direct accessibility of educational resources on rehabilitation self-management for commonly reported post-COVID-19 symptoms on various social media platforms has enhanced patients' experience for their better compliance to rehabilitation interventions, hence ensuring better outcomes throughout their recovery process.

From the clinical impact's perspective, we observed an improvement in the percentage of patients with symptom resolution, leading to a lower prevalence of PCC, which decreased from 67.5% pre-intervention to 47.7% (165/346) post-intervention in Cycle 1, followed by a further reduction to 43.9% (29/66) post-intervention in Cycle 2, and finally to 42.2% (20/47) post-intervention in Cycle 3.

PCC imposes significant economic burdens on affected individuals, primarily through increased healthcare expenses, reduced earnings, and lower quality of life (31). From a cost-saving perspective, the estimation focused exclusively on the rise in outpatient healthcare expenses. Based on estimates from Malaysia's Full Paying Patient fee schedule (32), a single outpatient multi-disciplinary rehabilitation cost for COVID-19 survivors with PCC is at least MYR420 per visit. This is inclusive of registration (MYR10), specialist consultation (MYR100), one-on-one education session (MYR20), group therapy (MYR20), functional evaluation (MYR50), cognitive evaluation (MYR60), rehabilitation program for all disabilities (MYR120), physiotherapy (MYR20), and occupational therapy (MYR20). Considering the requirement of at least two visits per COVID-19 survivor with PCC complications, the 245 PCC recoveries observed in this study have led to an estimated savings of at least MYR205,800 in outpatient healthcare expenditure.

Quality is closely associated with customer satisfaction, either fulfilling or exceeding their expectation. A self-administered customer satisfaction survey form, which was randomly distributed during the CROSS clinic between July to December 2021, achieved 253 total responses composed of 85% (215/253) moderate COVID-19 survivors and 15% (38/253) severe COVID-19 survivors. The CROSS service has been rated as excellent in 33.2% (84/253) and good in 66.8% (169/253). This reflected the primary importance of patient-centred service delivery in the healthcare system.

Our experience in managing COVID-19 survivors in this study led us to provide a national symposium training on post-COVID-19 Focused Rehabilitation Medicine, conducted on 7th March 2022, which was virtually attended by 460 multidisciplinary rehabilitation personnel from all states in Malaysia. Subsequently, another national training session, post-COVID-19 Focused Rehabilitation Medicine 2.0, was conducted on 29th May 2023 at HSgB, and was physically attended by 246 multidisciplinary rehabilitation personnel involved in post-COVID-19 management across Malaysia.

Our primary limitation was the change in COVID-19 virus virulence throughout the entire study, which resulted in limited data comparability across the three study cycles as reflected in the high variation of the number of COVID-19 survivors involved in this study (n=165 verification study; n=346 post-intervention Cycle 1; n=66 post-intervention Cycle 2; and n=47 post-intervention Cycle 3). Even though the current Omicron variant of COVID-19 has been reported to be more transmissible (33), the lower number of moderately severe COVID-19 survivors being referred for outpatient rehabilitation management and the favourable clinical outcome in the later Cycle studies may have been attributed by the lesser virulence of the current Omicron variant of COVID-19 compared to the Delta variant of COVID-19 at the beginning of the study (34,35).

Another limitation of this study is the limited generalisability of its results and outcomes at the state or national level. This is due to the study being conducted in a single specific facility, HSgB, the national referral centre for infectious diseases, which has the highest number of moderately severe COVID-19 survivor admissions.

The status change of HSgB from a full COVID-19 function to a hybrid hospital on 22nd April 2022 (13) has led to the challenge of having to attend to the influx of other diverse conventional rehabilitation cases. This is accommodated via rescheduling all moderately severe COVID-19 survivors referred for the CROSS clinic to a single day of the week.

Conclusion and the Next Steps

While there is availability of scientific evidence on the feasibility and effectiveness of multidisciplinary rehabilitation interventions for improving functional and exercise capacity and symptoms recovery post COVID-19 infection such as fatigue, dyspnoea mental health challenges (24,25), to our best knowledge there is still a dearth of studies examining the appropriateness of outpatient rehabilitation interventions in any given healthcare facility similar to the study being conducted. Hence, this study may be considered a baseline study, which has the potential to be replicated in other hospitals that face similar challenges.

This study found that only 16.3% of moderately severe COVID-19 survivors were provided with appropriate outpatient rehabilitation management. We identified the key contributing factors as a lack of awareness and knowledge involving multidisciplinary rehabilitation personnel; poor awareness and knowledge among post-COVID-19 survivors, non-availability of dedicated, structured, and coordinated multidisciplinary outpatient rehabilitation service, and limited access to educational resources related to rehabilitation self-management. Multi-faceted structure-related and process-related remedial measures have been implemented in phases, including serial training sessions, teleconsultation, a comprehensive one-stop centre known as CROSS, integration of framework into the e-HIS system, and provision of access to educational resources via social media engagement. These remedial measures have been effective, with post-intervention analysis showing an increased percentage from 16.3% to 44.2% in Cycle 1, to 87.8% in Cycle 2. The sustainability of the achievement was evident with a further increment of percentage to 89.4% in Cycle 3.

With these favourable outcomes achieved in this study, we aimed to expand the relatable structure-related and process-related remedial measures in this study for the improvement of other conventional rehabilitation services with fairly similar challenges, such as for post-intensive care survivors, in the future.

References

1. Davis, H.E., McCorkell, L., Vogel, J.M. et al. Long COVID: Major findings, Mechanisms and Recommendations. Nat Rev Microbiol 21, 133–146 (2023).

2. Barker-Davies RM, O'Sullivan O, Senaratne KPP, et al. The Stanford Hall consensus statement for post-COVID-19 rehabilitation. Br J Sports Med 2020;54:949–959.

3. Worldometer Data available at https://www.worldometers.info covid 19 accessed on 27th February 2025 at 0430H.

4. Ministry of Health Malaysia Data available at https://data.moh.gov.my/ accessed on 27th February 2025 at 0430H.

5. Sudre CH, Murray B, Varsavsky T, et al. Attributes and predictors of long-COVID: analysis of COVID cases and their symptoms collected by the Covid Symptoms Study App. MedRxiv 19 December 2020.

6. DeMars J, Brown DA, Angelidis I, Jones F, McGuire F, O'Brien KK, Oller D, Pemberton S, Tarrant R, Verduzco-Gutierrez M, Gross DP. What is Safe Long COVID Rehabilitation? J Occup Rehabil. 2023 Jun;33(2):227-230.

7. A clinical case definition of post COVID-19 condition by a Delphi consensus, 6 October 2021 available at https://www.who.int/publications/i/item/WHO-2019-nCoV-Post_COVID-19_condition-Clinical_case_definition-2021.1

8. Simon D, Wouther DG, Arienti C et al. Scoping Review of Rehabilitation Care Models for Post COVID-19 Condition. Bull World Health Organ 2022; 100: 676 – 688.

9. Spruit MA, Holland AE, Singh SJ, Tonia T, Wilson KC, Troosters T. COVID-19: Interim Guidance on Rehabilitation in the Hospital and Post-Hospital Phase from a European Respiratory Society and American Thoracic Society-coordinated International Task Force. Eur Respir J. 2020 Aug 13;56(6):2002197.

10. Hospital Sungai Buloh official website available at https://jknselangor.moh.gov.my/hsgbuloh accessed on 27th February 2025 at 0430H.

11. Hospital Sungai Buloh Annual Report 2021. Available at https://jknselangor.moh.gov.my/hsgbuloh/images/pdf/Laporan_Tahunan_2021.pdf

12. Press Conference Ministry of Health Malaysia dated 02/10/2021 https://covid-19.moh.gov.my/terkini-negeri/2021/10/kemaskini-negeri-covid-19-di-malaysia-sehingga-02102021/KA_KPK_COVID-19_02102021.pdf

13. Press Conference Ministry of Health Malaysia dated 28/04/2022 available at https://covid-19.moh.gov.my/semasa-kkm/2022/04/makluman-berkenaan-pertukaran-status-hospital-sungai-buloh-kepada-hospital-covid-19-hibrid

14. A H Zamli, N A Misnan, S Y Lim et al. COVID-19 Condition Characterization: Insights from a Cross-Sectional Study in a Malaysian Rehabilitation Center. Asia Pacific Journal of Public Health 1–8 © October 2023. https://doi.org/10.1177/101053952312031

15. Nasserie T, Hittle M, Goodman SN. Assessment of the frequency and variety of persistent symptoms among patients with COVID-19: a systematic review. JAMA Network Open. 2021;4(5):e2111417.

16. Moy FM, Hairi NN, Lim ERJ, Bulgiba A. Long COVID and its associated factors among COVID survivors in the community from a middle-income country: an online cross-sectional study. PLoS ONE. 2022;17(8):e0273364. doi:10.1371/journal. pone.0273364.

17. Tok PSK, Kang KY, Ng SW, Ab Rahman N, Syahmi MA, Pathmanathan MD, Appannan MR, Peariasamy KM, Sivasampu S. Post COVID-19 condition among adults in Malaysia following the Omicron wave: A prospective cohort study. PLoS One. 2024 Jan 5;19(1):e0296488. doi: 10.1371/journal.pone.0296488. PMID: 38181017; PMCID: PMC10769055.

18. Jarupan M, Jantarabenjakul W, Jaruampornpan P, et al. Long COVID and hybrid immunity among children and adoles cents post-Delta variant infection in Thailand. Vaccines. 2023;11(5):884. doi:10.3390/vaccines11050884.

19. Wise J. Long COVID: WHO calls on countries to offer patients more rehabilitation. BMJ. 2021;372:n405. doi:10.1136/bmj. n405.

20. Pan American Health Organization. Rehabilitation considerations during the COVID-19 outbreak. 2020. https://iris.paho.org/bitstream/handle/10665.2/52035/NMHMHCOVID19200010_eng.pdf?sequence=6&isAllowed=y (accessed 15 June 2023)

21. A H Zamli. Expanding our understanding of post COVID 19 condition web series—Rehabilitation care: interventions for rehabilitation of post COVID-19 condition. World Health Organization. Updated October 6, 2021. Accessed September 25, 2022. https://www.who.int/news-room/ events/detail/2021/10/06/default-calendar/expanding-our understanding-of-post-covid-19-condition-web-series-rehabilitation-care.

22. Ministry of Health Malaysia Clinical Management of Confirmed COVID-19. Updated December 2023 available at Annex 2e Updated December 2023 1 - COVID-19 MALAYSIA available at ovid-19.moh.gov.my/garis-panduan/garis-panduan-kkm/ANNEX-2E-CLINICAL-MANAGEMENT-OF-CONFIRMED-COVID-19-28122023.pdf

23. Sari and Wijaya: General rehabilitation for the Post-COVID-19 condition: A narrative review. Annals of Thoracic Medicine - Volume 18, Issue 1, January-March 2023.

24. Dimitra V. Pouliopoulou, Joy C. Macdermid, Emily Saunders et al. Rehabilitation Interventions for Physical Capacity and Quality of Life in Adults With Post–COVID-19 Condition. A Systematic Review and Meta-AnalysisJAMA Network Open. 2023;6(9):e2333838. doi:10.1001/jamanetworkopen.2023.33838.

25. Amaya Jimeno Almazán, Francisco Franco López, Ángel Buendía Romero et al. Rehabilitation for post-COVID-19 condition through a supervised exercise intervention: A randomized controlled trial. Scand J Med Sci Sports. 2022;00:1–11.

26. National Institute for Health and Care Excellence (NICE), Scottish Intercollegiate Guidelines Network (SIGN), Royal College of General Practitioners (RCGP). COVID-19 rapid guideline: managing the longterm effects of COVID-19. 2022. Accessed March 10, 2023. https://www.nice.org.uk/guidance/ng188/resources/covid19-rapid-guideline-managing-the-long term-effects-of-covid19-pdf-5103551574

27. WHO. Support for rehabilitation: Self-management after COVID-19-related illness. https://www.who.int/europe/publications/i/item/WHO-EURO-2021-855-40590-59892.

28. Klok FA, Boon GJAM, Barco S, et al. The post-COVID-19 functional status scale: a tool to measure functional status over time after COVID-19. Eur Respir J. 2020;56(1):2001494. doi:10.1183/13993003.01494-2020.

29. OPTIMUM: Panduan, Sokongan serta Inspirasi Bagi Pengurusan Kendiri Rehabilitasi Individu Pasca Jangkitan COVID-19". ISBN 978-967-19838-0-5. 2022. Infosihat Kementerian Kesihatan Malaysia E-Magazine MyHealth for Life Edisi September 2023. Post COVID-19 Condition (Long COVID) Sokongan Pemulihan: Pengurusan Kendiri Rehabilitasi Bagi Menangani Gejala Berkaitan COVID-19. P36 – 39. Available at infosihat.gov.my

30. OpenWHO.org training on rehabilitation for COVID-19 available at https://www.who.int/news/item/05-02-2021-who-launches-free-openwho.org-training-on-rehabilitation-for-covid-19

31. David M Cutler. The cost of Long COVID. JAMA Health Forum. 2022;3(5):e221809. doi:10.1001/jamahealthforum.2022.1809.

32. Ministry of Health Malaysia. Fee Schedule for Full Paying Patients (Medical) 2007. MOH/P/PAK/288.15 (GU), April 2015.

33. Manathunga, S.S., Abeyagunawardena, I.A. & Dharmaratne, S.D. A comparison of transmissibility of SARS-CoV-2 variants of concern. Virol J 20, 59 (2023). https://doi.org/10.1186/s12985-023-02018-x

34. Nyberg T, Bager P, Ingrid Bech Svalgaard I B et al. A standardised protocol for assessment of relative SARS-CoV-2 variant severity, with application to severity risk for COVID-19 cases infected with Omicron BA.1 compared to Delta variants in six European countries. Euro Surveill 2023;28(36). https://doi.org/10.2807/1560-7917.ES.2023.28.36.2300048.

35. Orel E, Sobel J, Zanella MC et al. Clinical severity of Delta and 3 different Omicron sublineages in patients hospitalized because of COVID-19 in a Swiss tertiary center. CMI Communications, Volume 1, Issue 2, 2024,100005, ISSN 2950-5909, https://doi.org/10.1016/j.cmicom.2024.100005

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Conflict of Interest

The authors declared no potential conflicts of interest with respect to the conduct of this study.

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Appendix 1: Summary of structure-related and process-related remedial measures during the phased implementation.

Remedial Measures	Implementation Phases			
	Phase 1 Jan – June 2021	**Phase 2** Jan – June 2022	**Phase 3** Jan – June 2023	**Phase 4** Jan – June 2024 (Sustainable)
Structure-related (multidisciplinary rehabilitation personnel)				
1. Physical and virtual **training series**	✓	✓	✓	✓
2. OpenWHO **online training** & **certification**	✓	✓	✓	✓
Process-related				
3. Dedicated, structured, and coordinated one-stop outpatient rehabilitation service (**CROSS**)	✓	✓	✓	✓
4. **Teleconsultation**		✓	✓	✓
5. CROSS service framework integration into the **e-HIS system**		✓	✓	✓
Structure-related (moderately severe COVID-19 survivors)				
6. Malay language translation of the WHO online rehabilitation self-management **animated educational video and poster resources**		✓	✓	✓
7. HSgB Malay language **e-book** on rehabilitation self-management "OPTIMUM"			✓	✓
8. HSgB rehabilitation self-management **live-action video resources**			✓	✓

Appendix 2:

List 1: Topics of Malay language translation of post-COVID-19 rehabilitation self-management education video

The Malay language translation of post-COVID-19 rehabilitation self-management educational video topics available on the WHO website (https://who.canto.global/b/NTTVB):

i. Managing Activities of Daily Living (*Menguruskan aktiviti harian kehidupan*)
ii. Managing Issues with Eating and Drinking (*Menguruskan masalah berkaitan makan dan minum*)
iii. Exercise After COVID-19 Infection (*Bersenam selepas jangkitan COVID-19*)
iv. Managing Breathlessness (*Menguruskan kesukaran bernafas)*
v. Managing Problems with Attention, Memory, and Thinking (*Menguruskan masalah berkaitan*
vi. *perhatian, daya ingatan, dan berfikir dengan jelas*)
vii. Managing Problems with Voice (*Menguruskan masalah berkaitan suara*)

List 2: Topics of the Malay language translation of post-COVID-19 rehabilitation self-management educational poster

The Malay language translation of post-COVID-19 rehabilitation self-management educational poster topics available on the WHO website (https://who.canto.global/b/U076U):

i. Managing Activities of Daily Living (*Menguruskan aktiviti harian kehidupan*)
ii. Managing Issues with Eating and Drinking (*Menguruskan Masalah Berkaitan Makan dan Minum*)
iii. Exercise After COVID-19 Infection (*Bersenam Selepas Jangkitan COVID-19*)
iv. Exercise and Post-Exertional Malaise (*Senaman dan Post-Exertional Malaise*)
v. Managing Breathlessness (*Menguruskan Kesukaran Bernafas*)
vi. Positions to Relieve Breathlessness (*Posisi-Posisi bagi Mengurangkan Kesukaran Bernafas*)
vii. Managing Problems with Attention, Memory, and Thinking (*Menguruskan Masalah Berkaitan Perhatian, Daya Ingatan, dan Berfikir dengan Jelas*)
viii. Managing Pain (*Menguruskan Kesakitan*)
ix. Managing Nutrition, Smell, and Taste (*Menguruskan Nutrisi, Deria Bau, dan Rasa*)
x. Managing Stress (*Menguruskan Tekanan*)
xi. Managing Problems with Voice (*Menguruskan Masalah Berkaitan Suara*)
xii. Managing fatigue (*Menguruskan kelesuan*)
xiii. Return to Work (*Kembali Bekerja*)

List 3: Topics of the Malay language live-action video series

The topics of the Malay language live-action video series and the respective view counts on Tik Tok channel:

i. Managing Insomnia (*Menangani gejala kesukaran tidur nyenyak*) – 6,307 views
ii. Managing Issues with Smell and Taste (*Menangani masalah berkaitan deria bau dan rasa*) – 6,307 views
iii. Exercise After COVID-19 Infection (*Bersenam selepas jangkitan COVID-19*) – 16,100 views
iv. Managing Breathlessness (*Menangani kesukaran bernafas*) – 3,974 views
v. Managing Problems with Brain Fog (*Menangani masalah berkaitan kekabutan otak*) – 4,954 views
vi. Managing Problems with Emotion (*Menangani masalah berkaitan emosi*) – 2,982 views
vii. Managing Problems with Cough (*Menangani gejala batuk*) – 4,104 views
viii. Managing Problems with Fatigue (*Menangani masalah berkaitan kelesuan*) – 2,939 views

List 4: Chapters of e-book “OPTIMUM”

The 13 chapters of the e-book “OPTIMUM: Panduan, Sokongan serta Inspirasi Bagi Pengurusan Kendiri Rehabilitasi Individu Pasca Jangkitan COVID-19”:

i. Identifying Red Flags (*Mengenali gejala-gejala amaran*)
ii. Managing Issues with Swallowing (*Menangani masalah berkaitan penelanan*)
iii. Physical Activities and Exercise After COVID-19 Infection (*Aktiviti fizikal dan bersenam selepas jangkitan COVID-19*)
iv. Managing Fatigue (*Menangani gejala kelesuan*)
v. Managing Breathlessness (*Menangani kesukaran bernafas*)
vi. Positions to Relieve Breathlessness (*Posisi-posisi bagi mengurangkan kesukaran bernafas*)
vii. Managing Problems with Cognitive Dysfunction and Brain Fog (*Menangani gejala fungsi kognitif dan kekabutan otak*)
viii. Managing Pain (*Menangani gejala kesakitan*)
ix. Managing Changes in Smell and Taste, and Healthy Nutrition (*Menangani gejala berkaitan deria bau dan rasa serta nutrisi yang sihat*)
x. Managing Emotion, Anxiety, and Insomnia (*Menangani gejala berkaitan emosi, keresahan, dan kesukaran tidur nyenyak*)
xi. Managing Problems with Voice (*Menangani masalah berkaitan suara*)
xii. Returning to Work (*Melangkah kembali bekerja*)
xiii. Social Support (*Sokongan sosial*)

IMPROVING THE PERCENTAGE OF COMPLETE FLUORIDE VARNISH APPLICATION AMONG TODDLERS: A QUALITY IMPROVEMENT STUDY AT RAUB DENTAL CLINIC, PAHANG

Nur Raihana Abd Razak[1], Farrah Iffadzillah Md Zeni[2]

[1]Klinik Pergigian Karak, Pejabat Kesihatan Pergigian Daerah Bentong, Pahang

[2]Pejabat Kesihatan Pergigian Daerah Raub, Pahang

Corresponding Author: Nur Raihana Abd Razak
Email: nurraihana93@gmail.com

Abstract

Fluoride varnish application (FVA) is applied to prevent dental caries among toddlers. An incomplete FVA may pose a higher risk of early childhood caries, causing severe pain and leading to weight loss and malnutrition. However, the percentage of complete FVA in the Raub Dental Clinic was low. The indicator used was the percentage of complete FVA among toddlers, with a standard of ≥30%. A complete FVA is defined as receiving four FVAs within two years. A quality improvement study was conducted from February 2020 to December 2023. Study instruments include a self-administered questionnaire for dental operators and parents, a dental observation form, and a review of the dental treatment card. The pre-remedial study showed that 12% of toddlers received complete FVA. The causes included inefficient recall system (57%), uncooperative children (57%), lack of parental awareness (55%) and support (44%), poor anticipatory guidance (48%), lack of commitment from operators in treating toddlers (46%), and unreachable parents' contact numbers (33%). Strategies implemented include a tailored toddler's follow-up book, custom FVA stickers, and a recall system through the WhatsApp Business application. Checklists, dental puppets, and reinforced education for operators were used to improve anticipatory guidance (AG). Parental education sessions and *Hari Anakku* were conducted regularly to enhance parental awareness. The active promotion was delivered via the clinic's Facebook page, flyers, and video sharing. Behavioural management techniques were reinforced for toddlers with post-treatment rewards. The percentage of complete FVA among toddlers increased from 12% to 19% in Cycle 1, then improved to 24% in Cycle 2, 33% in Cycle 3, and 43% in Cycle 4, exceeding the standard set at 30%. We successfully enhanced our recall system, the operator's commitment to the FVA programme, and parental awareness. We aim to continually sustain our strategies to ensure the provision of continuous good oral health care services to toddlers.

KEYWORDS: Fluoride varnish application; Early childhood caries; Caries prevention; Toddlers; Quality improvement study

Problem

Fluoride varnish application (FVA) is a community-based caries prevention programme for toddlers, introduced in 2009 under the initiative "*Program Anak Angkat Pergigian Toddler: Manjaku Ceria, Keluargaku Bahagia*". This initiative was piloted in 2011 under the Oral Health Programme in Sabah, Kelantan, and Terengganu (1). FVA is a professionally applied topical fluoride recommended for controlling and preventing dental caries in toddlers (2). It complements other fluoride sources, such as fluoridated water and toothpaste (3). A study has shown that FVA can help prevent or arrest caries formation on enamel surfaces in both primary and permanent teeth, especially in toddlers with early childhood caries (ECC) (4). The American Dental Association recommends applying fluoride varnishes every six months for moderate-to-high-risk populations (5), including toddlers in non-fluoridated communities or those from low socioeconomic backgrounds (6). For effective caries prevention, at least four applications every six months are necessary (2). A verification study carried out in 2019 at Raub Dental Clinic showed that only 12% (n=61/508) of toddlers received the complete applications of fluoride varnishes within two years. The District Specific Approach (DSA) 2020 standard in Pahang targets ≥30% of toddlers receiving four FVA. Thus, this problem must be addressed to ensure toddlers receive the complete course of FVA for them to gain the anticaries benefits on both primary and permanent teeth later.

Raub Dental Clinic is the main dental clinic of seven primary dental clinics in the Raub District, under the Pahang State Oral Health Division. It is equipped with five Dental Chair Cum Units (DCCUs) designated for primary dental care services. During the study period, the clinic had 21 primary care dental officers and 16 dental therapists. It provides dental services to various target groups, including toddlers, preschoolers, primary and secondary school students, antenatal mothers, adults, children with special needs, and senior citizens. The dental officers and therapists are responsible for procedures such as dental examination and treatments, FVA, and providing anticipatory guidance to parents for toddlers. According to an annual report published in 2020, Raub District had a toddler population of 1,928, with Raub Dental Clinic covering approximately 50% of the population (7). Water fluoridation in Pahang was discontinued in July 2012 following the privatisation of public water treatment services (8). In response, the FVA programme was strengthened to ensure each toddler received four applications every six months over a two-year period.

The Ministry of Health Malaysia defines toddlers as children aged four and below. According to Pahang's DSA 2020, toddlers should receive four FVA, given every six months, to complete the full course (9). After each application, anticipatory guidance (AG) is given to parents, a process of providing practical and health information to help them understand and know what to expect during the child's development (10). Parents play a critical role in their toddlers' oral hygiene as their knowledge, attitude, and awareness significantly influence oral healthcare outcomes. Fear of the dental environment and lack of cooperation from toddlers can further complicate FVA completion. Meanwhile, a team of dental operators which consists of dental officers and therapists are also crucial in the efforts towards improvement of toddlers' oral health. However, inconvenient schedule arrangements among dental operators and a poor follow-up system were among the factors that contributed to the problem of a high percentage of incomplete FVA among toddlers in the Raub Dental Clinic.

This quality improvement study was conducted to better understand the current problem, by identifying the possible contributing factors, and implementing remedial actions to increase the percentage of complete FVA among toddlers in Raub Dental Clinic from 12% to a standard set at ≥30%.

Background

Dental caries in primary teeth is a serious oral health concern in children. It is one of the most common non-communicable diseases in children worldwide and often remains untreated (12), with up to 510

million cases reported in 2019 (13). Two or more applications of fluoride varnish per year have been shown to be effective in preventing caries, particularly in high-risk populations such as toddlers in Raub (14). A study by Buckingham et al. in the United Kingdom reported that 29.9% (n=176) of children aged three to seven years did not receive two fluoride varnish applications per year (11).

Barriers to dental care include a poorly distributed dental workforce as well as diverse patient-related factors (15). A study by Manski et al. found that only 25% of dental hygienists use fluoride varnish as a caries control measure when treating ECC (16). During dental examinations, managing toddlers' behaviour is essential, as dental anxiety and fear of dental treatment have long been recognised as major challenges in paediatric patient management (17). A study by Almehmadi et al. reported that 66.2% (n=264) of parents had never heard about fluoride varnish, and among those who knew, only 32.6% (n=130) understood the effect of its application in enhancing tooth resistance to caries (18). In addition, only 19.5% (n=78) of parents knew that FVA required a visit every six months (18). However, a pilot study conducted in Malaysia reported that 82.3% of parents acknowledged the importance of primary teeth in the child's overall health and development. Despite this awareness, 31.3% of parents believed that there was no need for follow-up dental visits once their child's complaints were addressed, and 10.4% admitted to using force to bring their child to the dental clinic (19).

Several behavioural management techniques are employed in paediatric dentistry. One of the common methods is the tell-show-do technique, which involves verbally explaining the procedure and then demonstrating its visual, auditory, and tactile aspects before performing it. Another technique is modelling, which is a process of acquiring behaviour, where children learn from observing others, such as older siblings undergoing dental treatment (17). Observing a peer successfully complete dental treatment can effectively reduce a child's dental anxiety and fear (17).

A study in Manitoba, Canada, reported that hands-on activities, visual aids, and personal interactions such as puppet shows, 'lifting the lip' activities, as well as video and poster presentations were effective in communicating oral health information to parents and families (20). Moreover, exposing children to the dental environment at an early age may help them adapt and improve their behaviour and tolerance during future dental visits (19). Parents and family members, as the primary sources of child-rearing and health-related knowledge, play an essential role in shaping long-term oral health behaviours in children (21).

Measurement

This quality improvement study was conducted by three dental officers, eight dental therapists, and two dental surgery assistants at Raub Dental Clinic. It was carried out over four cycles from February 2020 to December 2023, using a convenience sampling method. The general objective of this project was to increase the percentage of toddlers receiving complete FVA at Raub Dental Clinic. The specific objectives included identifying contributing factors associated with a high percentage of incomplete FVA among toddlers, implementing remedial actions that address these contributing factors and evaluating the effectiveness of the remedial actions taken.

The indicator used in this project was the percentage of toddlers with complete FVA. The calculation formula for the indicator:

$$\text{Percentage of toddlers with complete FVA} = \frac{\text{Total number of toddlers with complete FVA}}{\text{Total number of toddlers who need FVA}} \times 100$$

The target standard was to achieve ≥30% completion, based on the District-Specific Approach set by Pahang State Dental Health Division. Data were collected from the Fluoride Varnish Form (FV3) for the years 2019 to 2023. A verification study conducted from January to December 2019 revealed that only 12% of toddlers had completed the full FVA course. The inclusion criteria included toddlers registered under

Raub Dental Clinic who received subsequent FVA at six-month intervals. Exclusion criteria were toddlers with asthma, ulcerative gingivitis/stomatitis, other known allergies, toddlers with special needs, and those who received care at other facilities such as *Klinik Desa* or *Taska*. The number of toddlers involved in each cycle was: Cycle 1 with 199 toddlers; Cycle 2 with 553 toddlers; Cycle 3 with 128 toddlers and Cycle 4, with 133 toddlers.

Initial Assessment of the Problem

The existing process of care related to operational procedures was reviewed and outlined (Figure 1). The process of care was divided into three phases: pre-dental assessment, during the dental assessment and post-dental assessment. Three critical steps were identified and listed in the Model of Good Care (Table 1).

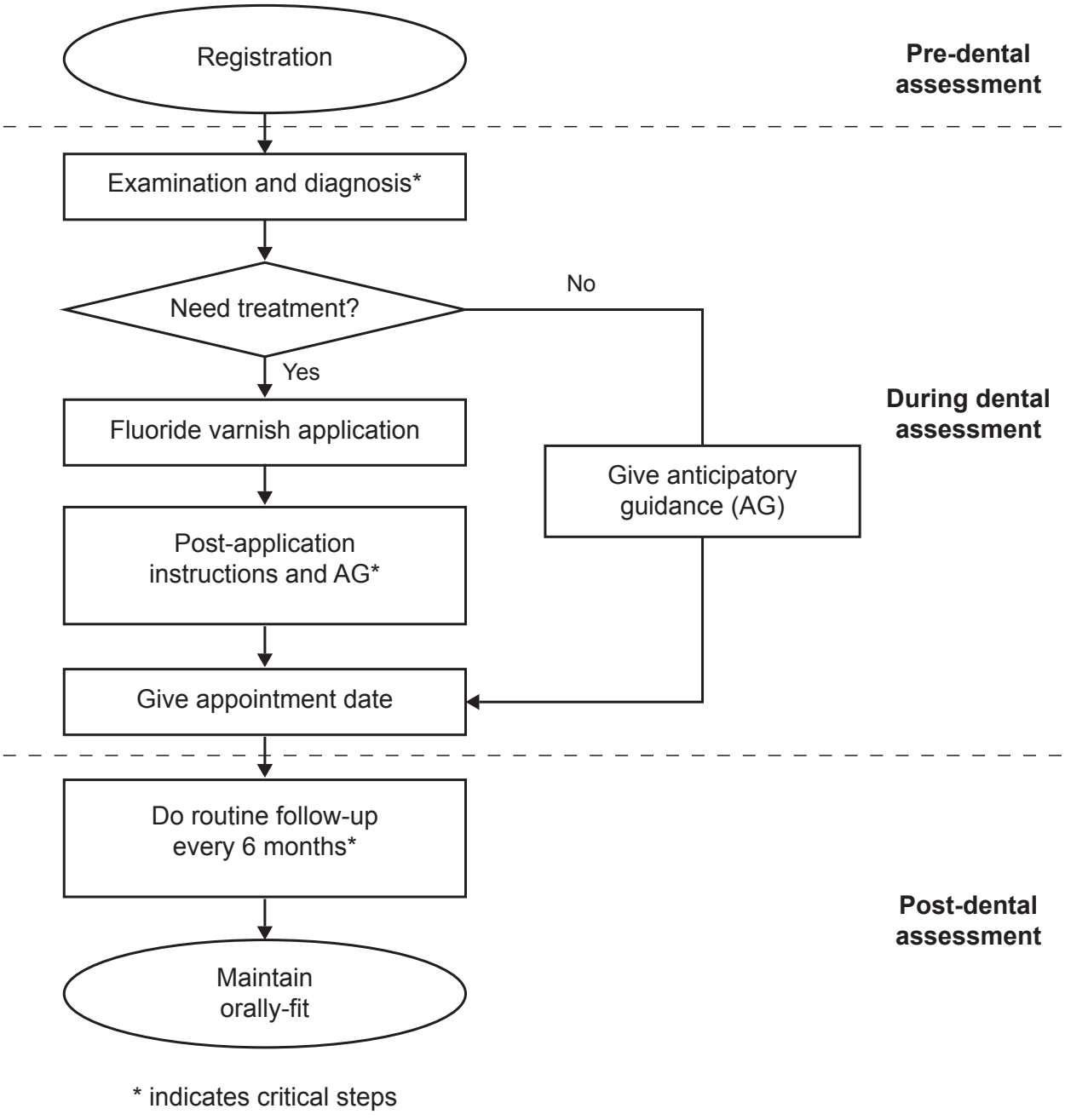


Figure 1: Process of care of operational procedures for oral health assessment and management

Upon reviewing these critical steps, the problem was further analysed to identify potential contributing factors to the high percentage of incomplete FVA among toddlers (Figure 2). The contributing factors identified were: (i) a lack of commitment among dental operators in treating toddlers, (ii) a poor follow-up system, and (iii) a lack of parental awareness regarding the importance of FVA.

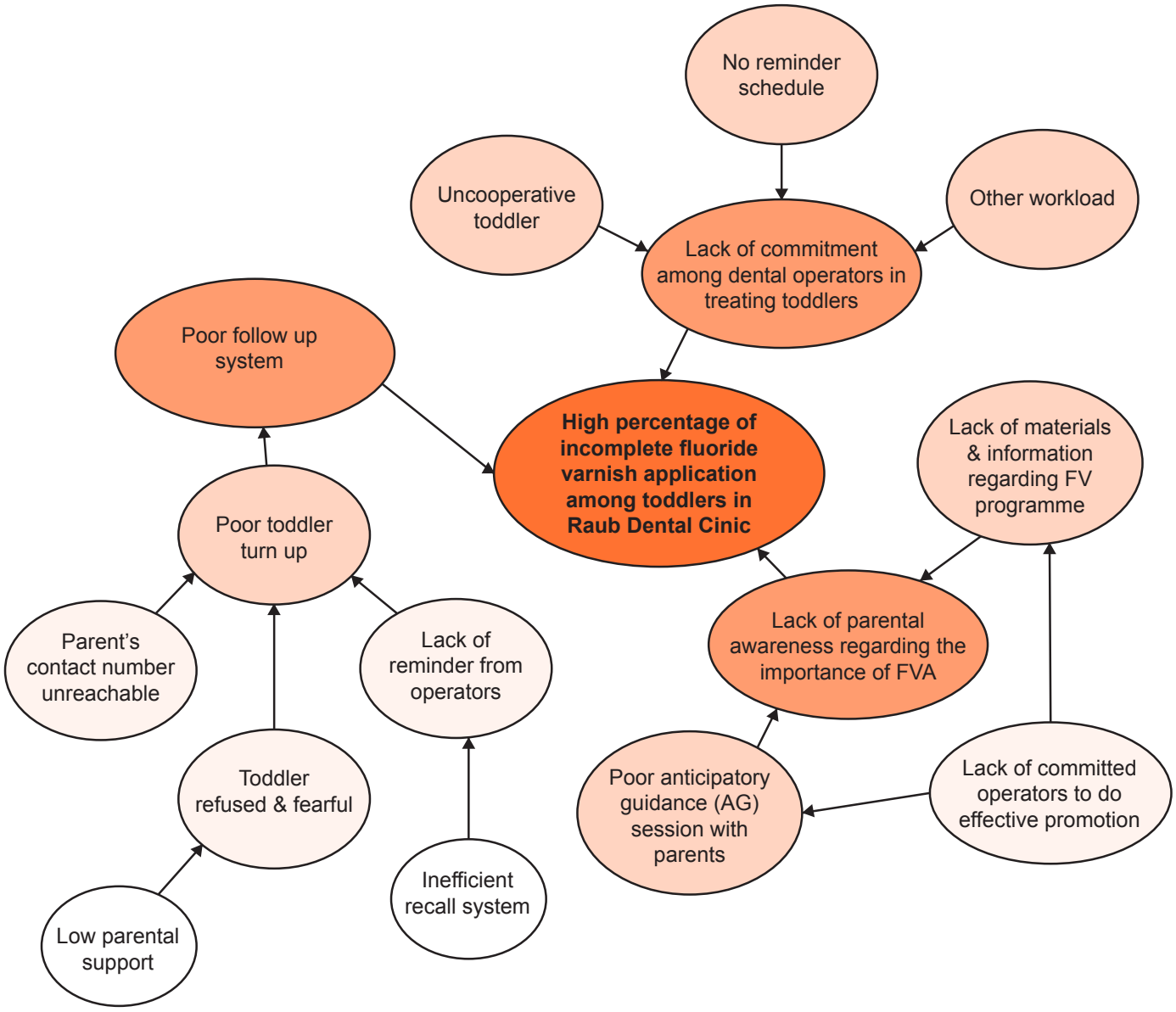


Figure 2: Problem analysis chart

To assess the magnitude of these factors, a self-administered questionnaire (Appendix 1) was distributed via Google Form to 14 dental operators at the Raub Dental Clinic. The questionnaire included three domains representing the three identified main contributing factors, comprising a total of 13 yes-or-no questions: four questions on operator commitment, four questions on the follow-up system, and five questions on parental awareness.

To determine parental awareness regarding oral health, fluoride varnish treatment, attitude, and practices, a structured questionnaire by Singhal et al. (23) was adapted, translated into simple Malay Language and administered to 30 parents (Appendix 2). The questionnaire consisted of 12 yes-or-no questions, which were completed either by face-to-face interviews with dental operators in the treatment room or independently by parents in the waiting area.

For assessing toddlers' cooperation and fear towards dental treatment (n=30), an observation form (Appendix 3) adapted from the Frankl Behaviour Rating Scale (FBRS, 1962) (22) was used. The dental operator determined the toddler's behaviour based on a scale of four behaviour categories, ranging from score 1 (definitely positive), score 2 (positive), score 3 (negative), and score 4 (definitely negative). In this study, a score of 3 was used to identify uncooperative toddlers. Meanwhile, score 4 indicated toddlers who refused or were fearful of dental treatment. The treatment cards were then marked with stickers for easier identification.

In addition, a dental treatment card was reviewed to determine the number of unreachable parental contact numbers during the recall process. Findings from the Questionnaire 1 (Dental Operators): 57% of dental operators had an inefficient recall system, 48% conducted poor AG sessions with parents, 45% lacked a reminder schedule, 30% felt overwhelmed by other workload demands, and 46% admitted neglecting recall scheduling and the use of effective behavioural management techniques due to lack of commitment.

Findings from Questionnaire 2 and Treatment Card Review (Parents): 49% were unaware of the importance of FVA, 44% were unsupportive in managing their child's behaviour, 33% had unreachable contact numbers, of which 85% were no longer in service, 10% were incorrect numbers, and 5% directed to voicemail. Additionally, only 6% reported not receiving reminders about their child's next FVA visit from dental operators.

Findings from the toddlers' observation, 57% were uncooperative, of which 85% attributed this to an unfamiliar clinic environment, and 15% were fearful of dental instruments. Meanwhile, only 13% were classified as refusing or fearful of dental treatment.

Strategy

Several strategies were identified and implemented to address the contributing factors to the high percentage of incomplete FVA among toddlers at Raub Dental Clinic. These strategies were executed over four cycles, from May 2020 to December 2023.

a) First Cycle

During the first cycle of remedial measures, a tailored toddler follow-up book was introduced (Appendix 4). This system allowed each operator to systematically recall toddlers by listing the operator's name, toddler's details, parent's contact number, date of each FVA visit, and remarks for missed appointments. Operators could then actively remind parents via phone calls and personal WhatsApp messages. Additionally, an FVA appointment card was given to parents as a written reminder of their child's next FVA visit.

In the second intervention, AG sessions were enhanced by fully utilising the AG checklist from the toddler's record book (*Rekod Kesihatan Bayi & Kanak-kanak*). Demonstrations of oral hygiene techniques using a teeth model and flipchart was conducted to emphasise the importance of FVA. Thirdly, two sessions of continuing dental education (CDE) were conducted for dental operators to ensure comprehensive knowledge and understanding of FVA protocols. The fourth strategy involved dedicated appointment slots for toddlers receiving FVA every afternoon from Monday to Thursday. This scheduling ensured that each operator could provide FVA visits without any limitations.

The fifth strategy leveraged the clinic's Facebook page to promote FVA more effectively. Monthly posts included four FVA-related posters and two posts about parental sharing sessions. Flyers were also distributed to raise parental awareness about FVA and a dedicated team of dental therapists was established to form a smaller, more focused group that could be closely monitored and supported. By working together as a unified team, they were able to share the workload more effectively, thereby increasing the efficiency of the new recall system.

The sixth strategy, chairside education using flipcharts, flyers, and teeth models was introduced to improve parental awareness and knowledge. In addition, multiple sharing sessions were organised with parents, both individually and in groups. As a result, parents were able to gain more knowledge and practice a good oral hygiene routine for their children.

Table 1: Improvements of the critical steps in Model of Good Care (MOGC)

Critical Steps	Criteria	Standard	Pre-remedial	Cycle 1	Cycle 2	Cycle 3	Cycle 4
Examination and diagnosis	Carried out with good behavioural management techniques for toddlers. [Refer to American Academy of Pediatric Dentistry: Behavior guidance for the pediatric dental patient (24)]	100%	57%	90%	93%	97%	100%
Post-application instructions and AG	Using AG checklist and emphasise the importance of FVA. [Refer to *Rekod Kesihatan Bayi & Kanak-kanak* (25) and Guidelines of Early Childhood Oral Healthcare (10)]	100%	50%	78%	88%	93%	97%
	Chairside education with parents	100%	35%	75%	88%	95%	98%
	Post-treatment rewards for toddlers	100%	58%	80%	95%	98%	100%
Do routine follow-up	Provide both verbal and written reminders via appointment card for the next FVA visit.	100%	70%	80%	90%	100%	100%
	Operator records toddler's visit in their own recall book.	100%	49%	78%	100%	100%	100%
	Provide a reminder to parents a few days prior to their child's upcoming visit via phone.	100%	51%	68%	95%	98%	100%

The seventh strategy involved recording two contact numbers for each parent in the dental treatment card. Contact information was updated and reconfirmed at each visit to improve effectiveness of the recall system. The eighth strategy focused on reinforcing the tell-show-do technique to familiarise toddlers with the dental environment. This technique involved verbal explanations of procedures using age-appropriate phrases/language. Toddlers were rewarded with items such as toothbrushes and toothpaste to encourage good behaviour for future visits.

b) Second Cycle

Additional strategies were initiated in cycle 2 to further improve the process. The ninth strategy involved upgrading the recall system by shifting communication from operator's personal WhatsApp accounts to the WhatsApp Business application using the clinic's phone number. This change was implemented by installing the application on the operator's smartphone, ensured a more official and professional communication approach.

The tenth strategy introduced custom FVA stickers (Appendix 5), which were

placed on the toddler's front books. This initiative was developed in collaboration with the Maternal and Child Health Clinic (MCHC) Raub. This sticker served two purposes: providing parents with a written reminder of upcoming FVA visit dates, and tracking tools for operators of the actual dates of toddler's FVA visits.

The eleventh strategy strengthened AG sessions by reinforcing CDE training among operators, focusing on techniques to manage uncooperative toddlers, particularly through the application of knee-to-knee position. This technique, commonly used for young toddlers, provide a comfortable actively involved parents during dental procedures. Additionally, dental puppets were also used to attract toddlers' attention and encourage cooperation.

The twelfth strategy involved video sharing via the WhatsApp Business application to raise parental awareness. Videos and e-flyers were compiled and made accessible through a QR code and a Google Drive link, allowing easy access for both operators and parents.

The thirteenth strategy was the introduction of *Hari Anakku*, a weekly event held every Thursday. Activities included video presentations, talks, and demonstrations for parents. This solidified the efforts aimed at increasing parental awareness and involvement. Finally, inflatable cartoon balloons were introduced as post-treatment rewards, helping toddlers feel more relaxed and improved their cooperation during their FVA sessions.

c) Third and fourth cycle

The interventions carried out in Cycle 1 and Cycle 2 were monitored, measured and evaluated throughout Cycle 3 and 4 to ascertain sustainability. No further interventions were introduced during these cycles.

Results

The remedial actions implemented from May 2020 to December 2023 showed an improvement in the percentage of toddlers completing FVA at the Raub Dental Clinic. The completion rate increased from a baseline of 12% to 19% in Cycle 1, 24% in Cycle 2, 33% in Cycle 3, and ultimately reached 43% in Cycle 4 (Figure 3). The final two cycles successfully met the DSA standard of ≥30%.

Improvements were also observed across all criteria in the Model of Good Care (Table 1) after four cycles of intervention. The post-remedial results showed that 100% of oral examinations were performed using appropriate behavioural management techniques, specifically the tell-show-do method combined with the knee-to-knee position. Both anticipatory guidance for parents and chairside education also improved to 93% and 95%, respectively, through the use of dental aids. The recall system was further strengthened, achieving 100% compliance in providing follow-up reminders and recording toddler's visit in the recall book.

Following the fourth remedial cycles, a notable reduction in Achievable Benefit Not Achieved (ABNA) was attained, decreasing from 18% to -13%. Furthermore, the proportion of toddlers with new carious lesions dropped from 19% to 3% among those who completed their FVA (Figure 4).

Lessons and Limitations

This study highlighted several key lessons. A well-structured follow-up system proved vital in ensuring toddlers received a complete FVA. The formation of a dedicated dental therapist team, combined with enhanced communication tools like custom FVA stickers and the WhatsApp Business application, significantly improved toddler attendance, parental engagement and dental operators' commitment. These strategies not only increased the percentage of complete FVA but also contributed to a reduction in caries rates, demonstrating strong potential for sustained, measurable impact.

However, the study encountered several limitations. Firstly, resource constraints were evident. While the use of FVA stickers was effective, the cost (RM97 per 1,000 pieces) may pose sustainability challenges, particularly in clinics with limited budgets. Secondly, although the transition to WhatsApp Business eventually improved communication and reduced operators' burden, the initial reliance on operator's personal numbers added to their workload during the early phases. Additionally,

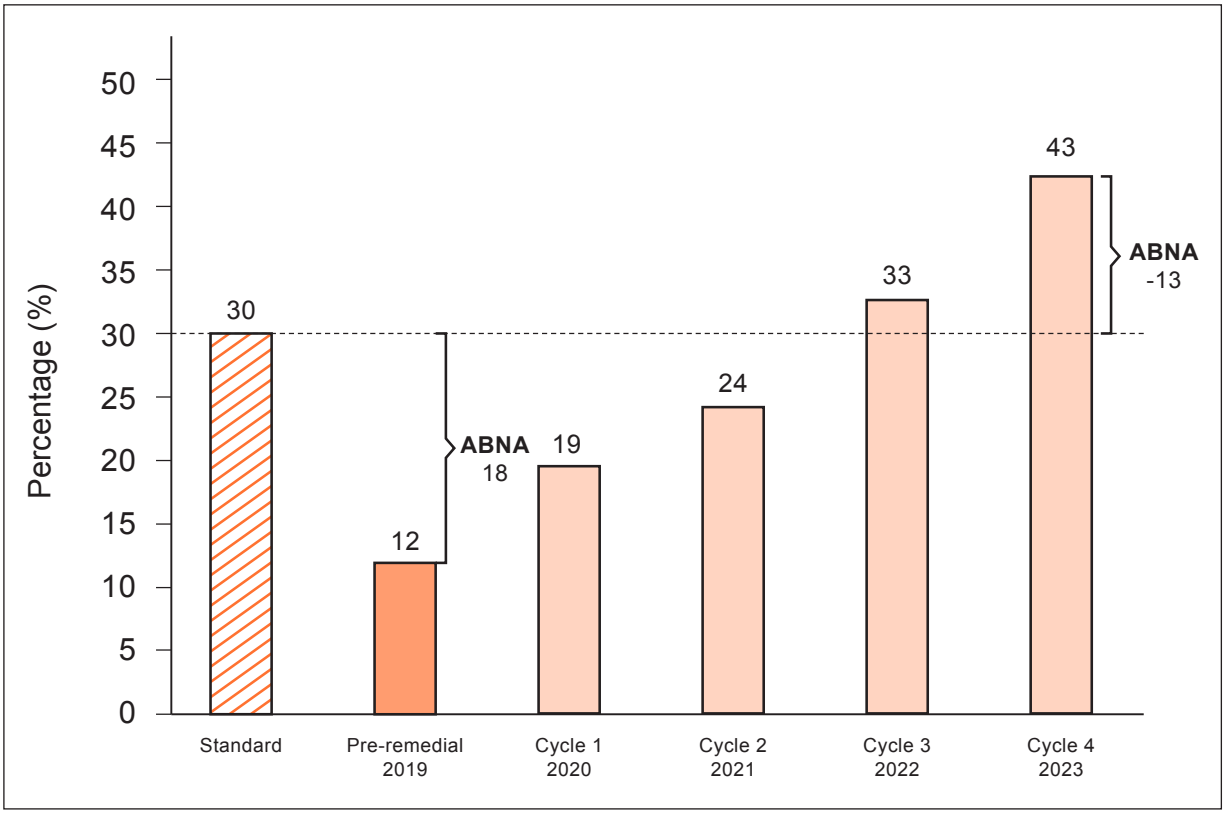


Figure 3: Percentage of completed FVA among toddlers at the Raub Dental Clinic

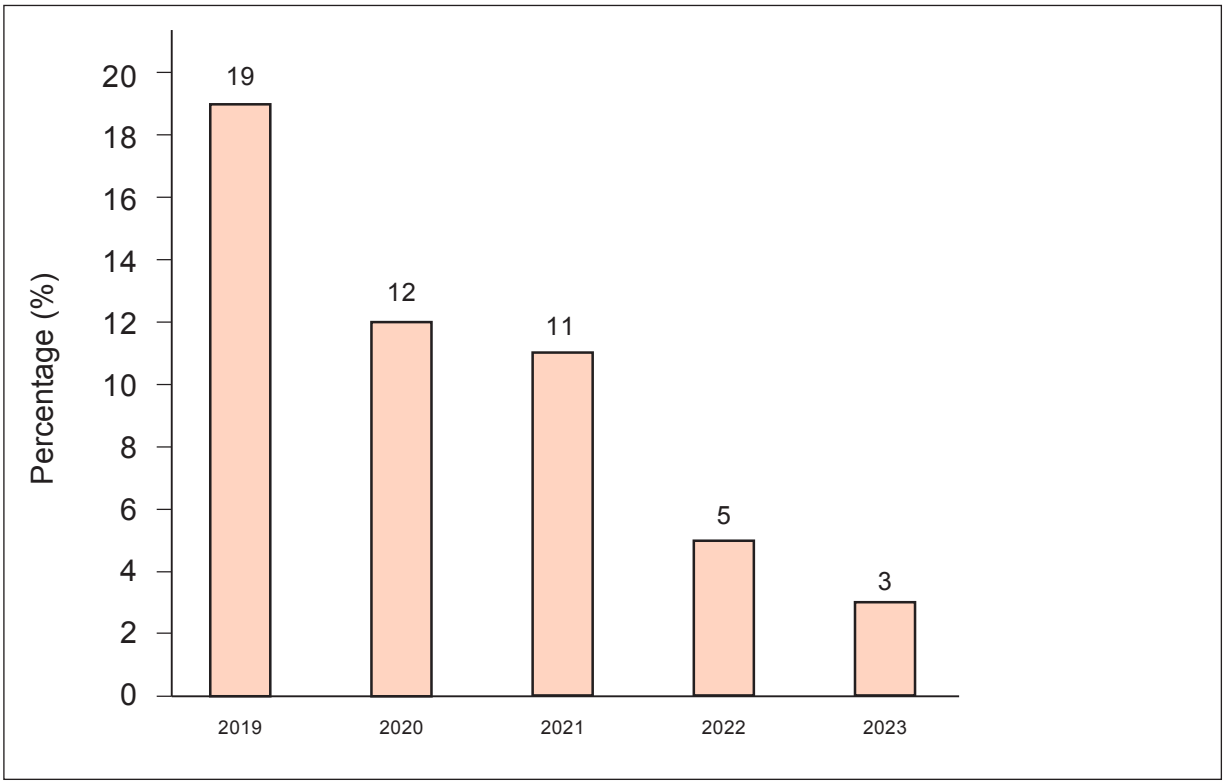


Figure 4: Percentage of new carious lesions among toddlers with completed FVA

the small sample sizes in Cycle 3 (128 toddlers) and Cycle 4 (133 toddlers) limit the strength of the findings and may affect their replicability beyond Raub District. The study's scope was confined to a single clinic using convenience sampling, which further limits the generalisability of the results.

Although the interventions showed promising outcomes, additional improvement cycles and long-term monitoring are necessary to evaluate their sustainability and broader applicability. If this study were to be repeated, it is recommended to adopt the WhatsApp Business application earlier, establish a centralised supply of stickers to manage costs more efficiently, or consider low-cost alternatives for written reminders - such as using clinic stamps or photocopied appointment card templates. Lastly, implementing a structured, digital appointment reminder system integrated with patient records could further enhance follow-up and communication.

Conclusion and the Next Steps

This study successfully identified the factors contributing to the high percentage of incomplete FVA among toddlers. Targeted interventions were also implemented to address these problems. Continuous monitoring of remedial measures is necessary to ensure the clinic surpassed the DSA standard of ≥30%. Given the positive outcomes of this study, all interventions have been replicated across all government dental clinics in the Raub district to enhance the FVA programme. Since 2023, two of the key interventions: (1) Customised FVA reminder stickers, and (2) FVA WhatsApp Business application for recalls have been scaled up for implementation across all districts in Pahang to improve the follow-up system for toddlers. Moving forward, it is hope that these remedial measures can be considered for national level implementation to further enhance the effectiveness of toddler oral healthcare services in Malaysia.

References

1. Oral Health Programme. Guidelines Clinical Prevention Programme for Caries (CPPC). Ministry of Health Malaysia;2020.
2. Oral Health Programme. Manual Fluoride Varnish Programme for Toddlers. Ministry of Health Malaysia;2019.
3. Weyant RI, Tracy SL, Anselmo T, Beltrán-Aguilar ED, Donly KJ, Frese WA, et al. Topical Fluoride for Caries Prevention: Executive Summary of The Updated Clinical Recommendations and Supporting Systematic Review. J Am Dent Assoc;2013:144(11):1279–91.
4. Marinho VCC, Worthington H., Walsh T, Clarkson JE. Fluoride Varnishes for Preventing Dental Caries in Children and Adolescents. Cochrane Database of Syst Rev. 2013(7). https://doi.org/10.1002/14651858.CD002279.pub2
5. American Dental Association Council on Scientific Affairs. Professionally Applied Topical Fluoride : Evidence-Based Clinical Recommendations. Journal of the American Dental Association. 2006;137(8):1151–9. https://doi.org/10.14219/jada.archive.2006.0356
6. Autio-Gold J. Recommendations for Fluoride Varnish Use in Caries Management. Dent Today. 2008;27(1):64-58.
7. Pejabat Kesihatan Pergigian Daerah Raub. Laporan Tahunan. 2020.
8. Karim FA, Yuzadi Z, Yusof M, Azlida N, Nor M. Prevalence of Dental Fluorosis and Its Associated Factors After Cessation of Water Fluoridation. Malaysian Journal of Medicine and Health Sciences. 2021;17(1):68-76.
9. Pahang State Dental Health Division. District Specific Approach Report. 2020.
10. Oral Health Programme. Guidelines Early Childhood Oral Healthcare 2008. Ministry of Health Malaysia;2008.
11. Buckingham, S., John, J. Recruitment and participation in pre-school and school-based fluoride varnish pilots – the South Central experience. Br Dent J 215, E8 (2013). https://doi.org/10.1038/sj.bdj.2013.834

12. Lee ZL, Gan WY, Lim PY, Hasan R, Lim SY. Associations of Nutritional Status, Sugar and Second-Hand Smoke Exposure with Dental Caries among 3-to-6-Year old Malaysian Pre-Schoolers: A Cross-Sectional Study. BMC Oral Health. 2020 Jun 3;20(1):164. https://doi.org/10.1186/s12903-020-01152-0

13. World Health Organization. Global Oral Health Status Report:Towards Universal Health Coverage for Oral Health by 2030. who.int/publications. Updated November 18, 2022. Accessed January 25, 2024.

14. American Dental Association Council on Scientific Affairs. Professionally Applied Topical Fluoride: Evidence-Based Clinical Recommendations. J Am Dent Assoc. 2006 Aug;137(8):1151–1159. https://doi.org/10.14219/jada.archive.2006.0356

15. Swigonski NL, Yoder KM, Maupome G, Ofner S. Dental Providers' Attitudes Regarding the Application of Fluoride Varnish by Pediatric Health Care Providers. J Public Health Dent. 2009 Fall;69(4):242-247. https://doi.org/10.1111/j.1752-7325.2009.00129.x

16. Manski MC, Parker ; M Elaine. Early Childhood Caries: Knowledge, Attitudes, and Practice Behaviors of Maryland Dental Hygienists. J Dent Hyg. 2010 Fall;84(4):190-195.

17. Tyagi R, Sharma A. Behavior Assessment of Children in Dental Settings: A Retrospective Study. Int J Clin Pediatr Dent. 2011;4(1):35–9. https://doi.org/10.5005/jp-journals-10005-1078

18. Almehmadi AH, Bannan A, Ahmad A, Alqadi R, Alhindi A. Parental Knowledge and Awareness of Fluoride Varnish Application on Their Children - A Cross-Sectional Study. Int J Gen Med. 2022 September;15:7435-7442. https://doi.org/10.2147/IJGM.S378194

19. Hussein AS, Abu-Hassan MI, Schroth RJ, Ghanim AM. Parent's Perception on the Importance of their Children's First Dental Visit (A cross-sectional Pilot Study in Malaysia). Journal of Oral and Dental Research. 2013;1(1):23-28.

20. Regional Health Authority W, Health M, Schroth RJ, Wilson A, Prowse S, Edwards JM, et al. Looking Back to Move Forward: Understanding Service Provider, Parent, and Caregiver Views on Early Childhood Oral Health Promotion in Manitoba, Canada. Can J Dent Hyg. 2014;48(3):99-108.

21. Singhal K, Prasanth MA, Singh V, Choudhary R. Knowledge, Attitude and Practice of Parents About Child Oral Health in Jodhpur City: A Questionnaire Survey. Int J Dent Med Res. 2015 March-April;1(6):34-41.

22. Riba H, Al-Jundi A, Al-Zahrani S, Al-Buqmi N. A Review of Behavior Evaluation Scales in Pediatric Dentistry and Suggested Modification to the Frankl Scale. EC Dental Science. 2017;16(6):269-275.

23. Khanduri N, Singhal N, Mitra M, Rohatgi S. Knowledge, Attitude, and Practices of Parents Toward Their Children's Oral Health: A Questionnaire Survey in Bhairahawa (Nepal). International Journal of Pedodontic Rehabilitation. 2018;3(2):59-61.

24. American Academy of Pediatric Dentistry. Behaviour Guidance for the Pediatric Dental Patients. The Reference Manual of Pediatric Dentistry. Chicago, III : American Academy of Pediatric Dentistry; 2024:358-78.

25. Family Health Development Division. Rekod Kesihatan Bayi dan Kanak-kanak (0-6 tahun) Pindaan 03/2021. Ministry of Health Malaysia;2021.

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Conflict of Interest

The authors declare that there was no conflict of interest.

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Appendix 1: Questionnaire 1 (Operators)

QUESTIONNAIRE FOR QA PROJECT RAUB DENTAL CLINIC 2020

Title : Towards High Percentage of Complete Fluoride Varnish Application (FVA) Among Toddlers in Klinik Pergigian Raub

Date :

	Questions	Answer	
1.	Do you do knee-to-knee position during intra-oral examination for toddler younger than one year old?	Yes	No
2	Do you perform tell-show-do technique prior intra-oral examination to toddler?	Yes	No
3	Do you inform each parent that fluoride varnish require 4 times application at 6 months interval in order for effective caries prevention?	Yes	No
4	Do you give appointment date for upcoming fluoride varnish visit to the parents via verbal dan written?	Yes	No
5	Do you call parents to inform their child's next visit few days prior their appointment date?	Yes	No
6	I ticked and ensure all the information in AG checklist in toddler's book was delivered to each patient	Yes	No
7	Fluoride varnish information is given to parents without any dental aids (eg : dental model, flipcharts)	Yes	No
8	Fluoride varnish application and oral hygiene instructions can be done around 10 minutes	Yes	No
9	It is difficult to give full commitment for follow up due to each other work tasks	Yes	No
10	Fluoride varnish information can be given sufficiently through verbal	Yes	No
11	I have my own toddler follow up book/list	Yes	No
12	Fluoride varnish information was given in treatment room only	Yes	No
13	Rewards are given in order to gain toddler's cooperation	Yes	No

Appendix 2: Questionnaire 2 (Parents)

No.	Questions	Circle your answer	
1	Have you ever heard about fluoride varnish application?	Yes	No
2	Fluoride varnish should be applied once a year.	Yes	No
3	Fluoride varnish can weaken teeth.	Yes	No
4	Fluoride varnish should be applied to children of age 5 and 6 years old only.	Yes	No
5	Do your child scared on going to the dentist?	Yes	No
6	Do nurses/doctors informed you regarding next appointment's date?	Yes	No
7	Do you only come to dental clinic when your child complaining of toothache?	Yes	No
8	Do you clean child's teeth after every meal?	Yes	No
9	Do you bring your child for routine dental check-up every 6 months?	Yes	No
10	My child always cries during dental visit.	Yes	No
11	Information regarding fluoride varnish is easy to understand & very interesting.	Yes	No
12	I know that frequent night time bottle feeding can cause tooth decay.	Yes	No

Appendix 3: Frankl Behaviour Rating Scale 1962 (Observation form)

TODDLER'S SHEET

No	Toddlers's name	Last 4 IC No.	Frankl Score			
			--	-	+	++
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						

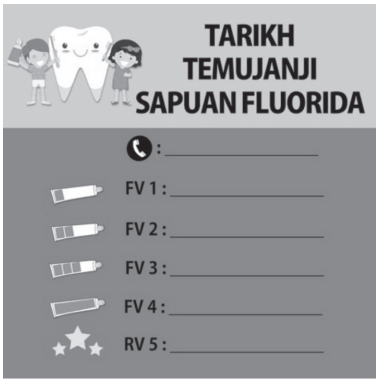
Appendix 4: Toddler's follow up template for recall system

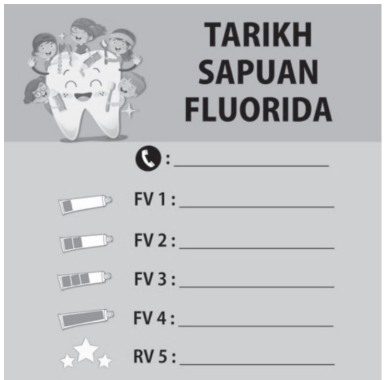
TODDLER'S FOLLOW-UP
(For toddlers receiving FVA at 6-monthly)

Operator's name : _____

No.	Toddler's Name	Date of Birth	Phone Number	Date of FVA visit				Remark
				FVA 1	FVA 2	FVA 3	FVA 4	

Appendix 5: Custom FVA stickers





REDUCING MISSED APPOINTMENTS AMONG ORTHODONTIC PATIENTS IN THE ORTHODONTIC UNIT, SEREMBAN DENTAL SPECIALIST CENTRE

Syaza Mohd Noor, Siti Sakhira Hamzah, Noraliza Amiruddin

Orthodontic Unit, Seremban Dental Specialist Clinic, Seremban, Negeri Sembilan

Corresponding Author: Syaza Mohd Noor
Email: syaza@moh.gov.my

Abstract

Orthodontic treatment requires regular follow-up to ensure the treatment's success. Failure to attend appointments regularly contributed to prolonged treatment duration, exposure to the treatment's side effects, and poor utilisation of clinical and administrative resources. Our study aimed to reduce the number of missed appointments from 22.4% to 0% in the Orthodontic Unit, Seremban Dental Specialist Centre. A questionnaire was developed to identify reasons for missed appointments and to assess patients' awareness of the missed appointments' effects. The main strategy for improvement was sending reminders through 'WhatsApp Bussiness Messages' to patients before their scheduled appointment, which was done in two cycles (December 2021 - February 2022 and September - November 2022). Reasons for missed appointments were due to other commitments (36%), forgetfulness (32%), and illness (18%), followed by difficulty getting transportation (10%), bad weather (3%), and miscommunication between staff and patients (1%). The majority of respondents were aware of the missed appointments' effects on their dental health, treatment progression, and clinical resources (87%). The first re-evaluation conducted in March 2022 showed a reduction in the percentage of missed appointments to 4.7%, and further reduced to 0% in the second cycle in December 2022. The intervention strategy showed an effect in reducing the number of missed appointments among orthodontic patients. Respondents expressed a preference for receiving a reminder via text message one day before their appointment. The added values from this study included improvement in organised documentation and updated patient information. A graphical flyer sent together with reminders has helped to increase patients' understanding of the importance of regular orthodontic follow-up, hence enhancing patients' compliance with their orthodontic appointments. Consistent efforts to provide reminders to patients, along with regular evaluation of the reminders' effectiveness, are essential in promoting patients' attendance. This, in turn, enhances treatment efficiency, shortens overall treatment duration, optimises resource utilisation, and contributes to improved clinical outcomes and patient satisfaction.

KEYWORDS: Missed appointment, Orthodontics, Quality improvement study

Problem

Correction of discrepancies in teeth and jaw alignment requires orthodontic treatment. A successful completion of orthodontic treatment depends on the patient's cooperation by attending appointments scheduled, wearing prescribed appliances as directed, and maintaining good oral hygiene (1,2). Unlike any other dental treatment, orthodontic treatment entails using fixed or removable appliances that require regular follow-up to complete the treatment. When a patient fails to appear on a regular visit, the appointment must either be rescheduled or postponed until the next appointment cycle. As a result, treatment time will be prolonged, and patients are prone to experience more side effects, such as dental decalcification, periodontal problems, ulcers, and root resorption (3,4). Furthermore, missed appointment contributes to poor utilisation of clinical and administrative resources, which leads to a decrease in clinic productivity (5,6). Rescheduling patients' appointments may also disrupt the efficient scheduling of the clinic.

Seremban Dental Specialist Clinic (SDSC) is a government dental facility under the Ministry of Health Malaysia located in the heart of Seremban, Negeri Sembilan. This facility consists of two administrative units and four clinical units, including the Orthodontic Unit, Restorative Unit, Periodontic Unit, and Dental Public Health Unit. This facility is equipped with twelve dental chairs and supported by a sterilisation room in each unit and a dental laboratory serving approximately 692,407 of the Seremban population. The Orthodontic Unit of SDSC serves as the main orthodontic referral centre in the district of Seremban. It has two orthodontic specialists, four dental officers, one orthodontic technician and six dental surgery assistants. On average, 440 patients are being seen monthly in this unit for orthodontic treatment.

In Malaysia, studies to highlight the issue of missed appointments in orthodontic clinics are lacking. A total of 18.7% of orthodontic patients missed their appointments in the Orthodontic Unit, Seremban Dental Specialist Centre in 2019. The percentage increased to 22.4% during the first quarter of 2000. This triggered an alarm that the issue of missed appointments among orthodontic patients must not be taken lightly. As the demand for orthodontic treatment continues to rise among the population in Seremban, patients whose malocclusion does not require immediate intervention are placed on an orthodontic waiting list. Delaying treatment progression of ongoing orthodontic patients not only affects the care but also results in wasted appointment slots. The inefficiency subsequently extends the orthodontic waiting list, creating longer delays for new patients.

Effective scheduling and patient compliance are crucial to minimise such disruptions and optimise treatment timelines. In addressing the problem, there is a need to further understand the reasons for failure in appointment attendance, which will be useful in developing strategies for the efficient delivery of health care services in the future. Therefore, to improve service efficiency, this study aims to reduce the number of missed appointments from over 20% to 0% in the Orthodontic Unit of SDSC by implementing appointment reminder strategies between December 2021 and December 2022.

Background

A missed appointment can be described as a failure to attend a session that has been scheduled at a particular time for a particular patient. Missed appointments have become a significant problem not only in primary care settings but also in specialist clinics. Studies in an orthodontic unit of King Saud University and an orthodontic unit of University Dental Hospital in Manchester showed that the rate of missed orthodontic appointments was 24.8% and 19.4 % respectively (7,8). The issue of nonattendance in orthodontic clinics has an important influence on patients and clinics. It is frustrating when failure in orthodontic attendance will not only slow treatment progression but also compromise the patient's dental health by exposing the patient to adverse effects of orthodontic treatment, such as root resorption, pain, dental decalcification, and periodontal diseases, as mentioned in a study by Nabeel (9). In addition to clinical consequences

for patients, missed appointments cause unnecessary costs and inefficiencies for dental care facilities. This is supported by a study by McLean et al that underutilisation of healthcare providers, equipment, space and staff will result in loss of revenue, which may lead to increasing overall charges to patients and payers (10).

Richard and Thomas stated in their study that patients commonly provide several reasons for missing appointments, including forgetfulness, confusion, or miscommunication over appointment information, feeling better, transportation issues, and difficulty leaving work or school (11). Reminders have been traditionally used to improve patient adherence to their appointment. A study by Crutchfield et al. reported that effective appointment reminder types include mail, phone calls, email, and text messaging (12). Crutchfield et al. suggested that giving initial reminders and sending the most preferred type of reminder may have the most impact on appointment attendance (12).

Another study by Guy et al. reported that appointment attendance improved by 50% after providing short message service (SMS) reminders to patients (13), whereas in a study by Ho et al., the no-show rate reduced from 30.2% to 21.3% when patients were reminded by a phone call a week before their scheduled appointment (14). This is supported by a study done by Wood et al. on the use of AI technology reminders within the National Health Service in the United Kingdom, which highlighted the importance of implementing tailored communication strategies to enhance patient engagement with their appointments (13).

Measurement

The objective of this study is to reduce the number of missed appointments among orthodontic patients in the orthodontic unit, SDSC. This study measured the percentage of missed appointments among orthodontic patients as the main indicator. This was calculated based on the number of orthodontic appointments missed over the total number of orthodontic appointments given. The formula used to calculate the indicator is stated below.

$$\text{Percentage of orthodontic missed appointments} = \frac{\text{Number of orthodontic appointments missed (n)}}{\text{Total number of orthodontic appointments given (N)}} \times 100$$

The selected study population was patients attending orthodontic treatment in the Orthodontic Unit at SDSC. Patients who had active fixed or removable appliance treatment and did not attend their appointment at least once were considered as missing their appointment; meanwhile, patients who had completed their orthodontic treatment and were in the retention phase were excluded. The number of missed orthodontic appointments and the total number of orthodontic appointments given were collected from the Orthodontic Appointment Book, which was then used to calculate the indicator performance by the study team member.

In view of the increasing trend of missed appointments from 18.7% in 2019 to 22.4% in the first quarter of 2020 in our setting, the urgency for intervention was identified. Based on expert consensus, the standard was set to achieve 0% missed appointments among orthodontic patients in the orthodontic unit SDSC.

Initial Assessment of the Problem

Factors contributing to the increase in missed appointments among orthodontic patients are shown in the problem analysis chart in Figure 1.

Under the supervision of an Orthodontist and a Dental Public Health Specialist, a structured, self-administered questionnaire was developed to identify reasons contributing to missed appointments and to evaluate patients' awareness of the effect of missed appointments on their dental health, treatment progression and clinical resources. The questionnaire was designed in *Bahasa Malaysia* and English, which consisted of three parts (Appendix 1). The first part consisted of five items for assessing patients' sociodemographic characteristics, including gender, age, race, education level and source of payment. The second part

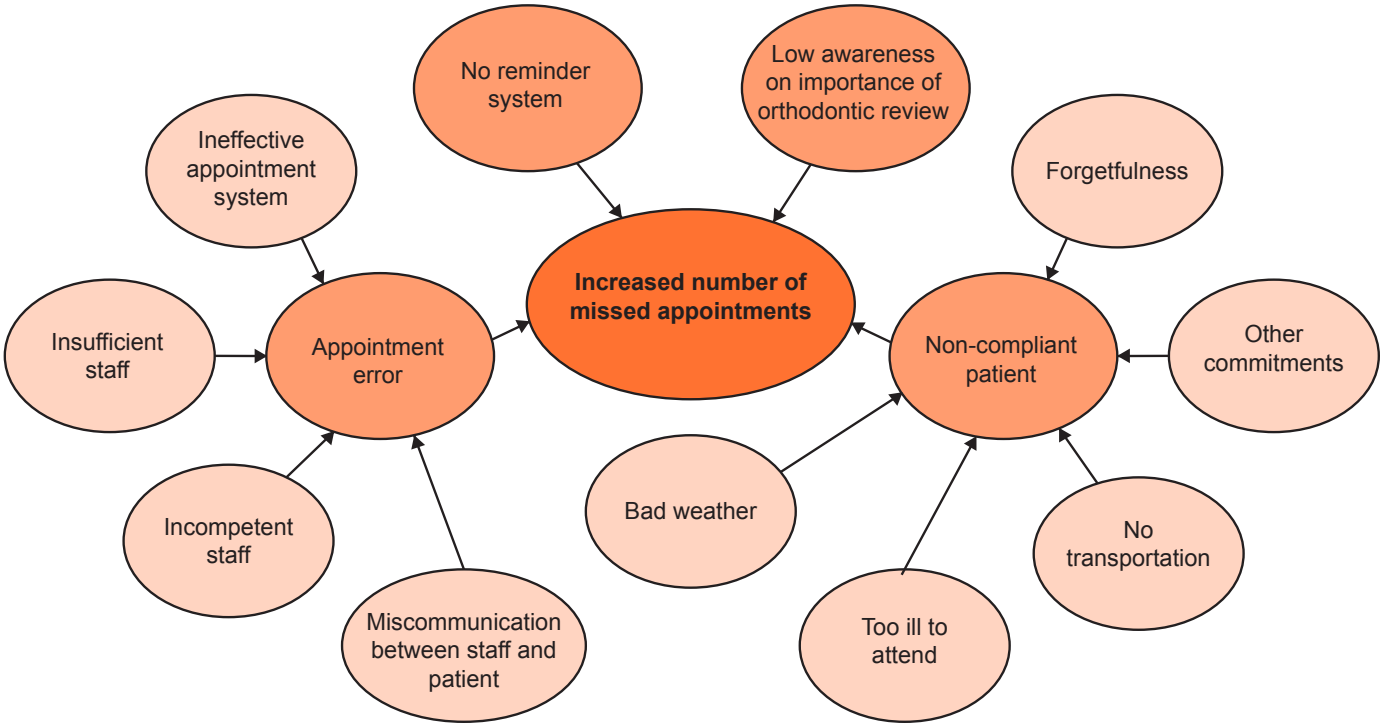


Figure 1: Factors contributing to the increase in missed appointments among orthodontic patients.

was about the reasons that contributed to missed appointments. Potential reasons for missed appointments, such as forgetting about appointments, having other commitments, being too ill to attend the appointment, having no transportation to go for an appointment, miscommunication with dental staff and bad weather, were listed in this section. Respondents were instructed to choose only one main reason for breaking their appointment. The third part consisted of three items to evaluate the patient's awareness of the effect of missed appointments on dental health, treatment progression and clinical resources. In this part, a tick box layout of 'yes' and 'no' was given to be answered.

The questionnaire was pre-tested before actual data collection to assess patient understanding of the components in the questionnaire. Thirty (30) orthodontic patients who had missed their appointment at least once were selected to participate in the session. Those participants were not included in answering the questionnaire during the actual study. Feedback from respondents regarding their understanding of the questionnaire content was obtained from this session. Necessary adjustments were made accordingly, and the questionnaire was re-revised by an orthodontist and public health specialist before being distributed in the actual study.

Subjects who fit the inclusion and exclusion criteria were selected for this study using a random sampling technique. The inclusion criteria were orthodontic patients who had active fixed or removable appliance treatment and who had missed their orthodontic appointment at least once before the study. Meanwhile, the exclusion criteria were patients who had completed their orthodontic treatment and were in the retention phase.

We enrolled 106 patients who fit the inclusion and exclusion criteria. Questionnaire distribution required only one visit and the questionnaire was collected back on the same day. Data from the questionnaire were entered into SPSS version 23 for analysis.

The mean age of the respondents was 22 years (range 16-28 years), with the majority of participants being females (79%). More than half were Malay (56%), followed by Chinese (29%) and Indian (15%) and mostly had a tertiary level of education (71.9%). Approximately two-thirds of the patients were self-paying patients (70.2%).

Findings showed that the reasons for missed appointments were mainly due to having other commitments (36%), forgetting about appointment (32%), being too ill to attend appointment (18%), followed by no transportation to go for appointment (10%), bad weather (3%), and miscommunication with dental staff (1%). 89.4% of the subjects were aware of the importance of orthodontic appointments. In addition, the majority of the subjects were also aware of the effect of missed appointments on their dental health (87.7%), orthodontic treatment progression (95.6%) and clinical administration (91.2%).

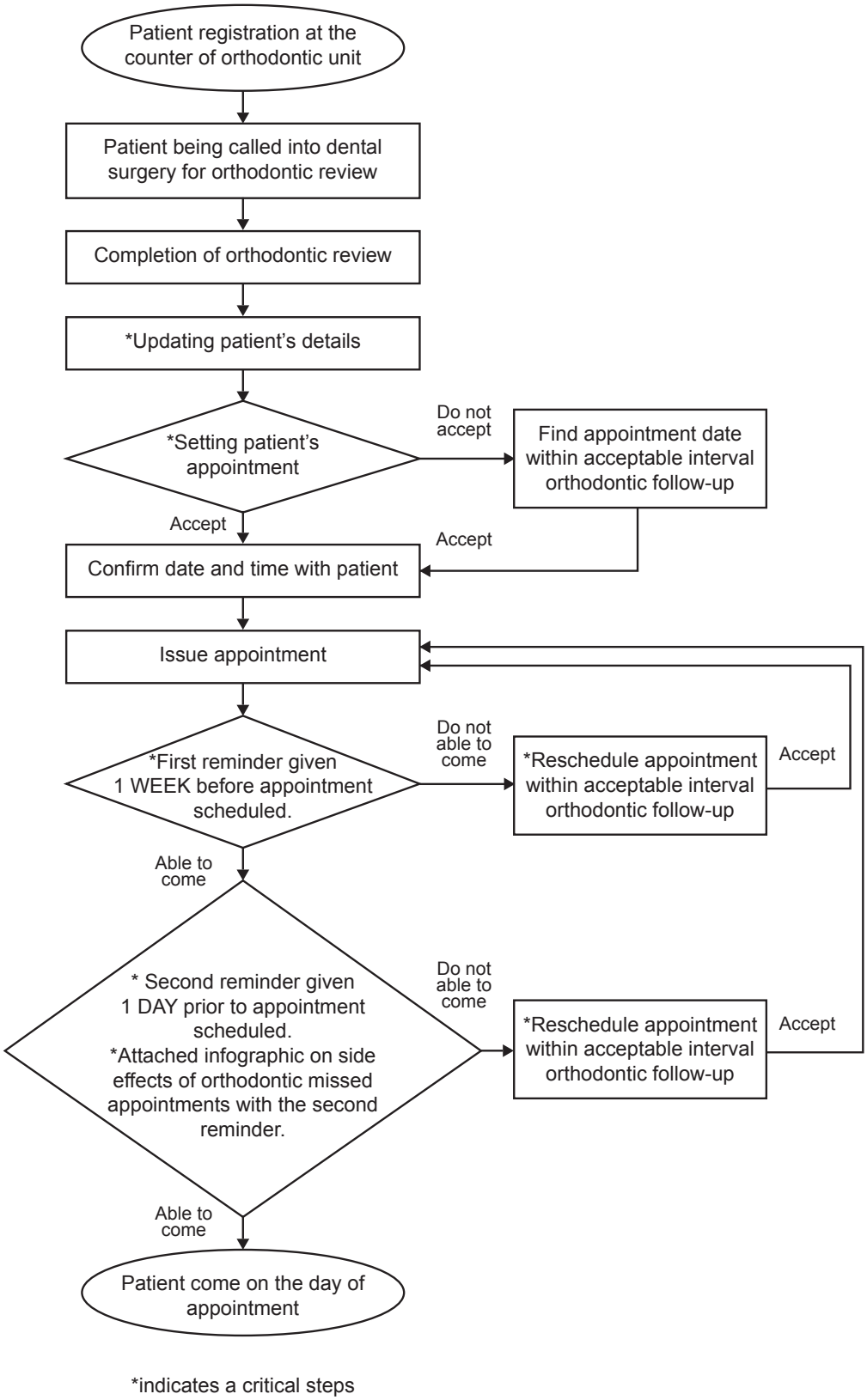


Figure 2: Flowchart on appointment process in Orthodontic Unit, Seremban Dental Specialist Centre

Strategy

Remedial measures were implemented in two cycles of three months each (Cycle 1: December 2021 - February 2022; Cycle 2: September 2022 – November 2022). Strategies in the previous cycle were continuously carried out in the following cycle throughout the study period. The effectiveness of remedial measures was evaluated in March 2022 and December 2022.

In Cycle 1, a reminder system was introduced in addition to traditional appointment cards to address factors of having other commitments, forgetting about appointments and being too ill to attend the appointment, which hinder the patients in keeping with their appointments. Starting from December 2021, all patients' contact numbers were updated following their orthodontic treatment review. The appointment date and time agreed upon by patients were issued and written down on the appointment card. A reminder was sent to patients using "WhatsApp Business Messages" one week before their scheduled appointment. This reminder includes the type of orthodontic review and the date and time for the orthodontic review. In the case of patients with unavoidable commitments on their scheduled appointment time, they were encouraged to give a call directly to our clinic at least a day prior to their appointment time to reschedule their appointment to another day within an acceptable period of orthodontic review interval. Using this approach, patients were not left unseen and the appointment slots were not wasted. Patients who had given a call to reschedule their appointment at least a day before their actual appointment were not considered as missing their appointment.

In Cycle 2 (September 2022 – November 2022), in addition to the first reminder sent a week before the appointment, a second reminder was sent a day before their scheduled appointment by using "WhatsApp Business Messages". This reminder was strengthened by adding an infographic attachment of the side effects of missed orthodontic appointments to the text messages delivered to patients, aiming to create an awareness of the importance of attending orthodontic appointments regularly. Improvement in the intervention for Cycle 2 has resulted from the subsequent questionnaire on a group of patients who still missed their orthodontic appointment despite the reminder given (Appendix 2). This was the improved version of the previous questionnaire, in which a new section was added on preferred type and timing of appointment reminders to improve their attendance at orthodontic appointments. Feedback received from this group agreed that they preferred to be reminded a day before their appointment by text messages.

Results

Following the implementation of remedial measures in Cycle 1 (December 2021 – February 2022), the number of missed appointments among orthodontic patients in the Orthodontic Unit, SDSC was observed to have reduced tremendously (Figure 3) from 22.4% in the pre-remedial phase to 4.7% during the evaluation phase conducted in March 2022. However, we were still unable to achieve our target of reducing the rate of missed appointments to 0%. Thus, the patient who continued to miss their orthodontic appointment was re-evaluated by giving another improved version of the questionnaire. The subsequent interventions were implemented as another remedial measure in Cycle 2 (September 2022 – November 2022). The evaluation of Cycle 2, conducted in December 2022, showed improved appointment attendance. We managed to obtain a 0% rate of missed appointments. Before this study, patients' information details were not updated in patients' dental records, leading to difficulty in contacting patients in case of rescheduling patient appointments or providing new information in regard of their treatment. Therefore, a discussion was convened with the staff at the registration counter to remind them to update the patient's information regularly each time the patient came for an orthodontic appointment. Consistent orthodontic attendance among orthodontic patients has accelerated treatment progress, enabling the treatment to be completed within a reasonable timeframe. Also, this allows efficient scheduling for orthodontic appointments and as a result, a significant reduction in the orthodontic waiting list was seen from two years in January 2021 to six months in January 2023.

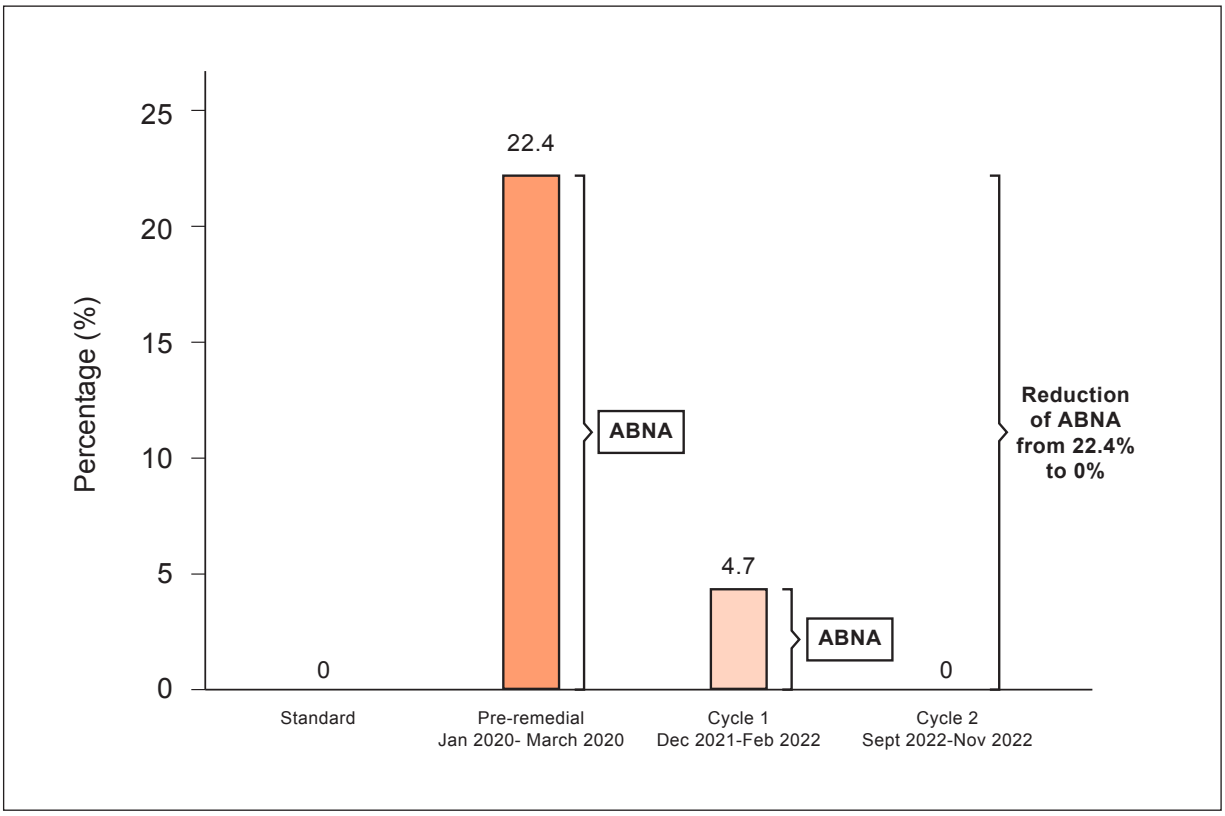


Figure 3: Percentage of missed appointments among orthodontic patients before and after remedial actions.

Table 1: Comparison of Model of Good Care Achievement Before and After Remedial Measures.

No.	Critical Step	Criteria	Standard	Verification	Cycle 1	Cycle 2
1.	Updating patients' details.	Ensure the correct patient attended his/her appointment at the time scheduled.	100%	100%	100%	100%
		Ensure that the patient's details are updated such as age, home address and contact number	100%	50%	100%	100%
		Ensure the details are properly registered and documented in the patient's dental record.	100%	70%	100%	100%
2.	Setting patients' appointments.	The date and time for the follow-up appointment are determined within a 6-week interval by the staff at the registration counter	100%	100%	100%	100%

	Ensure that the patient is available on the day of the follow-up appointment suggested.	100%	100%	100%	100%
	Once agreed, the date, time and type of appointment is documented on the patient's appointment card.	100%	100%	100%	100%
3. First reminder given 1 WEEK before appointment scheduled.	Send the first reminder with full details of the patient's appointment (date, time and type of appointment) through '*WhatsApp Business Message*'.	100%	0%	100%	100%
4. Reschedule appointment within an acceptable interval for orthodontic follow-up.	Patients who were not able to come on the date of the initial appointment given will be given a new appointment date, which will be no more than 8 weeks from the previous orthodontic appointment attended.	100%	0%	100%	100%
5. Second reminder given 1 DAY before appointment scheduled.	Send the second reminder with full details of the patient's appointment (date, time and type of appointment) through '*WhatsApp Business Message*'.	100%	0%	0%	100%
	Attached infographic on the side effects of orthodontic missed appointments with the second reminder.	100%	0%	0%	100%
6. Reschedule appointment within an acceptable interval for orthodontic follow-up.	Patients who were not able to come on the date of the initial appointment given will be given a new appointment date, which will be no more than 8 weeks from the previous orthodontic appointment attended.	100%	0%	100%	100%

Lessons and Limitations

Strong teamwork between dentists, assistants and nurses plays an essential role in ensuring the success of the mitigation. No similar study has been carried out in any Orthodontic Clinic in Negeri Sembilan. Thus, these findings have further proven that the intervention is effective in reducing the number of missed appointments among orthodontic patients in the Orthodontic Unit, Seremban Dental Specialist Centre. The added value of conducting this study included improvement in organised documentation and updated patient information. Improved communication channels by using graphical flyers have helped to increase patients' understanding of the importance of regular orthodontic follow-up, hence enhancing patients' compliance with their orthodontic appointments.

There are limitations in this study in terms of human resources. The Orthodontic Unit of SDSC is a small unit consisting of ten staff. As the main orthodontic referral centre in the district of Seremban, the rate of patients' attendance is high compared to other units in Seremban. It is sometimes challenging to find time to consistently provide reminders to patients daily. This strategy may be improvised in the future by establishing a digital platform of automated reminder systems that can be standardised across all dental facilities. However, the automated reminder system may impose additional approval, cost and trials before it can be implemented into the system. In the meantime, a manual reminder will be used to ensure the success of the intervention.

Conclusions and the Next Steps

The project was able to reduce the percentage of missed appointments to the standard set through the identification of contributing factors and the implementation of appropriate interventions to tackle this problem. The finding suggests that appointment reminders have the potential to increase patient adherence to orthodontic appointments. Consequently, it is expected that improved patient adherence to appointment attendance may result in improved patient orthodontic treatment outcomes and operational efficiency, and in the long run, will indirectly reduce the time on the orthodontic patient waiting list. Due to the significant result of this project, it would be beneficial for the knowledge gained and strategies implemented to be shared and adopted among other Orthodontic Units in the state.

To sustain the intervention project, staff will be appointed to maintain reminders to the patients by continuously discussing the results of practice change and appointment adherence rate at the clinic's monthly staff meeting. Staff will receive training focused on strengthening communication and delivering clear information regarding orthodontic appointment schedules. From time to time, patients and parents will be provided with ongoing education on the importance of maintaining consistent attendance to ensure optimal treatment outcomes, with emphasis on the potential consequences of missing appointments. The effectiveness of appointment reminders will be regularly evaluated to adapt to evolving communication patterns and mechanisms.

References

1. Nanda RS, Kierl MJ. Prediction of cooperation in orthodontic treatment. Am J Orthod Dentofacial Orthop. 1992;102:15-21.

2. Skidmore KJ, Brook KJ, Thomson WM, Harding WJ. Factors influencing treatment time in orthodontic patients. Am J Orthod Dentofacial Orthop. 2006;129:230-238.

3. Lindauer SJ, Jacob AP, Brian CL, Eser T, Bhavna S. Influence of Patient Financial Account Status on Orthodontic Appointment Attendance. Angle Orthod. 2009;79(4):755-758.

4. Omair MB , Keyvan S, Mary T. Factors affecting patient's adherence to orthodontic appointments. Am J Orthod Dentofacial Orthop. 2016;149(3):319-324.

5. Charity GM, Whitterspoon PW, Probst JC. Time and money: Effects of No-Shows at a Family Practice Residency Clinic. [online]. Researchgate: Family Medicine 2001; 33(7) :522-527. [Accessed 8 September 2021]. Available from https://www.researchgate.net/publication/11886118.

6. Sahar FA. Appointments Failure Among Female Patients at a Dental School Clinic in Saudi Arabia. Eur J Dent Educ. 2009;73(9):1118-1124.

7. Salwa AA. Frequency of missed and cancelled appointments in King Saud University orthodontic clinic. King Saud University Journal of Dental Sciences. 2013;4:77-80.

8. Can S, Macfarlane T, O'Brien KD. The use of postal reminders to reduce non-attendance at an orthodontic clinic: A randomized controlled trial. .2003;195:199-201.

9. Nabeel F.T. Adverse effects of orthodontic treatment. Saudi Dent J. 2011;23:55-59.

10. McLean SM, Booth A, Gee M, Salway S, Cobb M, Bhanbhro S, et al. Appointment reminder systems are effective but not optimal: Results of a systematic review and evidence synthesis employing realist principles.[online]. Dove Medical Press Limited. 2016;10:479–499. [Accessed 20 November 2021]. Available from www.tandfonline.com/journals/dppa20.

11. Deyo RA, Inui TS. Dropouts and broken appointments. A literature review and agenda for future research. Med Care. 1980;18(11):1146–1157.

12. Trisha MC, Christine EK. Getting patients in the door: Medical appointment reminder preferences. Patient Preference And Adherence. 2017;11:141–150.

13. Guy R, Hocking J, Wand H, Stott S, Ali H, Kaldor J. How effective are short message service reminders at increasing clinic attendance? A meta-analysis and systemic review. Health Service Research. 2012;47:2; 614-63.2.

14. Ho TL. Improving waiting time and operational clinic flow in a tertiary diabetes center: BMJ Quality Improvement Reports 2014;2:u201918. w1006.

15. Wood KV, Frings D, Flood C, Thomas N. Artificial intelligence machine learning-driven outpatient appointment management: A qualitative study on acceptability. Digital health. 2025 Jun;11:20552076251321016.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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Appendix 1: Questionnaire on Missed Appointment in Orthodontic Clinic 1.0.

Please read each question carefully before answering. Please answer all questions given. Thank you.

SECTION 1: SOCIODEMOGRAPHIC INFORMATION			Tick here to answer	For office use only
a.	Gender	Male		
		Female		
b.	Age	……. year old		
c.	Race	Malay		
		Chinese		
		Indian		
		Others *Please specify*		
d.	Education Level	Primary		
		Secondary		
		Tertiary		
e.	Payment Method	Guarantee Letter		
		Own Money		
		Others *Please specify*		
SECTION 2: REASON FOR MISSED APPOINTMENT				
a.	Which one of the following options is the reason you failed to attend your orthodontic appointment? (Please choose **ONE ANSWER ONLY**)	Forgetting about appointments		
		Having other commitments		
		Being too ill to attend appointment		
		No transportation to go for appointment		
		Miscommunication with clinical staff		
		Bad weather		
SECTION 3: PATIENT'S AWARENESS ON EFFECT OF MISSED APPOINTMENT				
a.	In your opinion, does missing an orthodontic appointment is important to you?	Yes		
		No		
b.	In your opinion, does missing an orthodontic appointment will have an effect on your oral health?	Yes		
		No		
c.	In your opinion, does missing an orthodontic appointment will have an effect on progression of your orthodontic treatment?	Yes		
		No		
d.	In your opinion, does missing an orthodontic appointment will have an effect to the clinic?	Yes		
		No		

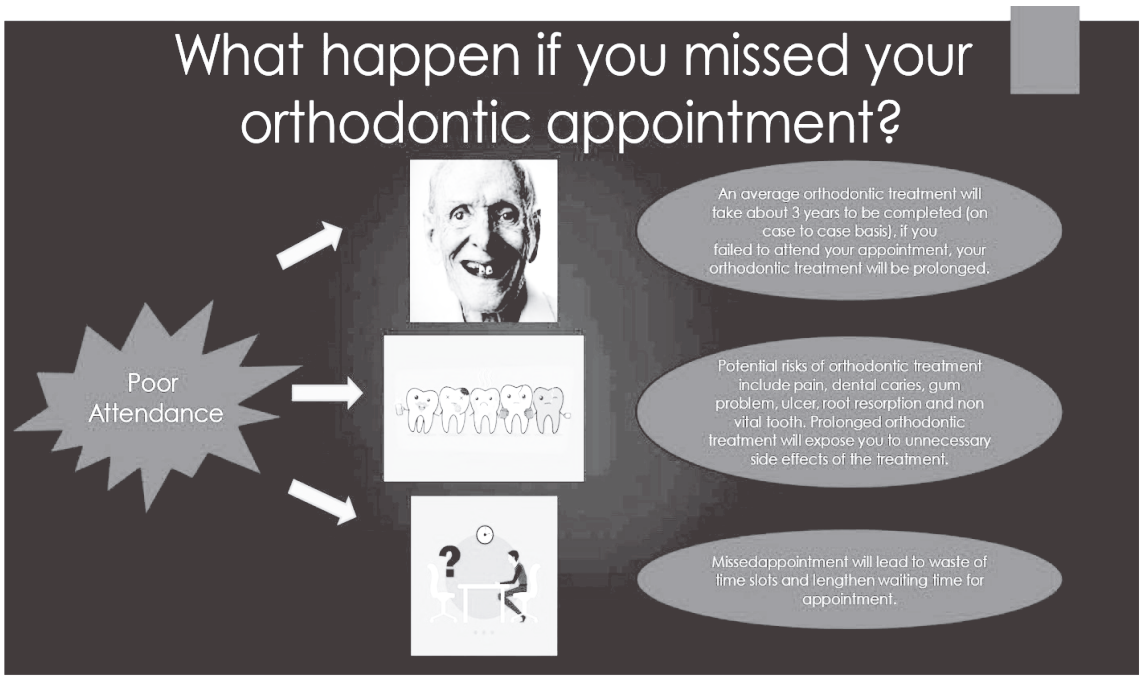
Appendix 2: Questionnaire on Missed Appointments in Orthodontic Clinic 2.0

Please read each question carefully before answering. Please answer all questions given. Thank you.

SECTION 1: SOCIODEMOGRAPHIC INFORMATION			Tick here to answer	For office use only
a.	Gender	Male		
		Female		
b.	Age	……. year old		
c.	Race	Malay		
		Chinese		
		Indian		
		Others *Please specify*		
d.	Education Level	Primary		
		Secondary		
		Tertiary		
e.	Payment Method	Guarantee Letter		
		Own Money		
		Others *Please specify*		
SECTION 2: REASON FOR MISSED APPOINTMENT				
a.	Which one of the following options is the reason you failed to attend your orthodontic appointment? (Please choose **ONE ANSWER ONLY**)	Forgetting about appointments		
		Having other commitments		
		Being too ill to attend appointment		
		No transportation to go for appointment		
		Miscommunication with clinical staff		
		Bad weather		
SECTION 3: PATIENT'S AWARENESS ON EFFECT OF MISSED APPOINTMENT				
a.	In your opinion, does missing an orthodontic appointment is important to you?	Yes		
		No		
b.	In your opinion, does missing an orthodontic appointment will have an effect on your oral health?	Yes		
		No		
c.	In your opinion, does missing an orthodontic appointment will have an effect on progression of your orthodontic treatment?	Yes		
		No		
d.	In your opinion, does missing an orthodontic appointment will have an effect to the clinic?	Yes		
		No		

SECTION 4: APPOINTMENT REMINDER				
a.	Do you think a reminder is useful to help you attend your appointment as scheduled?	Yes		
		No		
b.	What type of appointment reminder that you prefer? (Please choose **ONE ANSWER ONLY**)	a.By email		
		b.By phone		
		c.By text message (eg whatsapp)		
c.	What is your preferred timing of appointment reminder? (Please choose **ONE ANSWER ONLY**)	a.One day before appointment		
		b.One week before appointment		
		c.Two weeks before appointment		
		d.More than 2 weeks before appointment		

Appendix 3: Infographic attachment sent together with appointment reminder.



IMPROVING THE PERCENTAGE OF PATIENTS ON CLOPIDOGREL WHO RECEIVED APPROPRIATE PRESCRIPTIONS IN PRIMARY CARE SETTINGS

Simran Kaur Labir Singh, Norharlina Sulaiman, Noor Harzana Harun, Cheang Ching Ye, Lean Ean Pheng, Khoo Chong Chiang

Klang District Health Office Pharmacy Department, Selangor State Health Department, Ministry of Health Malaysia

Corresponding Author: Cheang Ching Ye
Email: michelle.cheang@moh.gov.my

Abstract

Clopidogrel, an antiplatelet agent, is often prescribed with aspirin for cardiovascular disease (CVD) patients. At the Klang District Health Office (DHO), concerns arose over its prolonged use. A verification study revealed that only 57% of clopidogrel prescriptions were appropriate. The indicator used was the percentage of patients on clopidogrel who received appropriate prescriptions, defined as adherence to recommended indications and duration (12 months). The study set a standard of 100% appropriate use and aimed to achieve this within three improvement cycles. A validated questionnaire was used to identify the contributing factors: lack of review and interventions by doctors (30%) and pharmacists (27%), incomplete clopidogrel indication and duration in prescriptions by doctors (24%), and high patient demands (19%). In Cycle 1 (July – December 2019), eight strategies were implemented, including the development of an in-house guideline, a clopidogrel assessment checklist, and continuous medical education (CME) sessions for doctors and pharmacists. A "Clopidogrel Intervention Mini Note" facilitated communication, while the *Buku Rekod Ubat Pesakit* (BRUP) provided essential patient details. A counselling checklist, standardised information delivery, and a clopidogrel counselling leaflet was created for patients. In Cycle 2 (January – June 2020), five strategies were implemented, including referring hospital and Klang DHO meeting to ensure discharge letters included both the diagnosis and clopidogrel duration. Additional measures included replacing the mini note with a prescription note, introducing QR codes for counselling pamphlets, and online counselling for patients. These interventions increased the appropriate clopidogrel prescribed from 57.0% to 87.2% in Cycle 1, to 94.2% in Cycle 2, and 98.0% in Cycle 3 (July 2022). Clopidogrel expenditure decreased substantially from MYR42,705 to MYR13,469 (Cycle 1), MYR1424 (Cycle 2), and MYR438 (Cycle 3). To sustain improvements, we integrated the Clopidogrel Assessment Checklist into our work processes, promoting continuity of best practices among new doctors and pharmacists.

KEYWORDS: Clopidogrel, Primary care, Quality improvement study

Problem

Clopidogrel, an antiplatelet agent belonging to the thienopyridine class, binds to P2Y12 adenosine diphosphate (ADP) platelet receptors, resulting in irreversible inhibition of platelet aggregation, thereby preventing thrombosis (1). According to the Ministry of Health National Medicines Formulary (2018), clopidogrel is indicated for preventing myocardial infarction, stroke, or established peripheral arterial disease (2). It is also recommended as a second- or third-line treatment for patients who are allergic to acetylsalicylic acid and intolerant to ticlopidine (2).

In Malaysia, clopidogrel therapy is typically started at tertiary healthcare facilities upon diagnosing cardiovascular disease (CVD) or following critical care and invasive procedures. After stabilisation, patients are discharged to primary care clinics for continuation of care. However, the primary care clinics faces a significant challenge in continuing treatment, as information on the indication and duration of clopidogrel prescribed for the secondary prevention of CVD, is often lacking during the transition from tertiary healthcare facilities to primary care clinics. This gap hinders the assessment of its appropriate continuation. Also, it affects medication budgeting, as clopidogrel is an expensive drug that is not routinely purchased or prescribed by the government primary care clinics.

Clopidogrel is categorised under 'group A prescriber drugs,' which can only be initiated by specialised physicians within the tertiary healthcare facilities. Upon discharged from hospitals, patients referred to primary care clinics will be given a referral letter with information on medications for initial consultations. Family Medicine Specialists (FMS) and medical officers are authorised to continue clopidogrel treatment for hospital-referred patients following a thorough clinical assessment. This process of care involves integral collaboration between prescribers and pharmacists to ensure appropriate medication management.

Klang district is one of the largest districts in Selangor state, serving a high-density population estimated at 842,146 people (3). Within the district, twelve healthcare clinics provide outpatient services (3). These clinics are operated by a total of 1209 healthcare workers, which include seven FMS, 202 medical officers, 60 pharmacists, as well as other healthcare staff such as nurses, paramedics, and support staff.

Primary care clinics provide essential ambulatory care services to both walk-in patients and those referred from nearby hospitals. The pharmacy department within these clinics plays a crucial role in ensuring optimal medication management practices. This encompasses various responsibilities such as screening prescriptions, intervening in medication errors, accurately dispensing medications, managing drug inventories, and providing comprehensive medication counselling to patients. In the context of clopidogrel, this involves ensuring prescriptions are appropriate in terms of indication and duration, correcting potential prescribing errors, verifying accuracy during dispensing, monitoring stock to minimise wastage, and counselling patients on the correct use of clopidogrel.

A verification study conducted in 2019 revealed that only 57.0% (513/900) of the prescribed clopidogrel were deemed appropriate (4). This project aimed to improve the percentage of patients on clopidogrel who received appropriate prescriptions under the Klang District Health Office (DHO) from 57% to 100% within three years.

Background

Studies worldwide consistently show significant overuse of clopidogrel, whether alone or as part of dual antiplatelet therapy (DAPT) (5 - 8). For instance, a Sri Lankan study found that less than half of clopidogrel prescriptions were for the correct indication and duration (8). Similarly, European research revealed that treatment durations often exceeded clinical guidelines, particularly for neurological conditions (87.8% of patients) and cardiac disorders (38.8%) (7). This overuse carries a substantial financial burden, with European estimates ranging from EUR2 to EUR4.4 million annually (7). A UK audit in Glasgow

further solidified this trend, finding nearly 40% of DAPT patients were treated beyond the recommended duration, leading to an estimated GBP8386 in excess costs from 7,537 weeks of unnecessary therapy (6). Beyond financial implications, prolonged DAPT (over one-year post-procedure) is linked to a higher risk of bleeding (6). Long-term use of clopidogrel exposes to a higher risk of adverse events such as severe neutropenia, various forms of haemorrhage, and cardiovascular events (5). Furthermore, research indicates that combining aspirin with clopidogrel for high-risk ischemic stroke or transient ischemic attack patients offers no significant additional benefit in reducing major vascular events (6). However, the risk of life-threatening or major bleeding was increased by the addition of aspirin (5). Another factor to consider when deciding whether to continue treatment beyond the recommended period is the impact this has on therapeutic compliance. Treatment complexity in these patients is one of the most important predictive factors of lack of treatment adherence (9).

Several factors contribute to inappropriate clopidogrel prescribing. Patient or caregiver exert additional pressure on physicians into prescribing outside established guidelines. Additionally, lack of awareness or understanding of current recommendations among healthcare professionals can lead to improper use (4, 6). Treatment complexity also contributes to inappropriate prescribing by increasing the likelihood of prolonged or incorrect usage (4, 6, 8, 9).

To address these issues, a variety of strategies have been implemented. Routine clinical audits help identify deviations from guidelines and support corrective measures (6, 8). Regular reviews of patient profiles ensure the ongoing appropriateness of clopidogrel therapy. These include cessation dates on prescriptions, to prevent extended use (5 - 7). However, the effectiveness of these strategies varies. As reported by George et al. (2022), periodic clinical audits revealed significant improvements in discharge prescription compliance (10). In other studies, clinical audits have been shown to significantly improve adherence to guideline-based therapy among patients with acute coronary syndrome (ACS) (6, 8). The regular review of patient profiles, led by pharmacists, has increased the appropriate prescribing of secondary prevention medications in ACS from 35% to 80% (11 - 12). Educational programmes aimed at healthcare professionals have also resulted in better prescribing practices and greater adherence to guidelines (6, 8, 12).

Measurement

This quality improvement study was conducted from July 2019 to July 2022. The study included patients discharged with clopidogrel for cardiovascular diseases from the tertiary healthcare facilities to the seven clinics under Klang DHO. The clinics included were Bandar Botanic Health Clinic, Pandamaran Health Clinic, Anika Health Clinic, Bukit Kuda Health Clinic, Port Klang Health Clinic, Kapar Health Clinic, and Meru Health Clinic. Patients who were allergic to aspirin, enrolled in the *Sistem Pendispensan Ubat Bersepadu* (SPUB), walk-in patients, or defaulters for more than six months were excluded from the study. SPUB is a follow-up medication supply service facilitated through prescription referrals. This service enables patients to obtain a supply of their medications from other Ministry of Health healthcare facilities (13).

The indicator assessed in this study was the percentage of patients on clopidogrel who received appropriate prescriptions. A 100% standard was set in 2019 by consensus among the Klang DHO Drug Committee, which included the health officer director, all FMSs, and pharmacists from the participating clinics. The indicator was calculated as below:

$$\textit{Percentage of patients on clopidogrel who received appropriate prescriptions} = \frac{\textit{Total number of patients appropriately prescribed with clopidogrel}}{\textit{Total number of patients prescribed with clopidogrel}} \times 100$$

The criteria for appropriately prescribed clopidogrel were determined based on published literature (14). It was defined as patients correctly prescribed with clopidogrel in adherence to the clinical indications and limiting its usage to a maximum duration of 12 months, except for patients with hypersensitivity to aspirin (14) or patients with recurrent cardiac issues requiring lifelong clopidogrel use (14), as specified by the referring hospitals.

Prescriptions were collected to identify the total number of patients on clopidogrel. Then, the appropriately prescribed clopidogrel was assessed using the clopidogrel assessment checklist (Appendix 1), developed by the members of the Drug Committee at Klang DHO in 2019. The form was filled out by doctors and kept in the patient's record for reference. During the study, the clopidogrel assessment checklist was used to evaluate and align both the appropriate diagnosis and the duration of treatment. This facilitated the determination of the total number of patients on clopidogrel who were appropriately prescribed.

Self-administered questionnaires on contributing factors were distributed to 250 healthcare professionals (100 doctors, 150 pharmacists) conveniently. The questionnaire was content validated by all FMSs from the clinics involved in the study. Another self-administered questionnaire used in a pre- and post-test was developed to assess the healthcare professionals' knowledge of clopidogrel. Further details are explained in the next section. An audit checklist was used to evaluate the critical steps in prescribing and dispensing clopidogrel, including diagnosis, treatment duration, and patient adherence. These tools helped identify areas for improvement and measure the impact of interventions.

The verification study was carried out between April and June 2019. The results revealed that only 57.0% (513/900) of patients prescribed clopidogrel were deemed appropriate. The Achievable Benefit Not Achieved (ABNA) was 43%.

Initial Assessment of the Problem

The problem analysis chart (Figure 1) showed the contributing factors to the problem. The major contributing factors to the inappropriately prescribed clopidogrel in primary care were a lack of reviews and interventions by doctors (30%), a lack of reviews and interventions by pharmacists (27%), incomplete indications and durations in prescriptions by doctors (24%), and high patient demand (19%).

As pharmacists and doctors were identified as potential contributors to the problem from various aspects, another self-administered questionnaire was developed. The content was reviewed by all FMS and pharmacists from the participating clinics to ensure it met the study's objective of evaluating the knowledge of pharmacists and doctors regarding the appropriate prescription of clopidogrel and their awareness of the workflow. The questionnaire was distributed to 100 respondents in all participating clinics (35 doctors and 65 pharmacists) during the pre-intervention and post-intervention phases to evaluate their knowledge levels. During the pre-intervention phase, only 40% (n=40) of respondents achieved a passing mark of 80% or more. This indicated that the majority of doctors and pharmacists had poor knowledge and awareness regarding appropriate clopidogrel prescription.

The process of care (POC) flowchart illustrates the process of prescribing and dispensing clopidogrel to patients in healthcare clinics (Figure 2). It is applicable to hospital-referred patients who were discharged and referred to healthcare clinics for continuation of care. This process will also extend to follow-up appointments for clopidogrel patients, ensuring that any missed patients during their initial visit are identified in subsequent appointments. Critical steps contributing to the appropriate use of clopidogrel were denoted with asterisks. These steps include clerking and examination, assessment by doctors, prescribing, recording prescription details and prepare *Buku Rekod Ubat Pesakit* (BRUP) as well as dispensing and counselling.

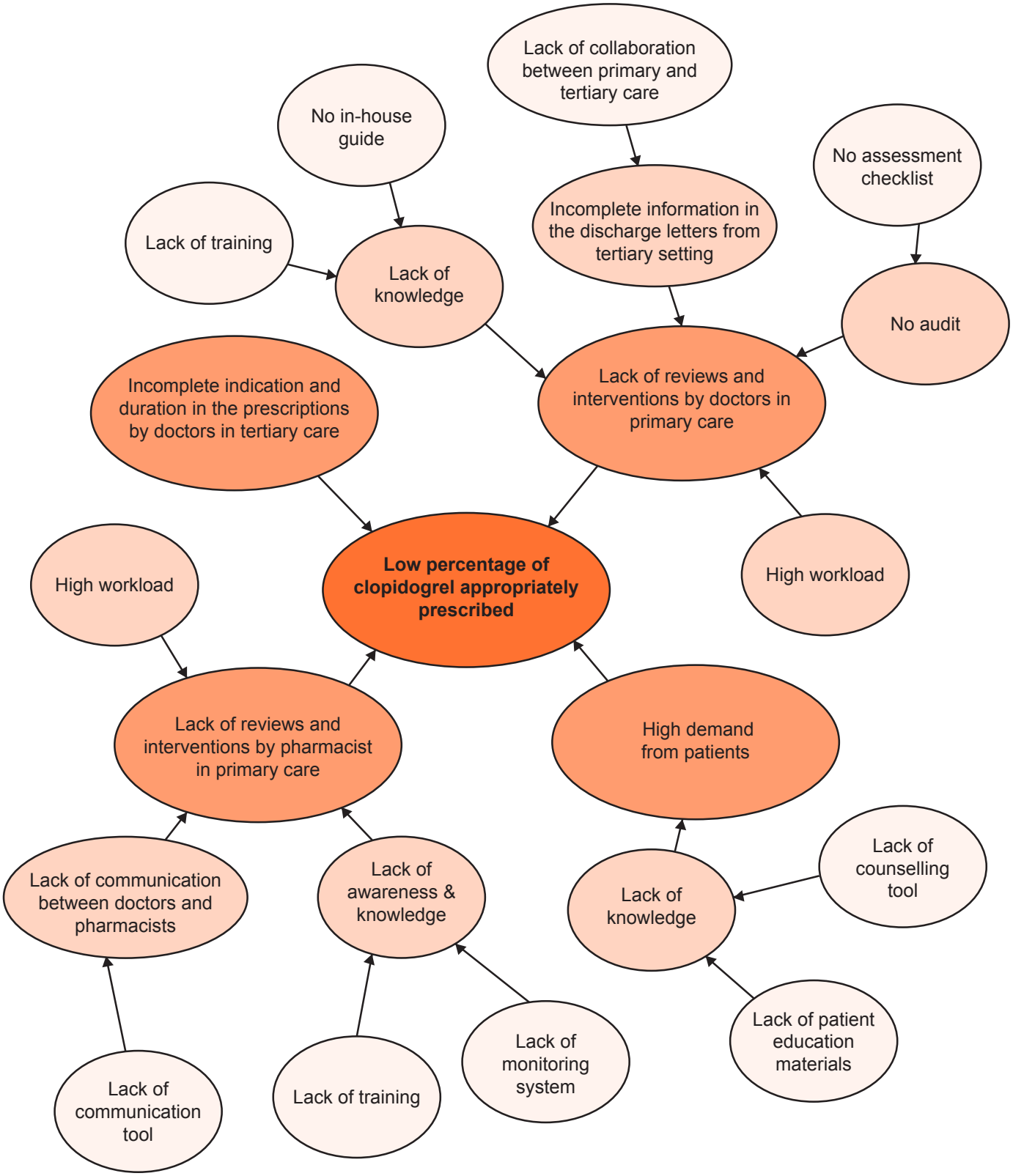
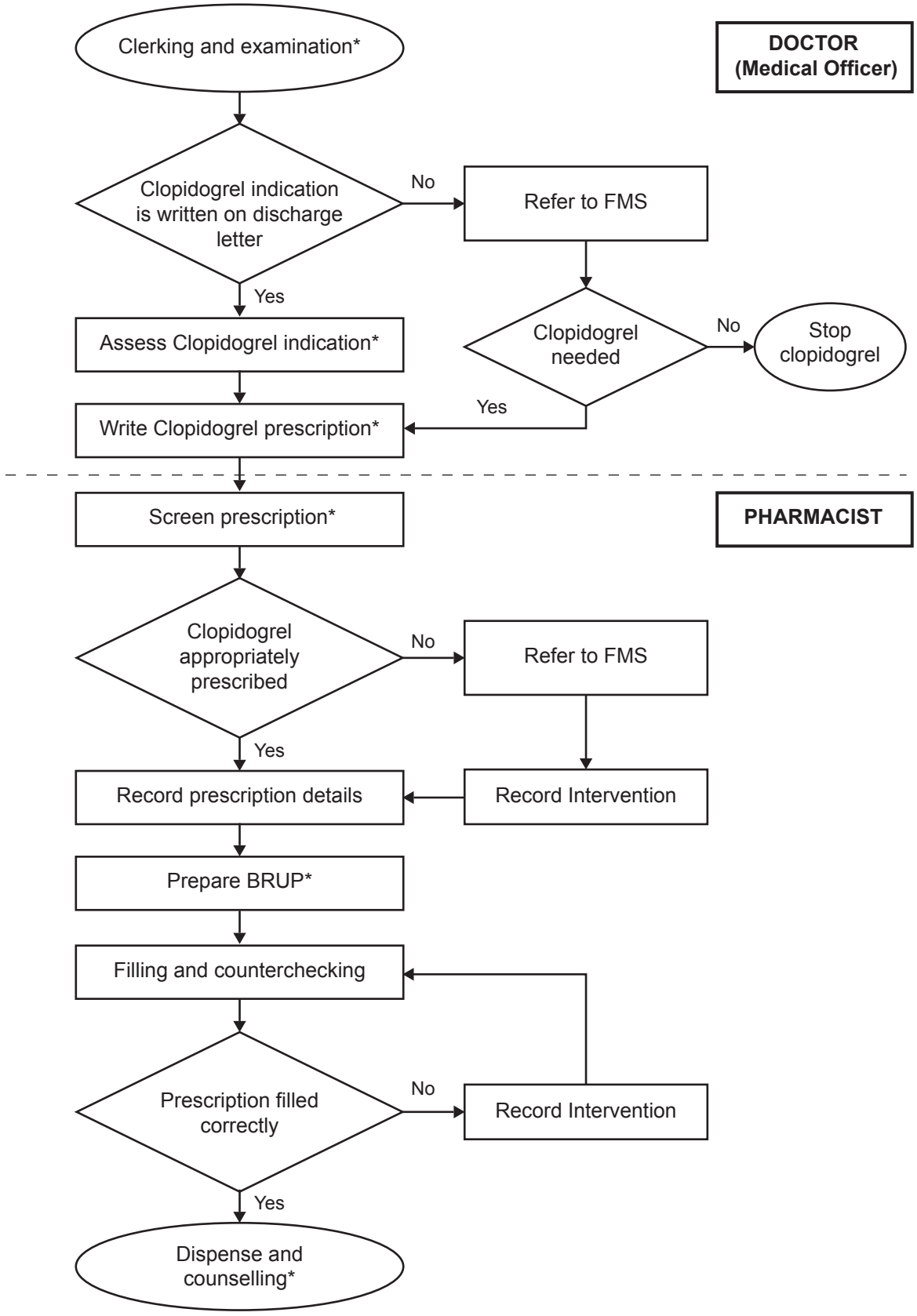


Figure 1: Problem analysis chart for low percentage of clopidogrel appropriately prescribed



* indicates critical steps

Figure 2: process of care for prescribing and dispensing clopidogrel in primary healthcare clinics

Strategy

The remedial measures were implemented in Cycle 1 (July – December 2019) and Cycle 2 (January– June 2020). Data collection and analysis were conducted in Cycle 1 (November–December 2019) and Cycle 2 (May–June 2020). Cycle 3, conducted in July 2022, evaluated the effectiveness of the previous strategies. During Cycle 1, eight strategies were implemented based on the identified contributing factors. To address the inadequate review and interventions by doctors, our team organised a meeting with all FMS and the pharmacists in charge from their respective clinics. The first strategy was designing a simplified prescribing recommendation for clopidogrel based on Clinical Practice Guidelines (CPG): Primary & Secondary Prevention of Cardiovascular Disease, published in 2017, (15) to assist doctors in determining the duration of clopidogrel treatment.

Second, an in-house clopidogrel assessment checklist (Appendix 1) was developed. This aid in ensuring systematic patient assessment by doctors on the treatment plan during the initial visit. This checklist served as an audit tool and facilitated doctors in reviewing and monitoring patients during subsequent visits. This checklist provided a concise access to patient's history, indirectly reducing their workload. Additionally, both the clopidogrel prescribing recommendation and assessment checklist assisted pharmacists in determining clopidogrel duration efficiently.

Third, a "Clopidogrel Intervention Mini Note" was designed to ensure information is effectively communicated to pharmacists from the doctors. It is sent to the pharmacy along with the prescription during the treatment initiation. The mini-note facilitated pharmacists screening process to ensure clopidogrel is appropriately prescribed. This note addressed the lack of reviews and interventions by pharmacists by providing essential information such as diagnosis and clopidogrel start and stop dates.

The fourth strategy introduced by entering patient details in a pharmacy database maintained using Microsoft Excel, to track clopidogrel usage. These details were then transcribed into the BRUP, provides essential details on initiation date, suggested end date, and diagnosis. This served as a tool utilised by pharmacists to streamline medication monitoring during subsequent patient visits.

The fifth strategy was to address the high demand for patient counselling; pharmacists developed a standardised clopidogrel counselling checklist to ensure consistent delivery of information to all patients prescribed the medication. The primary objective of these counselling sessions was to emphasise the treatment indication and duration. Pharmacists were required to provide counselling to all new patients initiating clopidogrel therapy, focusing on clearly explaining the rationale for the treatment, the prescribed duration, and highlighting both the benefits and potential risks associated with the medication.

A clopidogrel counselling leaflet for patients and their families, constituting as the sixth strategy. This leaflet served as a reference for patients who may forget information shared during the pharmacy counselling sessions. It also benefited family members who were unable to accompany the patient to the clinic, helping them understand the patient's treatment plan.

Seventh, continuous medical education (CME) sessions on clopidogrel prescribing were conducted at each clinic to increase doctors' knowledge. During these sessions, briefings on the prescribing recommendation and instructions on utilising the in-house clopidogrel assessment checklist were given. Pre- and post-test quizzes were given to ensure attendees comprehended the briefing content. With these measures in place, doctors can conveniently and confidently determine the treatment plan.

The eighth strategy was to address pharmacists' lack of awareness and knowledge; CME sessions were conducted in all clinics. These sessions focused on the prescribing workflow, monitoring, and counselling of clopidogrel. Pharmacists were organised into small groups for hands-on training regarding the recording and monitoring procedures, as well as patient counselling. Additionally, they were briefed on common challenges and participated in role-playing scenarios that depicted common challenges encountered with clopidogrel, along with strategies for addressing each scenario.

Following Cycle 1, we found that the criterion of the indication and treatment duration documented in the discharge letters from the referring hospital still had the lowest performance among all the criteria outlined in the Model of Good Care (MOGC). Thus, in Cycle 2, the first strategy involved a meeting between the heads of departments (HODs) from the primary care and the cardiology team of the tertiary care facility in the Klang district. A consensus was achieved; doctors in the tertiary setting will ensure that discharge letters are completed with both diagnosis (indication) and treatment duration for clopidogrel. This strategy significantly assisted primary care doctors in determining the clopidogrel treatment duration.

Second, we prioritised minimising manual documentation by removing the "Clopidogrel Intervention Mini Note" and directly recording essential information such as diagnosis, start date, and stop date of clopidogrel on prescriptions. The third strategy was to link the "Patients' Record List" to a QR code to streamline the recording process and improve accessibility for all pharmacy staff. This innovation allowed pharmacy staff to quickly check a patient's status from the counter using a smartphone, eliminating the need to access a computer for information.

Moreover, we improved accessibility to the counselling pamphlet for patients by linking it to a QR code, offering an alternative method for accessing the information anywhere and enabling easy sharing with their family members. Lastly, we introduced online counselling services for patients who still had queries regarding the medication or wished to include a counselling session with their caregiver who cannot physically attend the patient's clinic visit. During these online counselling sessions, patients and their family members can interact directly with pharmacists to inquire about information and have their queries addressed.

A key learning from Cycle 2 was the critical role of collaboration between the primary and tertiary care in ensuring complete and accurate discharge letters. Engaging the heads of departments (HODs) from primary care and the cardiology team at the tertiary care facility resulted in significant improvements in documentation, particularly in specifying diagnoses and treatment durations. This collaboration was essential in facilitating appropriate prescribing decisions at the primary care level.

In Cycle 3, the focus shifted from introducing new strategies to evaluate the effectiveness of previous strategies in Cycle 1 and Cycle 2. Instead of implementing new remedial measures, efforts were concentrated on reinforcing existing strategies and ensuring that the practices and procedures established in previous cycles became a permanent part of the workflow. This involved monitoring adherence to the guidelines, maintaining effective communication, and continuing patient education to ensure that the gains made in appropriate clopidogrel prescribing were sustained over the long term.

Results

After implementing several strategies, there was a significant increase in the percentage of patients on clopidogrel who received appropriate prescriptions in Klang DHO. Initially, only 57% (513 out of 900 patients) were prescribed appropriately, but this surged to 87.2% (840 out of 963 patients) in Cycle 1; then further increased to 94.2% (212 out of 225 patients) in Cycle 2 and 98% (198 out of 202 patients) in Cycle 3. The ABNA improved substantially across the three cycles, from 43% to 12.8%, then to 5.8% and lastly to 2% in Cycle 3. (Figure 3)

Each intervention contributed significantly to the improvement. Table 1 illustrates the enhancement of each process within the MOGC. Before the interventions, all criteria failed to meet the 100% standard. Criteria such as recording prescription details, preparing BRUP, dispensing, and counselling were all at 0%. Another crucial criterion with poor results was the clerking and examination, at only 25%.

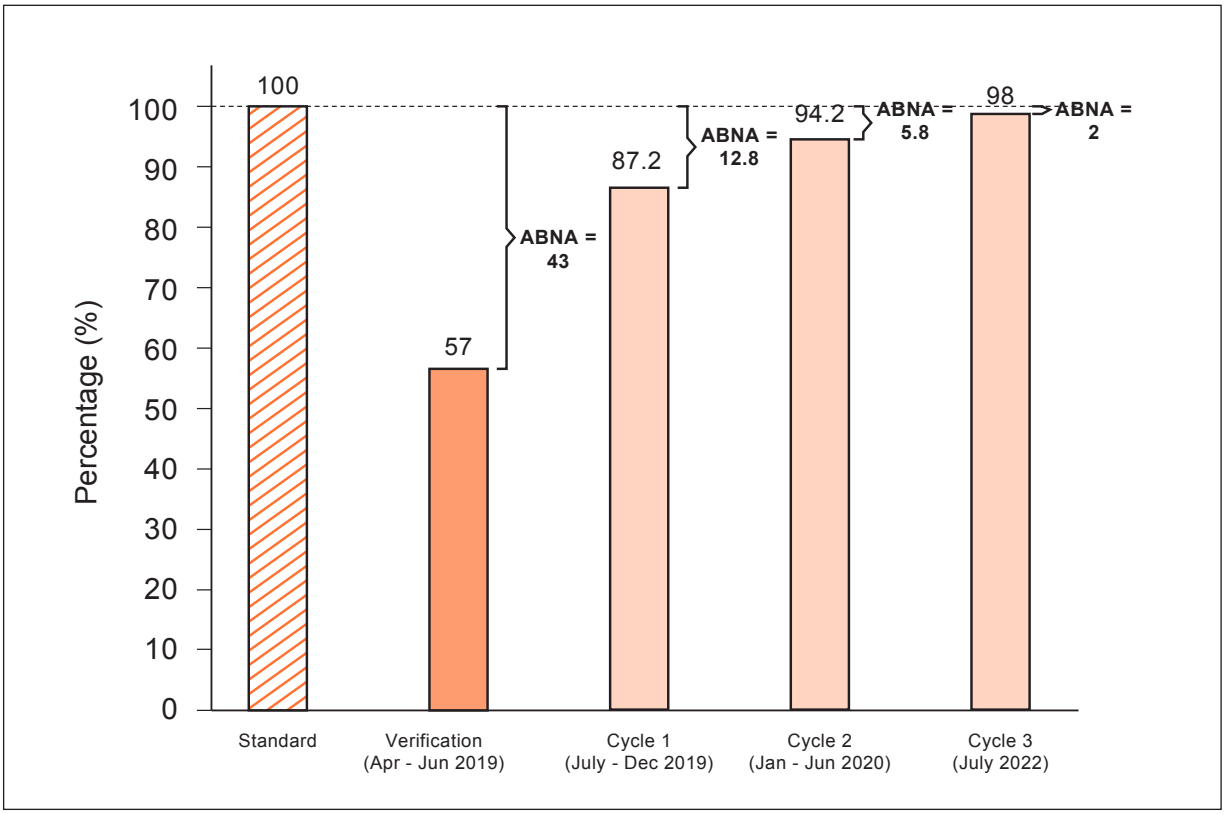


Figure 3: Percentage of patients on clopidogrel who received appropriate prescriptions from Cycle 1, Cycle 2, and Cycle 3

Table 1: Comparison of Model of Good Care Achievement Before and After Remedial Measures.

No.	Critical Step	Criteria	Standard	Verification	Cycle 1	Cycle 2	Cycle 3
1.	Clerking and examination	Ensure MOH discharge letter is complete with indication and duration	100%	25%	52.4%	78.3%	85.1%
2.	Assess clopidogrel indication	Identify indication(s) along with start and stop date for clopidogrel utilisation	100%	57%	87.2 %	94.2%	98%
3.	Write clopidogrel prescription	Document indication(s) along with start and stop date for clopidogrel	100%	57%	85.4 %	93.2%	96.8%
4.	Screen prescription	Screen clopidogrel indication, start and stop date and duration	100%	0%	79.8 %	91.4%	96.8%

5. Prepare BRUP	Transfer information (indication, start and stop date) to BRUP (*Buku Rekod Ubat Pesakit*)	100%	0%	79.8 %	93.2%	95.7%
6. Dispense and counsel patient	Provide counselling to patient emphasising indication and duration of treatment	100%	0%	78.2 %	89.6%	91.0%
	Provide leaflet	100%	0%	79.8 %	93.0%	91.0%

The criterion "ensuring MOH discharge letter is completed with indication and duration" increased significantly from 25% to 52.4%, then to 78.3%, and finally to 85.1% over the cycles. The collaboration strategy among HODs has helped sustain the continuous improvement seen. Similarly, the criteria assessing the appropriateness of prescribing clopidogrel rose to 87.2% in Cycle 1, 94.2% in Cycle 2 and 98.0% in Cycle 3. The in-house clopidogrel assessment checklist proved remarkably helpful in improving clopidogrel usage appropriateness. Following the remedial actions taken in Cycles 1 and 2, the screening of prescription details, dispensing and counselling of patients had also improved following the simplified and streamlined work processes.

The expenditure for clopidogrel significantly decreased by 99% indicating potential cost savings and resource optimisation. The expenditure decreased from MYR42,705 during the verification study to MYR13,469 in Cycle 1, which further decreased to MYR1424 in Cycle 2 and finally to MYR438 in Cycle 3. These reductions reflect the overall success of interventions aimed at improving medication management practices, hence contributing to more efficient resource allocation, ultimately enhancing healthcare delivery efficiency and sustainability.

Lessons and Limitations

In our study, we encountered a limitation involving the synchronisation of patients' clinical data between healthcare clinics under Klang DHO and hospitals, as there was no integrated information technology system. Consequently, doctors in healthcare clinics relied on referral letters from tertiary hospitals to decide patient treatment plans, which posed a significant challenge to the study. Further complicating matters were referral letters with incomplete information.

Additionally, there was a significant gap between Cycles 2 and 3 due to the COVID-19 pandemic, during which all activities were temporarily put on hold. Despite these challenges, the project's objective was successfully achieved by engaging the relevant parties involved and underscoring the seriousness of inappropriate clopidogrel prescription. Following Cycle 2, doctors from tertiary settings ensured the completion of discharge letters with diagnosis and treatment duration information.

Coordinating with seven clinics also proved challenging., Nevertheless over twenty CME sessions were organised for all these doctors and pharmacists to ensure they were acquainted with the strategies. However, because numerous parties were involved, human factors prevented the standard of 100% being fully achieved.

Despite these challenges, valuable insights were gleaned. Prior to the study, pharmacists lacked certainty about patients' diagnoses and treatment plans. Implementing clopidogrel prescribing recommendations and an in-house assessment tool enabled prompt and

accurate determination of diagnosis and treatment plans. Additionally, the study's strength lay in the provision of adequate counselling and education to patients at the onset of therapy, which enhanced their understanding, thereby alleviating concerns about long-term misperceptions of clopidogrel.

This study underscored the importance of engaging a multidisciplinary team in initiating and sustaining successful change. Both prescribers and pharmacists play pivotal roles in ensuring optimal treatment outcomes for patients on clopidogrel, thereby enhancing patients' quality of life and reducing unnecessary healthcare costs. This project was awarded second place in the QA (oral category) during the Innovation Carnival organised by Selangor State Health Department in 2020. Sharing our experiences and providing guidance on implementing these remedial actions can foster replication of our project which can lead to widespread improvements in medication management across primary care facilities, benefiting patients and healthcare systems alike.

Conclusion and the Next Steps

In conclusion, the strategies employed have brought us closer to the study goals. The verification study revealed only 57% of patients were appropriately prescribed according to the duration and indication as recommended in CPG 2017 (14), compared to the standard of 100%. The main contributing factors were lack of reviews and interventions by doctors, and pharmacists, incomplete indication and duration in prescriptions by doctors and high demand from patients.

Strategies formulated in Cycle 1 were the development of an in-house guideline, a clopidogrel assessment checklist, CME sessions, Clopidogrel Intervention Mini Note, and BRUP. A counselling checklist and leaflet standardised information delivery to enhance communication and patient management.

In Cycle 2, five additional strategies were introduced, such as ensuring discharge letters included diagnosis and clopidogrel duration, replacing the mini note with a prescription note, QR codes for documentation and counselling pamphlet, and an online counselling between patients and pharmacists. After two cycles of remedial measures, the percentage of appropriate use of clopidogrel increased from 57% to 94.2%. A follow-up sustainability study, conducted in 2022, two years after Cycle 2, achieved a remarkable appropriateness rate of 98%, demonstrating the lasting impact of implemented strategies.

The study faced challenges due to the lack of an integrated IT system, incomplete referral letters, and coordination across seven clinics. Despite challenges faced, we gained better prescribing decisions through assessment tools, a more structured system to monitor the usage, and reducing misconceptions about clopidogrel use.

To date, we have incorporated the Clopidogrel Assessment Checklist into our local formulary to ensure sustainability and familiarity of these practices among new doctors and pharmacists.

References

1. Dorsam RT, Murugappan S, Ding Z, Kunapuli SP. Clopidogrel: Interactions with the P2Y12 receptor and clinical relevance. Hematology. 2003; 8(6):359-65. Available from: https://www.tandfonline.com/doi/abs/10.1080/10245330310001621260

2. Formulari Ubat KKM (FUKKM) | Program Perkhidmatan Farmasi. Available from: https://pharmacy.moh.gov.my/ms/apps/fukkm

3. Ean Pheng L, Syellawaty Ahmad N, Ping Wun C, Hairani Ishak I, Anthony T, Zhu Yun T. Q Bulletin, Volume 1, No. 31, Jan-Dec 2022. Improving the Appropriate Prescribing of Proton Pump Inhibitors (PPI) Among Referred Patients in Healthcare Clinics Under the Health Office of Klang District. Q Bulletin. 2022; 31(1)72-9. Available from: https://myjms.mohe.gov.my/index.php/qbulletin/article/view/16884/110054.

4. Norharlina S, Su Li W, Kar Mun N, Siti Fatimah AB, Sivasakthy V, Simran Kaur LS. September 2019. Utilisation Review Of Clopidogrel In Primary Care. [Poster Presentation] Selangor Research Day 2019.

5. Diener PHC, Bogousslavsky PJ, Brass PLM, Cimminiello PC, Csiba PL, Kaste PM.. Aspirin and clopidogrel compared with clopidogrel alone after recent ischaemic stroke or transient ischaemic attack in high-risk patients (MATCH): randomised, double-blind, placebo-controlled trial. Lancet. 2004;24;364 (9431):331–7.

6. NHS Post Script: Dual anti-platelet therapy. 2014; 82:1-2. Available from: https://ggcmedicines.org.uk/media/uploads/postscript/1407_ps_82.pdf

7. Fornós-Garrigós A, Orozco-Beltrán D, Gil-Guillén VF, Puig-Barberà J, Fluixa C, Fernández A. Appropriateness of clopidogrel use according to current recommendations. Fam Pract. 2014; 31(6):694–8. Available from: https://academic.oup.com/fampra/article/31/6/694/591414

8. Wijekoon CN. Audit of clopidogrel use in a medical clinic in a tertiary care hospital in Sri Lanka. J Ceylon Coll Physicians. 2016; 47:82–5. Available from: http://doi.org/10.4038/jccp.v47i2.7788

9. Ho WM, Hill C, Michael H, Winckel K. Evaluation of the duration of dual-antiplatelet therapy after percutaneous coronary intervention: a retrospective audit on the compliance with guidelines or cardiologist recommendation. J Pharm Pract Res. 2022; 52(1):42-8. Available from: https://onlinelibrary.wiley.com/doi/10.1002/jppr.1780

10. George NE, Shukkoor AA, Joseph N, Palanimuthu R, Kaliappan T, Gopalan R. Implementation of clinical audit to improve adherence to guideline-recommended therapy in acute coronary syndrome. Egypt Heart J. 2022; 1;74(4):1-7. Available from: https://pubmed.ncbi.nlm.nih.gov/35020077/

11. Jabri AM, Alqahtani A, Alhazmi A. Pharmacist role to enhance the prescribing of hospital discharge medications for patients after heart attack. Saudi Pharm J. 2020;28(4):463-469. doi: 10.1016/j.jsps.2020.02.009.

12. National Health Systems Resource Centre (NHSRC). Prescription Audit Guidelines. New Delhi: Ministry of Health and Family Welfare, Government of India; 2021. Available from: https://nhsrcindia.org/sites/default/files/2021-07/1534_Prescription%20Audit%20Guidelines16042021.pdf

13. Jawatankuasa Farmasi Ambulatori, Farmasi Bahagian Amalan Dan Perkembangan, Malaysia. Garis Panduan Sistem Pendispensan Ubat Bersepadu, 2021. Edisi Keempat.

14. Clinical Practice Guideline: Primary & Secondary Prevention of Cardiovascular Disease. 2017. Available from: https://www.moh.gov.my/moh/resources/Penerbitan/CPG/CARDIOVASCULAR/3.pdf

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Conflict of Interest

The authors declare that there was no conflict of interest.

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Appendix 1: Clopidogrel Assessment Checklist

NO	CLOPIDOGREL CHECKLIST	
1	Reason to start clopidogrel (Please tick in the box below)	
		Post NSTEMI
		Post STEMI
		PCI / Stents Insertion
		Post CABG
		Allergy to aspirin (CAV / PVD)
		Recurrent CVA
		GIT Intolerance
		Others: Please specify: ….....
2	Treatment duration:	
	START date: ….....	
	Planned STOP date: ….....	
3	Contraindication to start clopidogrel (if present, please tick in the box below)	
		History of bleeding tendencies
		Allergy to clopidogrel
		Primary prevention
		Others: Please specify: ….....
4	Presence of warning signs /side effects:	
		Epistaxis
		Hematoma
		Bleeding
		Rashes
		Dyspepsia
		Others: Please specify: ….....
5	Compliance: ……. If not, please state the reason: ….....	
6	Vital signs: BP ……. PR …….	
7	Physical examination: Skin bruises, hematoma, rashes etc	
8	Investigation (if indicated): FBC/LFT/RP (eGFR)	
9	Plan:	
	i. Advice for compliance & continue clopidogrel in appropriate duration	
	ii. Potential for bleeding tendency	
	iii. Advice on risk of non-adherence	
	iv. Avoiding OTC	
	v. Advice on lifestyle modification - stop smoking, control BP, glucose, cholesterol, exercise	
	vi. TCA stat to KK/Hosp if presence of side effects/warning signs	
	vii. Next TCA: ….....	
10	Name of Doctor, signature and official stamp/Date	

CLOPIDOGREL PRESCRIBING RECOMMENDATIONS PKD KLANG 2019 **DURATION**		
1 Month	**12 Month**	**Lifelong**
Fibrinolytic therapy	NSTEMI ACS	Hypersensitivity to Aspirin
PCI with BMS	DES*	
Post CABG	NSTEMI (CABG)	
STEMI	NSTEMI (PCI with / without stent)	
	NSTEMI (with / without PCI)	
	PCI with BMS	
	PCI with DES*	
	STEMI (CABG)	
	Unstable Angina	
*DES duration for more than 1 year is being recommended in individual high-risk patients by some consultants due to concerns regarding later stent thrombosis on cessation of Clopidogrel therapy		

Appendix 2: Clopidogrel Counselling Checklist

Hospital/Klinik:
Patient Name:
Date of Birth:

Clopidogrel counselling checklist

This patient has been counselled on the following areas of Clopidogrel therapy by a pharmacist.

No	Counselling points	Sign	Comment
1.	What is Clopidogrel and how does it work		
2.	Indication for Clopidogrel		
3.	Alternative antiplatelet options/ dual antiplatelet therapy		
4.	Expected duration of therapy		
5.	How to take including dose, frequency, timing (aim to take at the same time every day) ● Clopidogrel can be taken with/ without food		
6.	Importance of adherence and persistence with treatment: ● Fairly rapid fall in drug levels (and therefore loss of effectiveness) if poorly compliant ● Important not to stop treatment unless discussed with doctor		
7.	What to do if a dose if missed – if unsure, talk to healthcare provider ● If a dose is missed take it as soon as possible, do not take a double dose ● Once daily dosing: take within 12 hours of missed dose, if more than 12 hours, omit the dose and then continue at the usual time		
8.	Extra dose taken accidentally? Contact doctor or healthcare team		
9.	Side effects and what to do if experienced		
10.	Potential for drug interactions		
11.	Alcohol intake		
12.	Procedures (including day surgery/ dental treatments etc); hospital admissions		
13.	Leisure activities: avoid contact sports (e.g. football, rugby, boxing) and other high-risk sports (e.g. skiing, and horse riding) as increased risk of head injury/ falls/ bruising/ bleeding		
14.	How to obtain further supplies		
15.	Who to contact for advice/ further information		
16.	Supply Clopidogrel Purple Card – patient to carry for follow up medication collection		
17.	Recheck patients understanding of the above points		
Counselled by: Sign & print name): ……. Designation: …….. Date: …….			
Patient's Signature: …… Date: ……..			

REDUCING THE PERCENTAGE OF PRESCRIBING ERROR FOR IRON DEXTRAN PRESCRIPTION IN OBSTETRICS AND GYNAECOLOGY (O&G) DEPARTMENT, HOSPITAL TENGKU AMPUAN RAHIMAH (HTAR), KLANG

Parimala Vijai Indrian[1], Low Shin Yee[1], P'ng Xiu Wen[1], Tan Huay Synn[1], Muna Atirah Ramli[2], Navamani Nedincheliyin[3]

[1] Pharmacy Department, Hospital Tengku Ampuan Rahimah, Selangor State Health Department, Ministry of Health Malaysia

[2] Obstetrics and Gynaecology Department, Hospital Tengku Ampuan Rahimah, Selangor State Health Department, Ministry of Health Malaysia

[3] Nursing Unit, Obstetrics and Gynaecology Ward, Hospital Tengku Ampuan Rahimah, Selangor State Health Department, Ministry of Health Malaysia

Corresponding Author: Parimala Vijai Indrian
Email: parimalamaniraja@gmail.com

Abstract

Prescribing errors can compromise patient safety and increase healthcare costs due to inappropriate indications. A verification study in the Obstetrics & Gynaecology (O&G) wards of Hospital Tengku Ampuan Rahimah (HTAR) in 2019 found that 46.7% of iron dextran prescriptions contained errors. The standard was 0% prescribing errors in iron dextran prescriptions. This quality improvement study involved all iron dextran prescriptions from the O&G wards. The verification study was conducted from August to December 2019, followed by cycle 1 (January - May 2020), cycle 2 (June - November 2020), and cycle 3 (January - April 2023). Data was collected via knowledge assessment questionnaires and iron dextran prescription analysis. Results showed that 48.6% was contributed by wrong dose, followed by 37.1% of incomplete prescriptions, 12.9% of wrong indication and 1.4% of wrong route. An iron dextran calculation worksheet with a QR code-linked user guide was introduced to quantify patients' iron dextran requirement as part of cycle 1. A customary stamp was implemented at cycle 2 to standardise the iron dextran prescription. Cycle 3 was carried out with the introduction of the *SteProCos* Reminder Card to reinforce the process of prescribing, with the incorporation of a dosing table to recheck the calculated dose. Errors in iron dextran prescriptions decreased from 46.7% to 15.3% after the first cycle, further declining to 9.7% after the second cycle and 5.3% following the third. Prescribers' knowledge regarding iron dextran increased from 62% to 94%. The implementation of these strategies resulted in hospital cost savings, with a total of MYR1956 saved annually on medication costs during the study period. The strategies were subsequently replicated by one of the cluster hospitals. The iron dextran calculation worksheet will be converted into a user-friendly electronic version, and internal audits along with continuous education sessions will be conducted at regular intervals.

KEYWORDS: Iron dextran, Prescribing error, Dose calculation, Quality improvement study

Problem

Intravenous (IV) Iron Dextran is primarily used in inpatient O&G wards to treat adult women with moderate to severe iron deficiency anaemia and is administered as a total daily infusion (TDI) dose. It is frequently given to antenatal patients who cannot tolerate or do not respond to oral iron, as well as those with significant blood loss or chronic anaemia due to obstetric or gynaecological conditions. The benefit of using intravenous (IV) iron is that it is generally well tolerated and, most importantly, more effective, with a mean increase in haemoglobin (Hb) of approximately 0.8 g/dl compared to 0.3 g/dl with oral iron (1). Although iron dextran is approved for intramuscular injection, the total dose infusion method is preferred because it allows for a shorter hospital stay with a single dose, thus improving patient compliance. It also causes less pain and tissue damage, as intramuscular iron dextran can lead to muscle fibrosis and abscess formation (2). It is not commonly used in primary care due to the need for monitoring during infusion and the risk of adverse reactions such as pain, swelling, discolouration at the injection site, flushing, fever, chills, headache, muscle pain, and delayed systemic responses (3). The total dose needed must be precisely calculated based on the patient's pre-pregnancy weight and in accordance with specific indications, as dosing parameters vary depending on the condition being treated.

The prescription process for IV iron dextran is complex and error-prone. It requires accurate weight-based dose calculation that takes into account the patient's haemoglobin level and iron deficit. Multiple steps are involved, including selecting the correct indication, performing the correct total dose infusion (TDI) calculation, and documenting the route and infusion details clearly. Inappropriate calculation of the iron dextran dose may compromise patient safety by increasing the risk of prescribing suboptimal or excessive amounts, which can lead to acute iron toxicity, metabolic acidosis, and hemosiderosis (4,5). Patients receiving a total dose of iron dextran should be routinely monitored for anaphylaxis and hypersensitivity reactions, typically after the administration of a 25 mg test dose (6).

HTAR is a tertiary hospital which comprises various speciality services, including *Kompleks Rawatan Ibu dan Bayi* (KRIBA), providing services for O&G treatment. There are five O&G wards for adult female patients, currently using a manual system for patient data entry, covering the entire process from medication prescribing to dispensing in the pharmacy. These patients are under the care of a multidisciplinary team that consists of doctors, pharmacists and nurses. The average number of patients admitted to O&G wards is approximately 20,000 per year. About 1.3% of these patients require the administration of a total dose of iron dextran to replenish iron loss.

A study carried out in our O&G wards from February to July 2019 found that 46.7% of 188 iron dextran prescriptions contained prescribing errors. Therefore, the primary aim of this study was to reduce the percentage of prescribing errors for iron dextran prescriptions in the O&G department from 46.7% to 0% within six months of the intervention period. This initiative has a direct impact on patient care by enhancing medication safety and can be readily measured through the accuracy of iron dextran prescriptions issued in the ward.

Background

Iron dextran is a medicinal product containing a combination of iron and dextran (7). Iron dextran is the drug of choice for the treatment of iron deficiency anaemia (IDA) in women or pregnant women who are not responding to oral iron therapy (8). The total dose infusion can be completed within a relatively short duration of about 4-6 hours, resulting in reduced bed occupancy (9). The formula for calculating the parenteral iron dextran dose for blood loss is as follows (10):

$$\text{Total dose (mg Fe)} = \left((\text{Target Hb} - \text{Actual Hb}) \times \text{Body weight (kg)} \times 0.24 \right) + \text{mg iron for iron stores}$$

* Haemoglobin (Hb) in g/dL

Data such as patient's body weight and actual haemoglobin are essential for the calculation of the total iron dextran dose required by the patient. Furthermore,

unnecessary therapy with iron dextran may lead to excessive iron storage, resulting in exogenous hemosiderosis. A test dose of iron dextran was given to the patient before administering the remaining dose to the patient due to anaphylactoid reactions. Patients were also monitored for anaphylaxis and hypersensitivity reactions. Some of the factors, such as a previous adverse reaction to iron or other drugs, a fast iron infusion rate, and a history of severe atopy and systemic macrocytosis, appear to increase both the incidence and severity of hypersensitivity reactions (11). The adverse event rate following the administration of iron dextran is up to 28% (12). A study done in Malaysia reported that adverse events occurred in five patients given iron dextran, indicating a higher risk associated with pregnant women.

Globally, medication errors, particularly in the preparation and administration of parenteral medications, are prevalent. A study highlighted that errors during these stages are common in intensive care units, with incorrect drug preparation and administration rates identified as significant areas of concern (13). Although this study does not focus exclusively on iron dextran, it highlights the global potential for errors in intravenous therapies. In Malaysia, comprehensive data specifically addressing prescribing errors related to iron dextran remains limited. However, a retrospective analysis of medication errors at a tertiary hospital in northern state of Malaysia revealed that the prescribing stage accounted for 97.4% of all medication errors, with incorrect dosages contributing to more than half of these cases(14). While study encompassed a range of medications, its findings indicate a significant prevalence of prescribing errors within the Malaysian healthcare system, suggesting that iron dextran could be similarly susceptible.

Prescribing error is defined as an error that occurs when there is an unintentional, significant reduction in the probability of treatment being timely and effective due to the process of medication prescribing (15). Types of prescribing errors include incorrect drug selection (based on indications, contraindications, known allergies, existing drug therapy, and other factors), dose, dosage form, quantity, route, concentration, rate of administration, or instructions for use of a drug product ordered or authorized by physician (or other legitimate prescriber); illegible prescriptions or medication orders that lead to errors that reach the patient (15,16). Statistics from the Ministry of Health showed that the total number of reported medication errors increased from 2818 to 3046 in 2019, and prescribing errors showed the highest proportion of cases (51%) (17).

Factors contributing to prescribing errors include knowledge and experience gaps, workload, complex dosing regimens, special populations, lack of guidelines, and inadequate decision support (18). Reducing the percentage of prescribing errors for iron dextran is crucial to ensure patient safety and optimal therapy outcomes. Several strategies have been employed in other settings to achieve this goal, such as implementing electronic prescribing systems that have built-in checks and alerts to flag potential errors or contraindications (19). Providing education and training for healthcare professionals on the proper prescribing and administration of iron dextran, including dosage calculations and monitoring parameters, has also been implemented in many other countries (20). Standardising medication practices is another strategy to reduce prescribing errors (21). Developing and adhering to standardised protocols for prescribing, preparation, dispensing, and administration, including using standard medication concentrations and avoiding dangerous abbreviations, will help to reduce variability and errors (21).

Measurement

This quality improvement study was conducted over three cycles from January 2020 to April 2023 by pharmacists, medical officers, and nurses in the O&G wards. Data were collected using the universal sampling method from all O&G wards. The study indicator was the percentage of prescribing errors of iron dextran, calculated using the formula below:

$$\textit{Percentage of prescribing error of iron dextran} = \frac{\textit{Number of iron dextran prescriptions with prescribing errors}}{\textit{Total number of iron dextran prescription}} \times 100$$

The standard for this study was set at 0% prescribing errors in iron dextran prescriptions according to the Malaysian Patient Safety Goals (22). The inclusion criteria were all iron dextran prescriptions from O&G wards. An Iron Dextran prescription analysis checklist was used to identify both the prescribing errors due to incomplete documentation, such as inadequate patient clinical information and inadequate patient clinical data, and prescribing errors due to wrong dose, wrong indication, and wrong administration. Any prescription identified with one or more prescribing errors was included in the number of iron dextran prescriptions with prescribing errors, which is the numerator of the indicator in the calculation. The prescription analysis checklist would thoroughly allow for identifying the types of prescribing errors, and separating each error type could help to target specific interventions. The data were collected during the screening of prescriptions in the wards with ward pharmacists and at the inpatient pharmacy before supplying iron dextran, both during and after office hours. The verification study was conducted from August to December 2019, followed by cycle 1 from January to May 2020, cycle 2 from Jun to November 2020, and cycle 3 from January to April 2023. The study was withheld for two years (2021 – 2022) due to the change of the O&G wards to COVID wards and medical wards. Thus, the improvement for further remedial actions could not be enforced.

Initial Assessment of the Problem

Prescribing errors with iron dextran, an intravenous iron preparation, can lead to serious consequences. These errors include incorrect dosing, inappropriate patient selection, or failure to recognise contraindications and precautions. An in-depth review of IV iron dextran prescriptions was conducted using a structured Prescription Analysis Checklist to identify and categorise errors. This checklist enabled the systematic detection of specific types of prescribing errors, including incorrect dosing, incomplete documentation, inappropriate indications, and incorrect routes of administration.

The data revealed that the most common error type was incorrect dosing, which accounted for 48.6% of all prescribing errors. This was followed by incomplete prescriptions (37.1%), wrong indication (12.9%), and wrong route (1.4%). By categorising errors in this manner, it became evident that targeted interventions could be more effectively designed to address the most prevalent and critical errors.

This structured error identification process provided the foundation for a tailored quality improvement approach, ensuring that interventions such as calculation aids, standardised stamps, and visual reminders addressed the specific shortcomings in current prescribing practices. The verification study revealed that no documentation of dose calculations was found in the patients' clinical records, although the prescribed doses were written on the prescriptions. A total of 10.6% of patients did not receive a test dose and subsequently developed adverse reactions such as rigours, shortness of breath, palpitations, and blurred vision after administration of the full dose. Data on adverse drug reactions were obtained from reports of iron dextran administrations. In addition, 4.6% of prescriptions were found to contain incorrect body weight entries for pregnant patients, resulting in higher prescribed doses and adverse effects such as shortness of breath and dizziness.

A validated knowledge assessment questionnaire was used to identify the main contributing factors, involving a total of 245 participants comprising all doctors and nurses in the O&G Department throughout the study period. The questionnaire consisted of eight questions assessing knowledge of iron dextran, with each correct answer scored as one point. A total score greater than four indicated good knowledge of iron dextran, while a score between 1 and 4 reflected poor knowledge. Along with this questionnaire, the respondents were required to complete a short survey on the availability of administration instructions and reference materials to analyse the issue of inadequate or unavailable references. Knowledge assessment showed that 65% of doctors and nurses scored between 1 and 4, representing poor knowledge regarding iron dextran. All respondents

(100%) also mentioned the unavailability of administration instructions and references in the ward. Figure 1 illustrates the possible contributing factors identified during the initial assessment of the problem. Three main factors were identified that could change the prescribing pattern of iron dextran in our local healthcare setting: inadequate knowledge among doctors and nurses, lack of administration instructions, and unavailable references in the ward.

During the pre-remedial phase, prescription of iron dextran used general medication prescription slips, where minimal emphasis was given for additional information, such as the patient's body weight, dose calculation, and other clinical data required for iron dextran prescription. The current process of care for doctors prescribing iron dextran in the ward was reviewed (Figure 2) to identify the critical steps involved in the prescribing process. The figure illustrates the sequence of activities, starting from identifying patients who require iron dextran to the prescribing and subsequent administration of the medication in the ward. The Model of Good Care (MOGC), as shown in Table 1, explains the steps taken at each factor in the critical steps highlighted in Figure 2. The iron dextran prescription analysis checklist was used to evaluate the criteria standard for each critical step in MOGC.

Strategy

Various remedial measures were implemented during the intervention phase from January 2020 to April 2023 to reduce iron dextran prescribing errors to 0% according to the standard. An iron dextran worksheet with a QR code-linked user guide was introduced to quantify patients' iron dextran requirement as part of cycle 1. Cycle 1 targeted the factor of inadequate patient clinical data and administration instructions. The doctor in the ward filled the Iron Dextran Calculation Worksheet with a QR code-linked user guide, and the pharmacist would countercheck the iron dextran prescription and calculation worksheet before supplying the medication accordingly. This worksheet was attached to the patient's record in the ward as proof of documentation.

Nurses in the ward, who would administer iron dextran to patients, needed to monitor for adverse drug reactions after the test dose was given and sign the worksheet before the remaining dose was administered. Additionally, knowledge empowerment and adherence to the correct prescribing of iron dextran were achieved through the provision of continuous education to the healthcare staff in O&G and pharmacists regarding iron dextran. Pharmacist-led continuous education sessions in the ward provided the staff with regular updates and knowledge on iron dextran prescribing. The nurses were also educated on monitoring tolerability, including the risk factors, signs and symptoms and potential complications of iron toxicity resulting from inappropriate iron dextran prescribing. They were further encouraged to consult pharmacists for any inquiries related to iron dextran prescriptions.

Upon re-evaluation of the MOGC (Table 1), several process steps that did not meet the established standards were reviewed, including the prescribed dose regimen, the remaining dose and the administration instruction prescribed. A customary stamp comprising the template of iron dextran dose and dilution prescribing was introduced in cycle 2 to replace manually written prescriptions, and this strategy demonstrated substantial improvements in prescribing iron dextran. A customary stamp was implemented in cycle 2 to standardise the prescribing of iron dextran (Appendix 1). The doctors should stamp on the prescription and fill in the calculated dose manually. The purpose of the iron dextran prescribing stamp was particularly to improve the prescribing, where the test dose and the remaining dose should be prescribed correctly, together with administration instructions on the prescription. Notification memos of every critical step change were circulated to the management of the hospital, the head of the Patient Safety Goals program and the O&G Department to create awareness and for the sustainability of the new interventions.

The next strategy was introduced to enhance the accuracy and consistency of iron dextran prescribing. In cycle 3, a summary of the prescribing iron dextran process was introduced in a small card form containing information on collecting the patient's details, calculating the body mass index (BMI) to decide on ideal body weight or actual body weight for dose calculation,

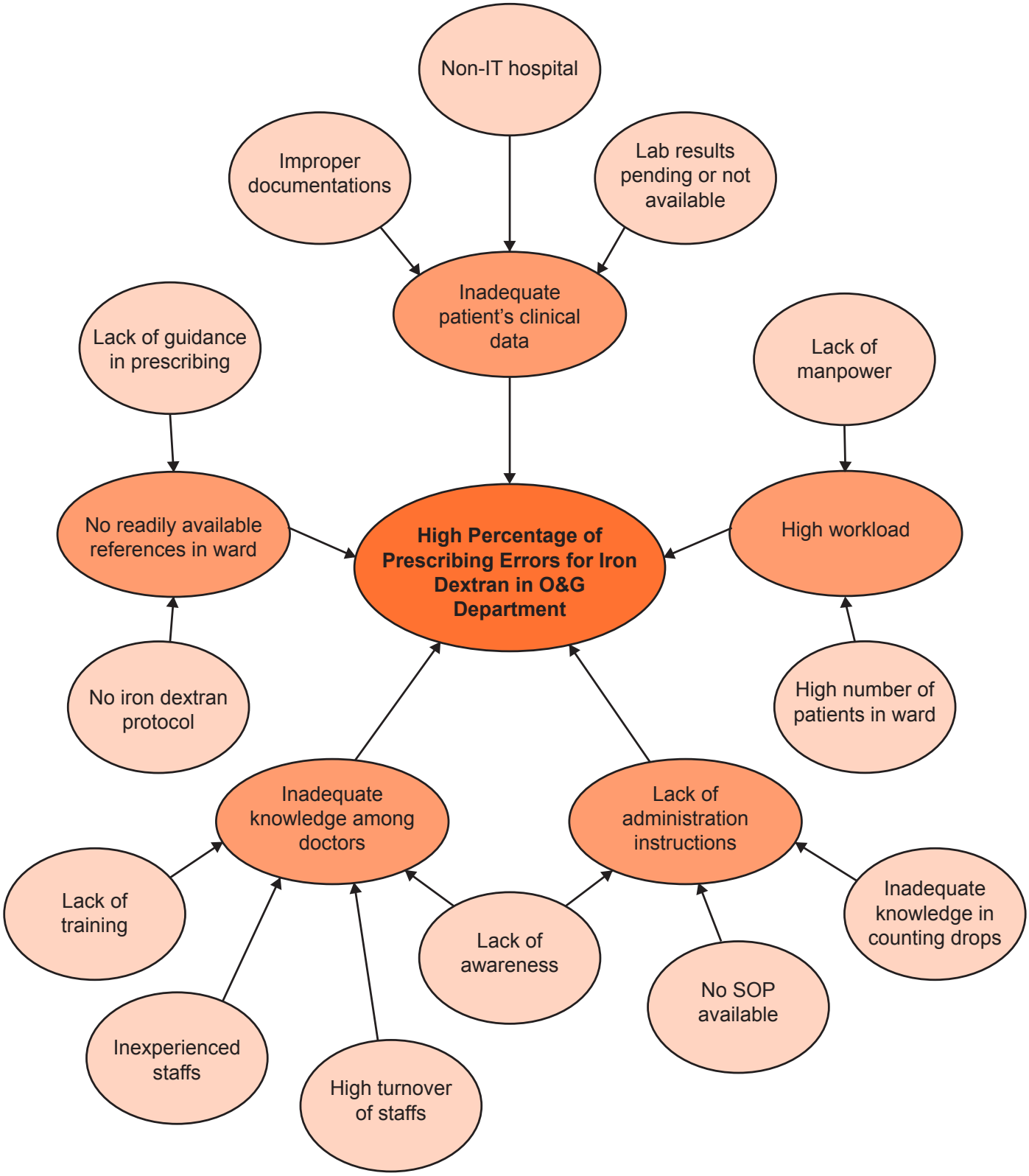


Figure 1: Problem analysis chart for the high percentage of prescribing errors for iron dextran prescriptions.

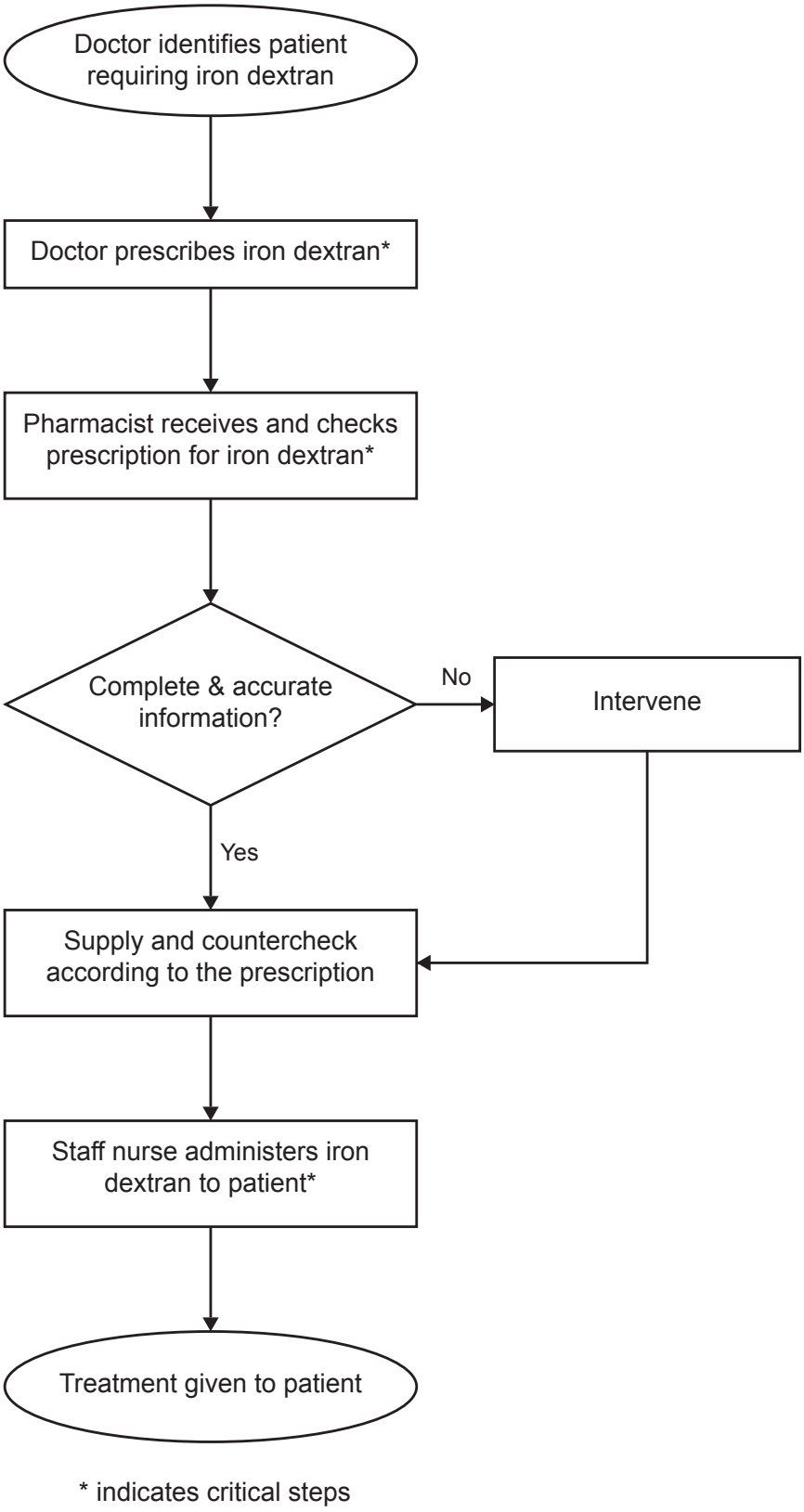


Figure 2: Current process of care for prescribing iron dextran in the ward

Table 1: MOGC for prescribing iron dextran in the O&G ward

No	Critical Step	Criteria	Standard	Achievements			
				Verification Study	Cycle 1	Cycle 2	Cycle 3
1	Doctor prescribes iron dextran	Adequate patient's clinical data available	100%	37.3%	100%	100%	100%
		Dose regimen prescribed for test dose	100%	60.7%	94.9%	100%	100%
		Dose regimen prescribed for the remaining dose	100%	60.7%	94.9%	100%	100%
		Administration instruction prescribed	100%	52.9%	93.2%	100%	100%
		Test dose and remaining dose prescribed with iron dextran stamp	100%	0%	0%	94.8%	96.5%
2	Pharmacist receives and checks the prescription for Iron Dextran	Required information in the worksheet is completely filled.	100%	0%	100%	100%	100%
		Total iron requirement calculated	100%	0%	91.1%	95%	97%
		Requirement rounded to the nearest 100mg	100%	20.3%	91.1%	94.2%	100%
		Calculation is counter-checked by a pharmacist	100%	0%	100%	100%	100%
3	Staff nurse administers iron dextran to the patient	Test dose of iron dextran is administered	100%	60.7%	99.3%	100%	100%
		Monitored and signed for patient's tolerability	100%	0%	100%	100%	100%
		Remaining dose administered accordingly	100%	60.7%	99.3%	100%	100%

calculating the total dose requirement and filling in the worksheet accordingly. The card serves as a quick reference tool to support adherence to protocol and streamline the prescribing process. The calculated dose could be verified by Ganzoni printed on the back of the card (23). This card, named the SteProCos Reminder Card (Appendix 2), was developed to minimise contributing factors to prescribing errors for iron dextran prescriptions, particularly those related to the test dose, remaining dose, and total iron requirement calculations. A survey was conducted to evaluate staff satisfaction, usability of the iron dextran calculation worksheet, knowledge of prescribing and administration of iron dextran and the impact of the reminder card.

Results

Post-intervention evaluations were conducted after each cycle. The percentage of prescribing errors for iron dextran prescriptions reduced from 46.7% to 15.3% after cycle 1 (Figure 3). In addition, completion of the iron dextran worksheet by prescribing doctors improved, with adequate documentation of patients' clinical data increasing from 37.3% to 100%. The completion and accuracy of essential information in the worksheet, including patient identity, appropriate body weight, target haemoglobin, actual haemoglobin, and clinical indication, improved significantly from 0% to 100%. This data would be required for the pharmacist to check before supplying the correct medication to the ward, especially in situations where the pharmacist is not available in the O&G wards or during after-office hour service. The administration of the test dose and the remaining dose was improved from 60.7% to 99.3% as it was compulsory to prescribe the test dose and its infusion time on the prescription as per the worksheet. All patients on iron dextran were compulsorily monitored and signed for patient tolerability by the nurses administering the iron dextran total dose infusion (0% pre-intervention to 100%).

The remedial action of continuous education for doctors, nurses, and pharmacists showed improvement in the healthcare personnel's knowledge assessment. The continuous education program increased the proportion of staff with good knowledge levels from 62% to 84% with a total of 154 personnel. Prescribing error was further reduced from 15.3% to 9.7% after cycle 2. Iron dextran prescriptions that were complemented with prescribing stamps used to record the test dose, prescribed dose according to the worksheet, and administration instructions achieved a compliance rate of 94.4%. Cycle 2 also improved the errors of administration by the nurses, where 100% of the iron dextran was diluted and administered according to the correct prescription.

Results from cycle 3 showed further reduction of iron dextran prescribing errors from 9.7% to 5.3%. Prescribing iron dextran with the iron dextran worksheet and administration instruction for iron dextran prescription remained 100% in cycle 3. This cycle showed slight improvement, with increased use of the test dose and remaining dose stamps, although they were not fully utilised. The prescribing step reminder card proved effective in prompting prescribers to stamp the prescription after completing the worksheet, improving compliance from 94.8% to 96.5%. Survey post-cycle 3 showed improvement in knowledge of prescribing iron dextran from 84% to 94%. A survey evaluating staff's satisfaction and the usability of the worksheet showed 95% satisfaction with 100% usability of the worksheet.

Pharmacists were able to perform 100% counterchecking of the information documented in the worksheet. Additionally, nurses consistently monitored and documented patient tolerability, with 100% of administrations properly signed and verified. Without a specific intervention that mandated test dose prescribing previously, nurses would proceed to administer the full iron dextran dose as written in the prescription, potentially bypassing the test dose. The monitoring of adverse drug reactions during test dose administration has been associated with reduced clinical costs and shorter hospital stays related to iron dextran administration. In our study, specific data on the reduction of clinical costs and hospital stay duration were not available, and further data collection is required to quantify the impact of this intervention.

The reduced incidence of inappropriate indications also led to decreased wastage of iron dextran ampoules. Each prescription required the indication to be documented in the iron dextran worksheet. This improvement contributed to reducing the overestimation of iron dextran dosage, which commonly occurred in cases of acute blood loss. When iron dextran is prescribed specifically for acute blood loss replacement, the dosage calculation should focus solely on correcting the immediate haemoglobin deficit, without accounting for the replenishment of long-term iron reserves. Ensuring the appropriateness of the indication during the prescribing process is crucial for accurate dose calculation and to prevent overestimation.

Iron stores replenishment is more relevant in chronic iron deficiency anaemia, where ongoing iron loss or inadequate intake over time has depleted the body's reserves. In contrast, for blood loss scenarios (such as postpartum haemorrhage or surgical blood loss), the iron requirement is calculated based on the estimated volume of blood lost and the haemoglobin concentration desired, with no additional allowance made for restoring storage iron (typically 500 mg in standard calculations). This approach avoids overestimating the dose, which can reduce the risk of iron overload and related adverse effects. This resulted in cost savings for the hospital, with a total of MYR 1,956 per year saved on medication costs during the study period.

Overall, the achievable benefit not achieved (ABNA) was successfully reduced from 15.3% cycle 1 to 5.3% after cycle 3 (Figure 3). All the critical aspects, which were subpar before the interventions were done, showed improvements following the implementation of the strategies. Nonetheless, there is still room for improvement as we have yet to achieve the standard of 0% prescribing errors.

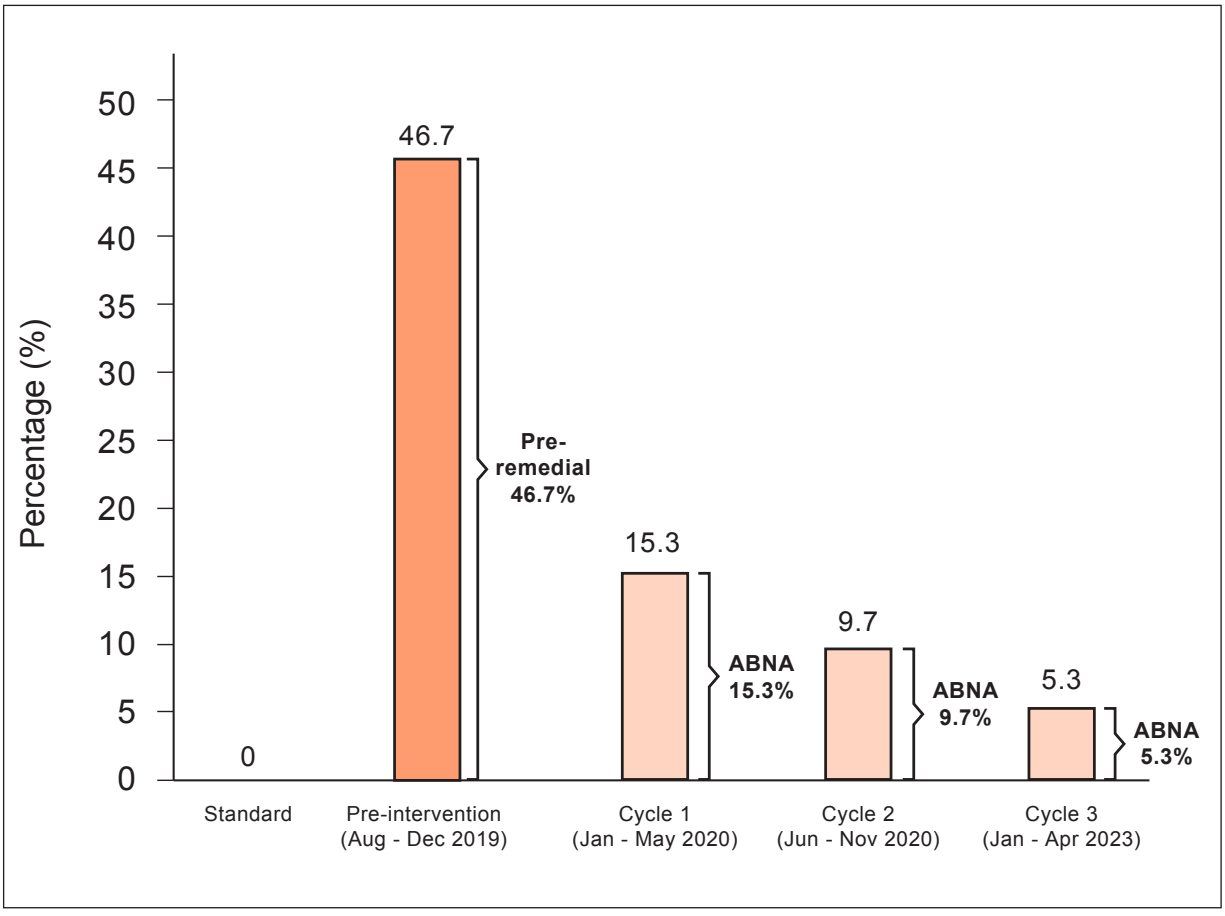


Figure 3: Achievement of the percentage of prescribing errors of iron dextran pre- and post-intervention cycles

Lessons and Limitations

This study looked into more specific aspects of prescribing iron dextran among O&G patients in hospital settings using manual systems. The collaboration between healthcare personnel is greatly needed to achieve better patient care. The iron dextran calculation worksheet and *SteProCos* Reminder Card also appear feasible and replicable to other department wards in HTAR or other hospitals, as it can be easily reproduced at minimal cost. Through this study, this approach has been proven to be beneficial in reducing prescribing errors for iron dextran prescriptions. Pharmacists, working together with other healthcare professionals, play an important role in ensuring the optimum dose and calculation of iron requirement. The survey evaluating staff satisfaction, usability of the iron dextran calculation worksheet stamp and reminder card, as well as knowledge related to the prescribing and administration of iron dextran, showed that most staff were highly satisfied with the use of the worksheet.

Although monitoring and proper administration of the test dose can be challenging in a busy tertiary hospital due to high patient turnover and limited staffing, this project successfully addressed the issue. The introduction of the iron dextran calculation worksheet, which included clear nursing accountability for administering the test dose and monitoring for adverse reactions, led to 100% compliance. This achievement underscores the project's strength in ensuring patient safety and standardising best practices for IV iron dextran administration. The importance of continuous awareness and education activities may enhance these steps.

Despite the success in reducing the prescribing errors for iron dextran, this study has several limitations and challenges. One of the limitations identified was the availability of multiple online calculators for estimating iron dextran dosage. This contributed to the lack of a standardised, universally accepted dosage calculation method, which in turn complicated the prescribing process and led to variability in prescriptions. While these tools may appear convenient, they can lead to errors if used without accurately inputting critical clinical parameters such as actual body weight, pre-pregnancy weight, trimester of pregnancy, and the appropriate clinical indication. Besides that, documentation and calculation may be missed and inaccurate when using online calculators to calculate the total dose required for iron dextran based on the indication, as the formula will be different for different indications.

This study did not involve other disciplines in HTAR, as they might not be using iron dextran total dose infusion. Other wards in this hospital might also have other choices of iron preparations to be administered. It will be an added value if future studies explore the usage and prescribing of other iron parenteral preparations in other wards.

Although a more favourable outcome, specifically a 0% prescribing error rate was anticipated, unexpected human factors may have influenced the effectiveness of the strategy. For example, the revised prescribing process for iron dextran required additional time and effort, including completing the worksheet, using the prescribing stamp, and monitoring patient tolerability. These added steps may have affected adherence, particularly during periods of high workload. Nevertheless, integrating the worksheet into the standard work process is expected to promote routine and consistent practice over time.

Conclusion and the Next Steps

This quality improvement study has determined the magnitude of prescribing errors of iron dextran in O&G wards of HTAR and identified the main contributing factors. This study successfully reduced the total percentage of prescribing errors for iron dextran from 46.7% to 5.3%, and identified key contributing factors, through the formulation and implementation of targeted strategies in the O&G wards. It also resulted in a reduction of adverse drug reactions and medication wastage costs associated with iron dextran. The implemented strategies incurred minimal cost and are sustainable for future practice through the incorporation of the revised forms into the Malaysian Standard: International Organisation of Standardisation (MS ISO) quality procedures of HTAR. This study has been replicated by the O&G departments of Hospital Banting,

which is one of the non-lead hospitals in the HTAR's cluster (Appendix 3).

An additional innovative strategy currently in progress involves digitalising the iron dextran calculation worksheet, enabling pharmacists to verify doses electronically and reducing paper waste. This project is scheduled for implementation across all wards in HTAR. Periodic internal audits and knowledge assessments will be conducted, supported by continuous education sessions at regular intervals. In the future, these remedial actions may be extended to other hospitals with manual prescribing systems, to improve overall clinical outcomes and enhance the safety of iron dextran prescribing.

References

1. Litton E, Xiao J, Ho KM. Safety and efficacy of intravenous iron therapy in reducing requirement for allogeneic blood transfusion: systematic review and meta-analysis of randomised clinical trials. BMJ [Internet]. 2013 Aug 15 [cited 2024 Mar 7];347(7923). Available from: https://www.bmj.com/CONTENT/347/BMJ.F4822

2. IV Iron Dextran Infusion Protocol | MedStar Health [Internet]. [cited 2024 Mar 7]. Available from: https://www.medstarhealth.org/news-and-publications/articles-and-research-reports/iv-iron-dextran-infusion-protocol

3. Bates DW, Cullen DJ, Laird N, Petersen LA, Small SD, Servi D, et al. Incidence of Adverse Drug Events and Potential Adverse Drug Events: Implications for Prevention. JAMA [Internet]. 1995 Jul 5 [cited 2024 Mar 6];274(1):29–34. Available from: https://jamanetwork.com/journals/jama/fullarticle/389136

4. New recommendations to manage risk of allergic reactions with intravenous iron-containing medicines | European Medicines Agency (EMA) [Internet]. [cited 2025 Jan 23]. Available from: https://www.ema.europa.eu/en/news/new-recommendations-manage-risk-allergic-reactions-intravenous-iron-containing-medicines

5. Failla S, Nicolas S, Parmar M. Iron Dextran. Reactions Weekly [Internet]. 2024 Feb 15 [cited 2025 Jan 23];NA;(1378):22. Available from: https://www.ncbi.nlm.nih.gov/books/NBK557747/

6. Failla S, Parmar M. Iron Dextran. StatPearls [Internet]. 2023 May 22 [cited 2024 Mar 5]; Available from: https://www.ncbi.nlm.nih.gov/books/NBK557747/

7. CosmoFer - Summary of Product Characteristics (SmPC) - (emc) [Internet]. [cited 2024 Mar 6]. Available from: https://www.medicines.org.uk/emc/product/48/smpc#gref

8. Api O, Breyman C, Çetiner M, Demir C, Ecder T. Diagnosis and treatment of iron deficiency anemia during pregnancy and the postpartum period: Iron deficiency anemia working group consensus report. Turk J Obstet Gynecol [Internet]. 2015 [cited 2025 Jan 23];12(3):173. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC5558393/

9. Myers B, Frcpath F, Myers O, Moore J, Frcog MD. Comparative efficacy and safety of intravenous ferric carboxymaltose (Ferinject) and iron(III) hydroxide dextran (Cosmofer) in pregnancy. [cited 2024 Mar 5]; Available from: http://whqlibdoc.who.int/publications/2008/9789241596657_eng.pdf

10. Iron dextran: Uses, Dosage, Side Effects and More | MIMS Malaysia [Internet]. [cited 2025 Jan 23]. Available from: https://www.mims.com/malaysia/drug/info/iron-dextran?mtype=generic

11. Rampton D, Folkersen J, Fishbane S, Hedenus M, Howaldt S, Locatelli F, et al. Hypersensitivity reactions to intravenous iron: guidance for risk minimization and management. Haematologica [Internet]. 2014 Nov 1 [cited 2025 Jun 20];99(11):1671. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC4222472/

12. Burns DL, Pomposelli JJ. Toxicity of parenteral iron dextran therapy. Kidney Int. 1999 Mar 1;55(69):S119–24.

13. Samsudin S, Dulasi M, Sany S, Balanathan K, Chong SE, Ali A. Safety and Efficacy of Intravenous Iron Sucrose versus Low Molecular Weight Iron Dextran for Treatment of Iron Deficiency Anemia in Pregnancy: A Randomized Controlled Trial. Int J Womens Health [Internet]. 2020 Dec 1 [cited 2025 Sep 12];Volume 12:1259–70.

14. Tan SY, Mohd Said M, Abdul Rahman R, Akmar Taha NB. An Investigation of Errors: The Preparation And Administration Of Parenteral Medications In An Intensive Care Unit Of A Tertiary Teaching Hospital In Malaysia. Int J Pharm Pharm Sci [Internet]. 2016 Mar 1 [cited 2025 Jan 23];325–9. Available from: https://journals.innovareacademics.in/index.php/ijpps/article/view/10098/4863

15. Yatim MF, Othman NH. A Retrospective Analysis of Medication Errors at a Tertiary Hospital in a Northern State of Malaysia. Malaysian Journal of Pharmaceutical Sciences. 2022 Jul 1;20(2): 79-92.

16. Dean B, Barber N, Schachter M. What is a prescribing error? Qual Health Care [Internet]. 2000 [cited 2024 Mar 6];9(4):232–7. Available from: https://pubmed.ncbi.nlm.nih.gov/11101708/

17. e-Incident Report – Patient Safety [Internet]. [cited 2025 Apr 30]. Available from: https://patientsafety.moh.gov.my/v2/?page_id=193

18. Dean B, Schachter M, Vincent C, Barber N. Causes of prescribing errors in hospital inpatients: a prospective study. Lancet [Internet]. 2002 Apr 20 [cited 2025 Aug 31];359(9315):1373–8. Available from: https://pubmed.ncbi.nlm.nih.gov/11978334/

19. Mamula P, Piccoli DA, Peck SN, Markowitz JE, Baldassano RN. Total dose intravenous infusion of iron dextran for iron-deficiency anemia in children with inflammatory bowel disease. J Pediatr Gastroenterol Nutr [Internet]. 2002 [cited 2024 Mar 6];34(3):286–90. Available from: https://pubmed.ncbi.nlm.nih.gov/11964953/

20. Ammenwerth E, Schnell-Inderst P, Machan C. The Effect of Electronic Prescribing on Medication Errors and Adverse Drug Events: A Systematic Review. J Am Med Inform Assoc [Internet]. 2008 [cited 2024 Mar 6];15:585–600. Available from: https://academic.oup.com/jamia/article/15/5/585/732256

21. Liou JH, Wang SC, Hou YC, Yen CH, Chen HM, Liou WS, et al. Effect of an automated dispensing cabinet system on drug distribution effectiveness in a surgical unit. Heliyon [Internet]. 2023 Nov 1 [cited 2025 Jan 23];9(11). Available from: https://www.americandatanetwork.com/patient-safety/essential-strategies-for-preventing-medication-errors/

22. Ab Rahman N, Low EV, Kamaruddin F, et al. A retrospective study on prevalence, characteristics, and outcomes of transcribing error: analysis of data from the National Medication Error Reporting System in Malaysia. J Pharm Policy Pract [Internet]. 2025 [cited 2025 Sep 12];18(1):2528244. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC12265094/

23. Kalra P, Bhandari S, Spyridon M, Davinson R, McCafferty K, Mikhail A, et al. SaO001THE Nimo UK Study: Is 1000 Mg Of Intravenous Iron Enough To Achieve Hb Targets In Pre-Dialysis Anaemic Patients? Nephrology Dialysis Transplantation [Internet]. 2018 May 1 [cited 2025 Sep 12];33(suppl_1):i315–i315. Available from: https://dx.doi.org/10.1093/ndt/gfy104.SaO001

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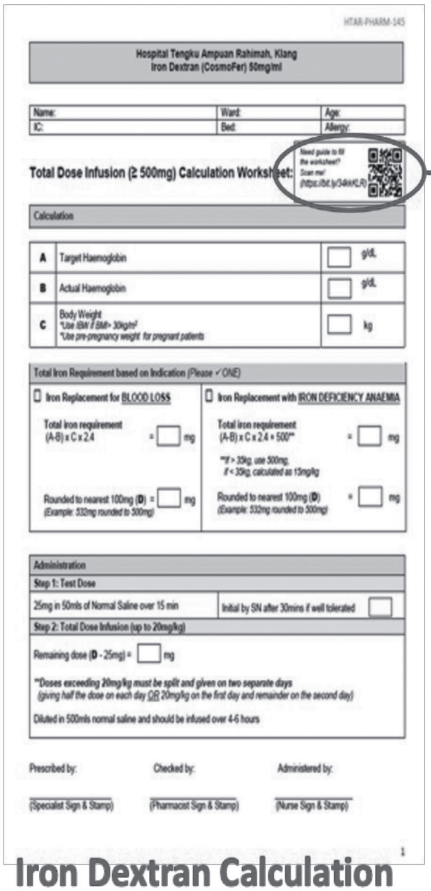
Conflict of Interest

The authors declare that there was no conflict of interest.

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Appendix 1: Iron Dextran Calculation Worksheet



Hospital Tengku Ampuan Rahimah, Klang
Iron Dextran (CosmoFer) 50mg/ml

Name: | Ward: | Age:
IC: | Bed: | Allergy:

Total Dose Infusion (≥ 500mg) Calculation Worksheet:

Need guide to fill the worksheet? Scan me! (https://bit.ly/34kKLR)

Calculation

A	Target Haemoglobin	g/dL
B	Actual Haemoglobin	g/dL
C	Body Weight *Use IBW if BMI> 30kg/m² *Use pre-pregnancy weight for pregnant patients	kg

Total Iron Requirement based on Indication (Please ✓ ONE)

☐ Iron Replacement for BLOOD LOSS

Total iron requirement (A-B) x C x 2.4 = mg

Rounded to nearest 100mg (D) = mg
(Example: 532mg rounded to 500mg)

☐ Iron Replacement with IRON DEFICIENCY ANAEMIA

Total iron requirement (A-B) x C x 2.4 + 500** = mg

**If > 35kg, use 500mg,
If < 35kg, calculated as 15mg/kg

Rounded to nearest 100mg (D) = mg
(Example: 532mg rounded to 500mg)

Administration

Step 1: Test Dose

25mg in 50mls of Normal Saline over 15 min | Initial by SN after 30mins if well tolerated ☐

Step 2: Total Dose Infusion (up to 20mg/kg)

Remaining dose (D - 25mg) = mg

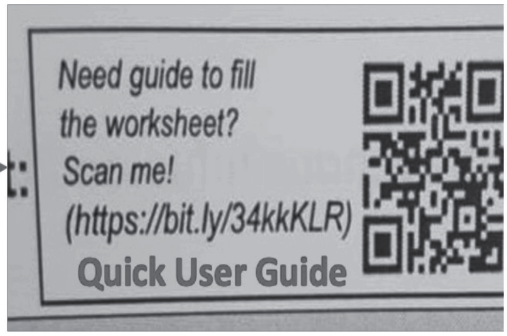
**Doses exceeding 20mg/kg must be split and given on two separate days (giving half the dose on each day OR 20mg/kg on the first day and remainder on the second day)

Diluted in 500mls normal saline and should be infused over 4-6 hours

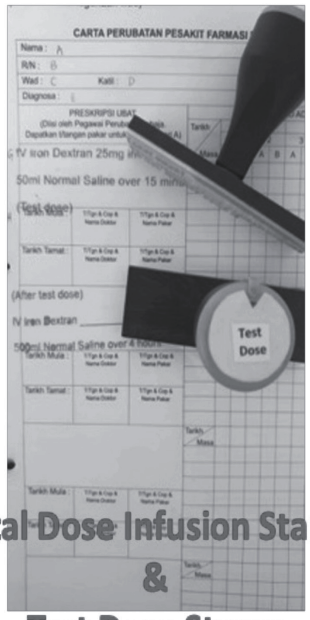
Prescribed by: (Specialist Sign & Stamp)
Checked by: (Pharmacist Sign & Stamp)
Administered by: (Nurse Sign & Stamp)

1

Iron Dextran Calculation Worksheet



Remedial Tools

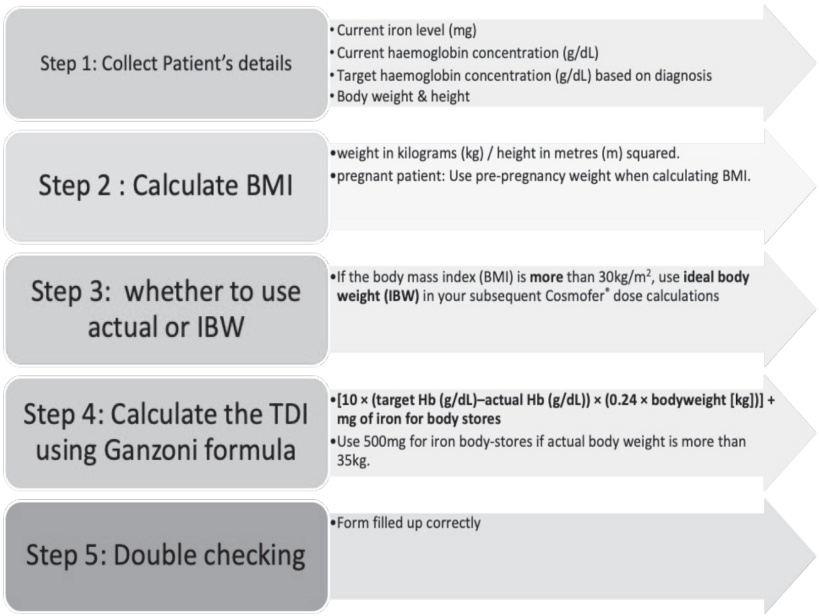


Total Dose Infusion Stamp & Test Dose Stamp

Appendix 2: Stepped process of Cosmofer (*SteProCos*) Reminder Card

STEPROCOS

Stepped Process for Cosmofer Reminder Card



Safe and Rapid correction of Hb in Pregnant women with Total Dose Infusion of COSMOFER

	Increase in Hb required (g/dL) = Target Hb minus Actual Hb						
Body wt (kg)	1g/dL	2g/dL	3g/dL	4g/dL	5g/dL	6g/dL	7g/dL
40kg	6	7	8	9	10	11	12
45kg	6	7	8	9	10	11	12
50kg	6	7	9	10	11	12	13
55kg	6	8	9	10	12	13	14
60kg	6	8	9	11	12	14	15
65kg	7	8	10	11	13	14	16
70kg	7	8	10	12	13	15	17
75kg	7	9	10	12	14	16	18
80kg	7	9	11	13	15	17	18
85kg	7	9	11	13	15	17	19
90kg	7	9	11	14	16	18	20

Appendix 3: Replication of project with Hospital Banting

HOSPITAL BANTING
Jalan Sultan Alam Shah
42700 Banting
Selangor Darul Ehsan
Malaysia

Tel : 603-3187 1333
Faks : 603-3181 8834
E-mel : hospitalbanting@moh.gov.my
Laman Web: http://hbanting.moh.gov.my

Ruj : HBTG.740/03 Jld. 9 (22)

Puan Aziah binti Abdullah
Ketua Jabatan Farmasi
Hospital Tengku Ampuan Rahimah, Klang

4 Mac 2021

Puan,

Cadangan Replikasi Projek "*Reducing the Percentage of Prescribing Errors for Iron Dextran in Obstetrics and Gynaecology (O&G) Department*, HTAR Klang" di Hospital Banting

Dengan hormatnya, perkara di atas adalah dirujuk.

2. Merujuk kepada edaran senarai pemenang Karnival Inovasi 2020 Jabatan Kesihatan Negeri Selangor, projek disebutkan di atas adalah johan bagi kategori Clinical Audit dan adalah pasukan di bawah jabatan puan.

3. Jabatan Farmasi bersama Jabatan Obstetrik dan Ginekologi Hospital Banting bercadang untuk menjalankan replikasi projek ini di fasiliti kami. Buat masa ini, fasiliti kami tidak mempunyai format khusus untuk pemberian *Iron Dextran*. Kami berharap dengan usaha replikasi ini, kesilapan pengubatan berkaitan *Iron Dextran* di fasiliti kami dapat dikurangkan dan penjagaan pesakit dapat dItambahbaik. Kami mengharapkan kerjasama baik daripada pihak puan dan jabatan bagi cadangan replikasi projek ini.

4. Pihak kami boleh dihubungi oleh puan atau wakil pihak puan melalui Puan Siti Nurfairuz binti Mohd Fathir, Pegawai Farmasi yang bertugas di Wad O&G di talian 03-3187133 (samb. 356) , 012-3940821 atau email nurfairuz@moh.gov.my

Sekian, terima kasih

"PRIHATIN RAKYAT : DARURAT MEMERANGI COVID-19"
"BERKHIDMAT UNTUK NEGARA"

Saya yang menjalankan amanah

DR. MALAR KANDASAMY
NO. PENDAFTARAN PENUH MPM: 33260
PAKAR PERUBATAN O&G GRED KHAS C
HOSPITAL BANTING

(DR MALAR KANDASAMY)
Ketua Jabatan O&G,
Hospital Banting
s.k Pn Norima bt Md Noor
Ketua Jabatan Farmasi
Hospital Banting

PENYAYANG, PROFESIONALISME DAN KERJA BERPASUKAN ADALAH BUDAYA KERJA KITA
(sila catatkan rujukan surat ini apabila berhubung)

Hospital Rakan Bayi

CERTIFIED TO ISO 9001:2015

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

Your manuscript should include:

1. Abstract (up to 300 words)
2. Main text (up to 5000 words; excluding abstracts, tables and figures)
3. Maximum of 5 tables or figures.
4. Please use Font Arial, Size 12, double spacing.
5. Maximum of 5 pages allowed for the supplementary files; however, all supplementary materials should be relevant, concise, and directly support the content of the manuscript

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 literature is there that this problem exists? b) What existing literature is there on the factors contributing to the problem? c) What literature is there that other people have tried to solve this problem in the past? d) Is there any literature for what works and what doesn't to solve your problem?
Measurement	Describe which measures/indicator 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 the data for indicator, contributing factor and/or MOGC throughout your project. Include here the results of your baseline measurement/indicator (verification study).

Initial assessment of the problem	Describe what processes are involved in your problem including the critical steps in the processes that will contribute to the achievement of your final goal. Describe 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. Include the Model of Good Care (MOGC) as appropriate.
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 several 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 c) Any improvements? d) Describe how contextual elements interacted with the intervention(s) and affected your results. e) 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). Were there any financial savings that your project made? Being able to demonstrate that your intervention delivered savings really helps to add value.
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. Were efforts made to minimize/adjust for any 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? Are more data points/cycles required? Comment on the limits of generalizability. Describe whether chance, bias, or confounding have affected your results and whether there was any imprecision in the design or analysis of the 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?-Was it a useful project? 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. Were your measures appropriate and did you use balancing measures?
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.
Acknowledgements	Please include here the names of anyone who is not on the author list but whose input you wish to acknowledge.
Conflict of Interest	Please declare any conflict of interest, if any.
Funding	Please declare any source of funding, if any.



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Institute for Health Systems Research
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Block B2, National Institutes of Health Complex,
No 1, Jalan Setia Murni U13/52, Seksyen U13,
Setia Alam, 40170 Shah Alam, Selangor.

+603 3362 7500
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